International Center for Living Aquatic Resources Management

MEDIUM TERM PLAN
2000 – 2002

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ICLARM's Medium-Term Plan 2000-2002

Executive Summary

The International Center for Living Aquatic Resources Management (ICLARM) presents its Medium Term Plan (MTP) for 2000-2002 for the consideration by TAC and members of the CGIAR. The Plan has been developed in a period when there is growing public disquiet over the limitations of global fish catches from natural environments and the provision of adequate nutrition for the burgeoning human population, especially in developing countries.

The current plan is an annual update of the plan for the period 1998-2000 and is based on the consultative development process undertaken in 1996 and 1997 which prioritized the institute's activities for the forthcoming three to five year period. Changes in the current plan are therefore the result of progress with projects in 1998, further projections for milestones in 2001/2 and the anticipated availability of donor support for the period. The plan describes research and research-associated activities amounting to US$14.39 million in 1999.

ICLARM has maintained the anticipated progress towards project outputs in the majority of its research and research related activities described in the original MTP for the period. Affirmations or adjustments in project direction have been supplied by two center commissioned and one donor review in 1997/8. ICLARM's second External Program and Management Review has also been conducted in late 1998/early 1999 and has provided further confirmation of the appropriateness of ICLARM's work in living aquatic resources management described in this plan.

To accommodate the relatively rapid changes in Living Aquatic Resources Management (LARM), particularly in aquaculture and the general global context of fisheries in the 1990s and continuing trends, ICLARM is developing a new strategic plan. This will be published in 1999 and provide the basis for the development of a new ICLARM MTP and project portfolio, constructed on the more recent TAC activity classifications and the logframe approach. This new MTP will be available in the year 2000 and will govern research beyond the current MTP.

The following is therefore a summary account of progress that we achieved in1998 and expected achievements in the year 2000 and 2001.

ICLARM's Work in Increasing Productivity

Project 3. The Genetic Improvement of Fish for Tropical Aquaculture: Work has focused on genetic improvement of carp species in Asia and in developing further research on the genetic enhancement of tilapia in Asia and in Africa. Simultaneous genetic improvement programs for carp are being conducted in six countries of Asia. For instance, first generation selection responses show improved growth rates are between 13-30% in rohu in India, 7% increase in bodyweight in silver barb in Bangladesh and up to 20% growth improvement in blunt nosed bream in China. These indicative results confirm the rapid improvements that can be achieved in aquaculture species appropriate for developing countries through selective breeding approaches. Socioeconomic surveys of supply and demand for carp species to prioritize species and traits for further enhancement research are in progress in the same countries. Links have been formed to advanced research institutes in the U.S. and in Europe to introduce the methods of monosexing, cloned inbred lines and genetic markers into selection procedures for Nile tilapia and carps.

Project 9. Development of Integrated Aquaculture-Agriculture Systems: The project has successfully completed a study of upland integrated aquaculture agriculture systems in forest buffer zone management in the Philippines. With partners from Kassel University, a dynamic simulation model of Philippine rice-fish farming systems had been further refined and expanded. Despite the extensive flooding in Bangladesh in 1998, institutional arrangements for community-based rice-fish culture were designed and tested at three sites. Similar institutional arrangements have been implemented succesfully in Vietnam where, in some circumstances, the profit obtained from rice-fish culture was double that of single rice culture. ICLARM has responded to national and regional requests for the development of IAA approaches and implementation by the development of teaching materials, the training of NGOs, and the holding of workshops with the FAO and other regional partners in Asia.

Project 10. Sustainable Coral Reef Aquaculture and Stock Enhancements: ICLARM has initiated research with New Zealand partners on the effects of alternative logging practices on coral reef and coastal aquatic resources utilizing its regional Coastal Aquaculture Center in the Solomon Islands. With Australian partners, the project is implementing an investigation of the feasibility of utilizing wild caught larval fish in grow-out trials to supply the marine aquarium and food fish industries to overcome biodiversity threatening overexploitation of adult fish. ICLARM is providing its technological improvements in the captive rearing of high value molluscs (pearl oysters, giant clams) to the organization of regional efforts to promote coastal aquaculture industries in partnership with coastal farmers, NARS, and the private sector. Significant advances have been made in the spawning, larval rearing and knowledge of the ecology of sea cucumbers (with Canadian partners) as a basis for stock enhancement of these high value but over exploited species in the Indo-Pacific.

Project 17. Fish Health: ICLARM is currently revising approaches to integrated management of aquaculture on the African continent and will place a greater emphasis on the selection of local strains and the genetics of adaptive traits such as resistance to stress including disease. Many fish diseases are introduced along with the transfer of fish from elsewhere and/or are induced by stress due to poor aquaculture management and the intensification of production.

Protecting the Environment

Project 8. Fisheries Resources Management: Data Acquisition, Methods and Models: Under this project, ICLARM conducts research on tropical fish stock assessment and the management of multispecies fisheries. A test version of the ecosystem modelling software, Ecopath, was developed in 1998, which includes the dynamic simulation module, Ecosim, developed in conjunction with Canadian partners. A further spatial model, Ecospace, developed by Canadian scientists, has also been incorporated and ICLARM staff conducted seven international training workshops based on the use of Ecopath during 1998. A computer package, TrawlBase, has been finalized and is being used to analyze the dynamics of coastal fisheries in eight participating Asian countries. ICLARM has completed Phase I of its Caribbean Marine Protected Areas Project and has shown that in relatively degraded reef situations where overfishing occurs, that recruitment stems largely from juveniles with long lived larval stages. This and the migration of reef fish (which has also been studied), contribute important scientific information to Phase II of the project which will be implemented in 1999 and which will address the best use of marine protected areas in the rehabilitation of coastal coral reef fisheries within the appropriate social context.

Project 4. Assessing and Managing Coral Reef Degradation: Preliminary genetic analysis has been carried out on reef organisms to assess diversity and linkage between coral reef stocks in the South China Sea ecosystem. Version 3.0 of ReefBase, an interrelational compendium of information of global coral reef data has been published on CD ROM. The "Reefs at Risk" assessment of the status of the world's coral reefs (jointly with WCMC, WRI and UNEP) was also published in 1998. This publication has had a major impact on policymakers responsible for ocean and environmental health. ICLARM has applied a technique (the Rapid Assessment of Management Parameters, RAMP) to develop integrated biosocioeconomic indicators in coral reef fisheries. ICLARM has held two major courses on coastal zone management training in 1998. This project was commended and supported by a center commissioned external review in 1998.

Project 6. Multi-Sectoral Use of Inland Aquatic Resources Systems: This does not exist presently as an ICLARM project but discussions have been held in three different areas - strategy development for integrated use of wetlands in the lower Mekong Basin, multi-purpose use of reservoirs, and the system-wide initiative on irrigated water. The first of these will commence activities in 1999 as part of ICLARM project 11. This holistic approach is also reflected in ICLARM's

proposed work on Lake Nasser with the holding of an inaugural workshop in 1998.

Project 7. System-Wide Program on Coastal Environments: The earlier MTP did not envision the continuation of the System-Wide Program on Coastal Environments, but rather, a more specific initative on the implication for coastal biota and water quality of deforestation and mangrove depletion. In 1998, ICLARM has initiated an evaluation of the effects of terrestrial disturbance (logging) on coastal aquatic biota under project 10. Ongoing ICLARM work in integrated coastal resources management was also reviewed and priorities for future studies developed. Projects are now being developed in key areas.

Saving Biodiversity

Project 1. Assessing Aquatic Biodiversity and Genetic Resources: ICLARM's improved and updated database, FishBase 98, has been released covering information on 20,000 fish species drawn from over 12,000 references. Following a one year feasibility study, ICLARM has obtained donor support to add data on the rearing of fish larvae to FishBase to expand its utility for fisheries and aquaculture managers. Work has continued to characterize the extent of biodiversity in important aquaculture species for developing countries, particularly tilapiine species in West Africa and the small carp species, *Barbodes gonionotus* in Southeast Asia with European collaborators. In 1998 ICLARM conducted with the FAO a Bellagio conference "Towards Policies for Conservation and Sustainable Use of Aquatic Genetic Resources". ICLARM has provided contributions to the System-Wide Genetic Resources Program and its information project, SINGER as well as to the subcommittees of the Convention on Biological Diversity.

Improving Policies

Project 11. Ecological Economics for Sustainable Use of Aquatic Resources Systems: ICLARM has completed the first phase of its worldwide collaborative research project on case studies of coastal fisheries co-management. A further phase will be initiated in collaboration with Danish partners in 1999 with emphasis, in Asia, on sociological analysis of community participation and conflict resolution. Action research on co-management and community based fisheries management has continued in Bangladesh, and will be evaluated more widely as a preferred means of management of inland water fisheries in developing countries. Small scale work has also commenced on the evaluation of coral reef systems in the Philippines to provide baseline studies for more generally applicable resource valuation methods.

Project 12. Aquatic Resources Research Impact: Methods and Assessment: Work in this project, following the continuing impact analysis of genetic improvement technologies in developing country aquaculture, has focused on the determining of impact of giant clam mariculture in Pacific islands states and on the success of adoption of improved aquaculture practices in Bangladesh. The bioeconomic model developed for the giant clam species is being used to investigate optimal harvesting time and the trade-off between harvesting time and the application of husbandry labor by village clam farmers.

Project 13. Policy Analysis of the Contribution of Fisheries to Food Security: The project has completed resource assessments in a) the Philippines describing the constraints on the supply of bangus (milkfish) fry for aquaculture and b) on aquatic resource use by smallholder households in Cambodia and Vietnam. This work and that of the MRC and other partners suggests that official statistics underestimate aquatic resource use in these countries substantially (up to tenfold in Cambodia). Legal and institutional analysis of fisheries in the Mekong Basin countries will be developed into a wider approach to resource evaluation and governance of the wetlands of this region with existing partners. A database for the assessment of developing country fisheries utilizing official FAO statistics and other contributory data has been developed to assist ICLARM's internal planning and priority setting.

Strengthening National Programs

Project 2. Aquatic Biodiversity and Genetics Resources Training: This covers training in the use of FishBase as a biodiversity management tool to be conducted in ACP countries as part of the EU supported FishBase project. Regional training courses on fisheries and biodiversity management were given for the Caribbean region (in Trinidad and Tobago) and for Southern Africa, (in Namibia) in 1998. These activities contribute to ICLARM's work in strengthening the NARS.

Project 14. Dissemination and Communication of Scientific Information: This activity continues under strong demand from fisheries scientists in both developed and developing countries. ICLARM continues to seek ways within current resources of conducting greater public awareness activities in line with CGIAR recommendations.

Project 15. New Methods and Technologies for Training in Living Aquatic Resources Management: ICLARM finalised its long term strategy for the evolution of institute-associated training as part of its strategic plan development in 1998. Substantial training activities took place in relation to existing projects particularly projects 2, 3, 8, and 16.

Project 16. Information and Research Networks and Linkages: To enhance synergy in research amongst country members of ICLARM's International Networks for Genetics in Aquaculture (INGA). Membership has been extended to leading ARIs in aquaculture genetics worldwide and eleven such institutes are now included in the INGA network covering four continents. An intensive training course in quantitative genetics and its application to aquaculture was organized in collaboration with Norwegian scientists in which 22 scientists from 13 developing countries participated. INGA continues to assist in the exchange of germplasm between INGA member countries following FAO guidelines and appropriate material transfer agreements. ICLARM has contributed to the establishment of the Group on Fisheries and Aquatic Research (GoFAR) under the regional agricultural organization, APAARI to give a voice to the fisheries and aquaculture sector in agricultural regional groupings.

An Overview of Progress

In 1998 and 1999, ICLARM is reviewing and revising its Strategic Plan for research and management of living aquatic resources to guide the Institute beyond the current plan period and into the first decades of the next century. When finalized in 1999, this Plan will form the basis of a new and revitalized MTP 2001-2003.

The program portfolio maintains an emphasis on productivity enhancement in natural and culture systems, while giving strong weight to NARS strengthening, conservation, biodiversity and improving policies.

A more specific coastal zone initiative has been initiated in 1998. Rather than initiating the Project 6 (on the multisectoral use of inland aquatic resources systems), new activities in this field are instead being conducted by existing Projects 9 and 11. Project 17 is being reconsidered as part of a continental approach to African aquaculture and is likely to be closely linked to the activities under Project 3.

Several new activities have been launched : a) with New Zealand partners research on the effects of alternative logging practices on coral reef and coastal aquatic resources, b) with Australian partners, an investigation of the feasibility of utilizing wild caught larval fish in grow-out trials for the sustainable utilisation of coral reef resources, c) in a complementary approach ICLARM's biodiversity project will add data on the rearing of fish larvae to FishBase to expand its utility for fisheries and aquaculture managers, d) a new computer package, TrawlBase, has been developed and is being used to analyze the dynamics of coastal fisheries in eight participating Asian countries, and e) legal and institutional analysis of fisheries in the Mekong Basin countries are being developed into a wider approach to resource evaluation and governance of the wetlands with key partners in the region.

ICLARM has continued its self-evaluation program conducting a center commissioned external review of Project 4, Assessing and Managing Coral Reef Degradation in 1998. ICLARM also profited from a major donor review of the work of its Coastal Aquaculture Center in relation to aquaculture in the Pacific. The centre itself was subject to the quinquennial External Program and Management Review in late 1998, early 1999.

ICLARM continues to work on global databases and widely applicable modeling approaches. Work on aquaculture and coastal fisheries is concentrated in Asia and the Pacific but 1999 will mark the expansion of operations at the Abbassa site and at least three new actvities (in biodiversity, genetics, and lake management) in Africa. The Fish Health Baseline Studies and Diagnostics project will not commence in 1999 as originally formulated but discussions with partners in this field are continuing to develop more comprehensive and integrated linkages to other aspects of aquaculture research, especially genetics, for extended relevance to developing countries. Socio-economic and policy analysis is increasingly integrated into all aspects of the research portfolio.

In May 1997, ICLARM's Regional Center for Africa and West Asia at Abbassa in Egypt became fully under ICLARM research and facilities management. The upgrade has been virtually completed with support from the Government of Japan. Full operation commenced in 1999 and a major focus of efforts in the future will be to promote new and enhanced research partnership through the facility as a hub and as a research site.

The ICLARM Board, has been seeking alternative sites for ICLARM's headquarters with a view to securing ICLARM's long term future and its high quality research and management contributions to the sustainable use of living aquatic resources for the poor of developing countries. After a selection process based on objective criteria the Board has decided that ICLARM will pursue the offer of the Government of Malaysia to establish a head quarters site in that country. ICLARM anticipates that the centre will move to the new head quarters in Penang in the year 2000.

A. PROGRAMS

1. Strategic Overview

1.1 The Global Context

In stark contrast to the increase in the yields of staple cereals and price stability provided through genetic enhancement research, the relative supply of wild caught fish is in decline and prices are increasing, often beyond the reach of poor people.

Today the majority of the world's consumption of fish and other aquatic products is still provided by capture fisheries. In 1989, the volume of the world's capture fisheries was estimated at just over 100 mmt[1], representing approximately 89% of total production. Although total world fishery production is continuing to show annual increases[2], capture fisheries had declined to 81% of total production in 1995 and all indications are that the trend is accelerating. Aquaculture products provide the balance of the total catch, and world production (from both marine and freshwater aquaculture) has more than doubled in the decade since 1984 and in 1995 reached 21.3 mmt. However, it is not yet clear whether such production can make up for the capture fisheries short-fall in most tropical regions, and ensure a continued supply of aquatic food for a growing population. New technologies and the wider adoption of aquaculture can certainly help, but aquaculture (even under optimistic projections of both aquaculture and capture fisheries development) is unlikely to provide more than about 28 - 30% of total production of the sector by 2010.

There is therefore an urgent need to provide better management advice and methods to conserve current fish stocks and to provide for their sustainable use, and to develop more efficient technologies for aquaculture so that it can provide the necessary augmentation in productivity needed to meet growing global demand. ICLARM, the only tropics-based research institute that focuses equally on both fisheries and aquaculture research for low-income people, has a unique role in providing such advice and technologies.

ICLARM's broad and complex mandate allows its a breadth of vision ideal for the generation of international public goods derived from desk and laboratory studies and field research conducted at sites throughout the developing world. Developed in 1975, the original tenets of the Center still underlie the current goals and objectives, which govern its work today:

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[1] The majority of statistics are taken from Williams, M.J. The Transition in the Contribution of Living Aquatic Resources to Food Security, Food Agriculture and the Environment, Discussion Paper 13, 2020 Vision, IFPRI, Washington, USA and the FAO data sources quoted therein.

[2] The FAO catch statistics for 1993 shows a significant upward revision from the earlier figures, mainly due to adjustment of statistics on China. China's total fishery production in 1993 reached 37.97 million metric tons of which aquaculture contributed 13.28 million metric tons. In 1992, reported total catch for China was only 15.01 tons although aquaculture statistics showed 11.00 metric tons of production from cultured sources. Figures quoted for 1995 are also from FAO statistics.

ICLARM's goal is to enhance the well-being of present and future generations of poor people in the developing world through improved production, management and conservation of living aquatic resources.

ICLARM's objectives are through international research and related activities, and in partnership with national government and non-government research institutions, to:

- improve the biological, socioeconomic and institutional management mechanisms for sustainable use of aquatic resource systems ;
- devise and improve production systems that will provide increasing yet sustainable yields and;
- help develop the capacity of national partners to ensure sustainable development of aquatic resources.

As described in detail in subsequent sections, ICLARM's program over the Plan period continues to give approximately equal weight to research on both fisheries and aquaculture with a dominance of biophysical research but an increasing emphasis on socioeconomic and policy research. The program blends biological and social science with state of the art communications technologies to provide outputs of value to a wide range of clients, from fishing families to aquatic resources research scientists and resource managers.

Global debate and statistics however tend to mask many different regional, national and local fishing practices (most glaringly between commercial fishing fleets and small scale artisanal fishers), and the sector, because of the general connectivity of aquatic ecosystems and the open access to fishers of much of the world's aquatic resources, is subject to a number of interacting and sometimes contradictory constraints. Direct conflict between the need to reduce fishing to conserve stocks, and the need to keep up employment often leads to policy deadlock. In the industrialized world, massive overcapacity is aggravated by enormous subsidies and the political clout of the sector. In developing countries, whose total marine catch has, since around 1986, exceeded that produced by developed countries, small-scale fisheries provide direct employment for 50 million people involved in catching, processing and marketing. However, overcapacity and hence overfishing is widespread, and alternative employment can be difficult or even impossible to find. For these and other reasons, both marine and freshwater ecosystems are being degraded by a variety of factors. Coral reefs, a major habitat for tropical fish and among the world's most biologically diverse ecosystems, are deteriorating. Large numbers of fresh water fishes are in danger of extinction.

Intensive aquaculture, which accounts for much of the dynamic growth of the sector, is capital intensive and export oriented. Exports yield cash and foreign exchange, which may be used to import food. However, water is in short supply in many regions of the world and water quality is in decline. Aquaculture is in competition with other uses for water and aquaculture itself (together with livestock rearing) consumes about 30% of fish meal production (or 5% of the fish

catch) as feed. Tension still exists in the international debate over opportunities for aquaculture development in developing countries between producer-targeted, low input aquaculture versus consumer-targeted, intensive aquaculture with sometimes deleterious effects on environment and sustainability. A start is only now being made in exploiting the genetic potential of fish for aquaculture, possibly centuries behind similar approaches to plant commodities and more than 50 years behind farm animal breeding.

Because of the decline in production, fish prices are starting to rise. About one billion people, many of them poor, rely on fish as their main source of animal protein. Further losses in productivity or long term price rises are likely to jeopardize the nutrition and livelihood of many, especially the poorest of the urban and rural poor of developing countries.

Although fisheries scientists became concerned several years earlier, it was not until well into the 1990s that the world became more generally aware of the precarious condition of the world's fisheries. Highly publicized international fishing disputes have multiplied in number and severity, and popular articles on the cost of fish for poor people, and the environmental cost of fishing practices, have increased public demand for accurate and impartial information on the underlying issues.

In the context of these changes, governments are seeking help in scientific assessments of the problem, and technical, managerial and policy solutions. ICLARM's MTP program addresses these issues accompanied by a growing effort in improving policies and impact assessment.

1.2 Regional Differences

As already mentioned, the global trends outlined above need to be refined to take into account important regional differences, which have affected ICLARM's choice of program priorities. The bulk of both marine (45.0%) and inland fisheries (77.5%) production is in Asia which, by the year 2000, is still expected to have 584 million people living below the poverty line, the majority in South Asia. Many Asian nations have a tradition of fish-farming and many island states of Asia and the Pacific are heavily dependent on fish as a source of dietary protein. Continued concentration of research to maintain current output, particularly from coastal fisheries, is essential for the future of Asia's aquatic resources productivity, while experience shows that technical advances in aquaculture, backed by continuing research, are swiftly adopted, and can show substantial impact over a wide area. The preponderance of ICLARM's research will continue to be undertaken in Asia and the Pacific, in collaboration with regional partners, and targeted primarily at Asian beneficiaries. Within the Plan period there will be a concentration on the poorer countries of Asia.

Whilst the world's greatest number of poor people reside in Asia, the most dramatic anticipated rise in the number of people living in poverty in the near future will be in Africa. (In sub-Saharan Africa, those living in poverty are expected to number over 300 million; this figure rises to almost 400 million if North Africa and the Middle East are included). The marine fisheries of West Africa and the Indian Ocean represent major resources requiring continued or improved management. Inland fisheries production in Africa provides 10% of the world total. In the face of the rapidly growing population it will be critically important to manage successfully the continent's lakes and other inland water bodies to sustain their productivity and unique diversity in aquatic biota. Aquaculture is practiced in an increasing number of countries in Africa with eight countries (including Egypt) reporting production of over 500 tons per annum by 1992. Efforts are required to extend and adapt existing technologies more widely in concert with the improved management of water and sustainable agricultural practices. ICLARM has previously recognized these requirements but, within the plan period and with the recent acquisition of a facility in Egypt, will design and initiate new programs of research to assist aquaculture and fresh water fisheries development with a primary focus on sub-Saharan Africa and a secondary focus on WANA. ICLARM's work in Africa will increase steadily in the next plan period.

The Center will continue to expand linkages with countries in Latin America and the Caribbean within its area of expertise (e.g., methods for the assessment of coastal and coral reef fish stocks) and will continue active research on marine protected areas with national programs in the Caribbean.
Despite regional differences, the issues of fisheries and aquaculture are global and resource-system specific. ICLARM therefore manages its research through a series of programs implemented at field sites throughout the developing world. Field research projects are supported by centralized capacity to develop software tools, relational databases and research methods which can inform national planners and scientists about fisheries management options, fish biodiversity, coral reef monitoring and sustainable use and contribute to decision making for better fisheries management.

1.3 Evolution of ICLARM's Program Structure

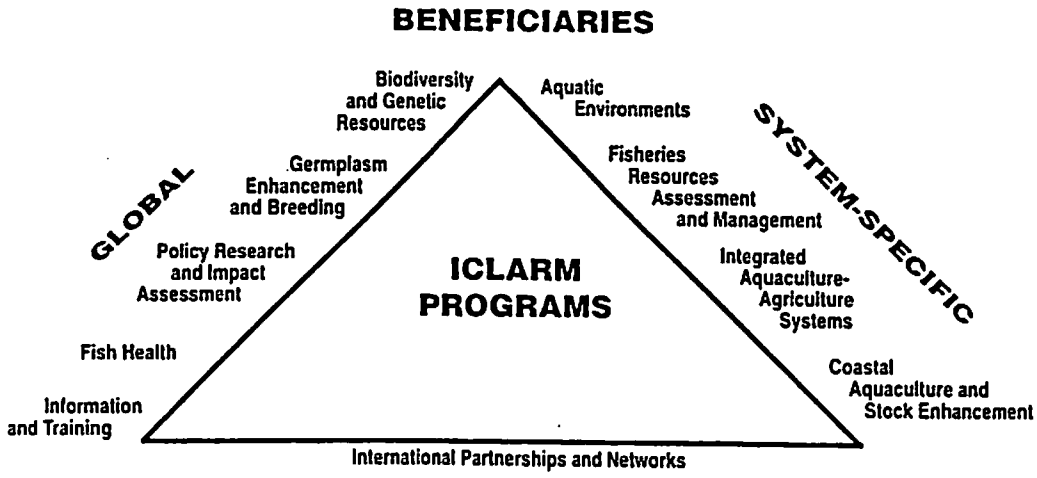
Although public awareness of fisheries issues has grown in recent years, the fundamental approaches on which ICLARM's present plan is based recognized the scientific and development issues much earlier, and ICLARM will not make dramatic course changes in the evolution of its program in the decade of the 90s. ICLARM's original Strategy[3], developed in 1991/92 used a resource system approach to setting research priorities, and identified seven resource systems on the basis of catch and aquaculture production, number of fishers and potential for increase of each system. Analysis of this data led to the identification of seven priority issues for international research.

[3] ICLARM's Strategy for International Research on Living Aquatic Resources Management, ICLARM, Manila, 1992.

Further analysis by priority resource systems yielded a three-program research structure based on key resource systems: (i) Inland Aquatic Systems (focusing on ponds); (ii) Coastal Resource Systems (focusing on estuaries and lagoons); (iii) Coral Reef Resources (focusing on coral reefs), while a fourth program, National Research Support, provided capacity building services for NARS. This remains an appropriate and relevant agenda but the organization of scientists within a few, large problems was not ideal for fostering cross-program interactions and learnings and some activities fell across program boundaries, or were of a more generic nature.

In preparation for the new MTP period and to accommodate TAC's request for the development of "CGIAR" projects for research reporting purposes, ICLARM convened a program planning meeting in early 1996. Attended by all senior researchers, and facilitated by an external consultant, the meeting revisited each research priority in turn, and restructured the program as summarized in the figure below. A further refinement was made in early 1998 to amalgamate one program, fish health, with other aquaculture programs, especially the Germplasm Enhancement and Breeding Program.

Figure 1. The present ICLARM program structure.



Within this 9-program structure, ICLARM aims to implement its work through 17 projects; Table A shows which projects are implemented in the various programs.

Table A. Relationship between ICLARM's program structure and the CGIAR project portfolio.

ICLARM Program	"CGIAR" Project (ICLARM Project Number)
Global Programs	
Biodiversity and Genetic Resources	Assessing Aquatic Biodiversity (#1) Aquatic Biodiversity Training (#2)
Germplasm Enhancement Breeding (including Fish Health)	Fish Germplasm Enhancement (#3) (Previously Project #17)
Policy Research and Impact Asssessment	Ecological Economics (#11) Aquatic Research Impact (#12) Policy Analysis (#13)
Information and Training	Multi-Lingual Information & Communications (#14) New Methods and Technologies for Training (#15)
System-Specific Programs	
Integrated Aquaculture-Agriculture Systems	Aquaculture-Agriculture Systems Analysis, Management (#9)
Fisheries Resources Assessment & Management	Fisheries Assessment and Management (#8)
Coastal Aquaculture and Stock Enhancement	Aquaculture, Enhanced Fisheries on Reefs (#10)
Aquatic Environments	Assessing, Managing Reef Degradation (#4) Multi-Sectoral Use of Inland Systems (#6) Decision-Making in Coastal Zones ($5) System-Wide Initiative on Coastal Environments (#7)
Foundation and Outreach Program	
International Partnership, Networks	Information & Research Networks & Linkages (#16)

1.4 Evolution of ICLARM's Program Priorities

ICLARM's 1992 strategy called for an allocation of resources and effort approximately in the ratio: Resource conservation and management - 35%; Fish productivity - 25%; Social Sciences - 20%; Institution Building - 20%.

This allocation was chosen on the basis of an analysis that measured fish catch, aquaculture production, potential to increase production in both of the above, and an index of potential gain, along with modifiers for numbers of poor, NARS strengthening needs, threats to sustainability and equity. The allocation also drew on the "research activity types" outlined by TAC in their document "A Possible Expansion of the CGIAR".

ICLARM's mandate potentially could have been broadly interpreted - there are for instance approximately 27,000 species of finfish (nearly ten thousand of which could be considered as food fish) and tens of thousands of other living aquatic organisms which encompass invertebrates, algae, seagrasses and mangroves. The use of these aquatic resources occurs across a spectrum of activities from simple hunting and gathering from the wild, and to sophisticated modern industrial harvesting and high technology culture. This presents a staggering array of potential research topics to augment the productivity and sustainability of living aquatic resources. It is also quite different from a mandate to improve a single agricultural commodity supported by a relatively small number of resource species to be grown as a monoculture.

ICLARM's resource systems approach[4], bearing in mind the CGIAR's poverty target groups simplifies this choice with research conducted on the monitoring and improved management of the individual system or on species assemblages and community analyses. However, addressing the needs of biodiversity research, or aquaculture and stock enhancement for widely important aquatic species groups, the scientific focus shifts to the species level either in its natural setting or in production systems akin to those considered by agricultural researchers. For selected aquaculture species whose better productivity is sought through genetic enhancement, ICLARM has developed programs which are essentially commodity-focused although the underlying research methods (e.g. selective breeding) are generic. At this level the choice of commodity is determined by its value as a food resource for large numbers of poor people and the amenability of the species/group to the research methods (e.g. Nile tilapia and carps) or in promoting income generation for coastal communities through the appropriate exploitation of low-input but high-value species such as giant clams, oysters or sea cucumbers.

In preparing for the previous MTP covering the period 1998-2000, ICLARM decided against a detailed re-analysis of the type undertaken for the strategy since shifts in base data had been minimal. Instead, a large number of experts (400) were asked to comment on revised priorities. Over 100 replied, and their views have been carefully assessed by ICLARM's Board, management and staff, as explained in the section below on the preparation of this MTP. Although the categories only approximate those in the 1992 plan, the year 2000 allocations are: Increasing Productivity - 29%; Protecting the Environment - 24%; Saving Biodiversity - 13%; Improving Policies - 18%; Strengthening National Systems - 16%.

The reasons for the distribution of priorities are given in the discussion of the program portfolio (see Section 2).

[4] See ICLARM's 1992 Strategy for International Research on Living Aquatic Resources Management and the Appendix tables which bear on the evaluation and selection of target aquatic species groups.

1.5 MTP Program Focus

As noted above, aquaculture will have an important role in gap-filling the total fisheries product requirement as the world's capture fisheries decline and provide significant economic and livelihood opportunities which benefit food security. ICLARM seeks to lead new initiatives in the genetic enhancement of freshwater aquaculture species appropriate for tropical developing countries and will continue programs on the stock enhancement of important marine aquaculture species not being addressed by others. ICLARM has adopted an environment-saving, resource-conscious approach to both freshwater and marine aquaculture systems for the sustainable exploitation of these technologies by smallholders and their communities.

Developing appropriate schemes for the productive and sustainable use of the coastal zone of tropical countries in the face of competing uses, some of which carry with them the risk of pollution or degradation of existing coastal resources, is a major challenge. However, the coastal zone is home to large numbers of artisanal fisherfolk and others, many of whom are women, who earn income from the use or processing of aquatic products. To support these people, the need is for interdisciplinary research coupled with the development of policies which create an equitable and profitable environment whilst paying due regard to the conservation of the resources for future generations. In providing inputs to the development of such policies and research, ICLARM will collaborate with others providing expertise in forestry, soil and water management, coastal agriculture and institutional arrangements, as envisioned through a revised development of the initiative on coastal environments. The aim will be to study and provide general methods for the improved management of the coastal zone taking into account the numerous actors and ICLARM's expertise in coastal fisheries management and data analysis systems.

Special emphasis will continue to be placed on the policy and implementation aspects of technological solutions through research on the co-management aspects of commonly held fisheries resources, the ecological economics of key aquatic resource systems, and on technology impact assessment. ICLARM has made conscious and pragmatic decisions since its inception to work in scientific partnership and thus extend the scope of its research and expertise and to provide immediate applicability of its research results.

Partners in the fisheries sciences and development community include NARS and universities in developing countries, NGOs, advanced research institutions and development agencies. As a unique international institute conducting research on both marine and freshwater fisheries for developing countries, ICLARM has an especial responsibility to provide technical and other literature for scientific and development advances and to provide information on which improved management decisions can be based. The Center intends to continue and strengthen the dissemination of its research products and information services and, where appropriate, will consider cost-recovery mechanisms to enhance these services. ICLARM will continue to support the two main networks with which it is currently involved (i.e., the International Network for Genetics in

Agriculture, or INGA, and the Asian Fisheries Social Science Research Network) and to provide a coordinator for INGA. Similarly, ICLARM will be continuing steps already initiated to work more closely with existing regional groupings of NARS, such as APAARI, and their NGO partners.

Finally, because of ICLARM's position at the nexus of fisheries, aquaculture and conservation research, the Center continues to be called upon to provide input on fisheries and aquatic resources to international debates on fisheries policy and management, the conservation and use of biodiversity and genetic resources, natural resource management at the ecosystem level, food security and sustainable agriculture, in fora within and outside the CGIAR. The Center believes that it plays an important role in providing information and cross fertilization in these debates, often conducted by institutes and agencies which are part of the wider research and developmental community. Such inputs improve the impact of ICLARM's work and ICLARM will make provision for the continuance of this role through the Plan period.

ICLARM acknowledges the range of institutes and agencies which provide research and information relevant to the improved utilization and management of fisheries both globally and more regionally. ICLARM seeks not to duplicate these other sources of expertise but, through collaborative and open partnerships, to focus research advances or new data on the problems of developing country fisheries and on research solutions which benefit poor people.

Because of its relatively small size, ICLARM continues to exercise prudence in its strategic approach and to identify with its partners strategically important research topics on which to focus. Rather than developing additional research programs however, but in line with its mandate, ICLARM will develop information and position papers on such topics as the evolution of smallholder and commercial aquaculture in the next century, and supply and demand issues in developing country fisheries. International Workshops are planned on fisheries policy as it affects food security in developing countries; on strategic issues affecting the development of aquatic protected areas, and policies for the conservation and sustainable use of aquatic genetic resources.

Similarly ICLARM is planning its participation in major events such as the Species 2000 project, the International Year of the Oceans in 1998, and will continue to work closely with the Fisheries Department of the FAO and to liaise with the IUCN in the classification and conservation of marine and coastal resources. ICLARM's membership of the CGIAR since 1992 has helped raise awareness within the system of the important role played by fish and other aquatic resources in human nutrition and food security for poor people in developing countries. ICLARM is confident that this full range of interactions and its strong portfolio of programs will develop results and methods of direct benefit to the enhancement and sustainability of fisheries and aquatic resources. Improvement in the provision of these resources will ensure their contribution to global efforts to enhance food security and substantially alleviate poverty in the context of protecting our world's environment.

1.6 ICLARM's Research Agenda and CGIAR Goals

ICLARM fully subscribes to the CGIAR goals of developing generic methods and technologies which provide international public goods that have an impact on poverty alleviation, food security and environmental protection. ICLARM believes that its research agenda and outputs will make a contribution to each of these goals.

1.6.1 Poverty Alleviation

Communities engaged in small-scale fishing and farming are often very poor and in danger of being further disadvantaged as resources degrade or as larger-scale operators dominate land and resource use. These poor fishing and farm families are the main ultimate targets of ICLARM's work but the provision of increased quantities of low-cost aquatic produce will similarly assist the urban poor. The Center recognizes that food security is best obtained through promoting equitable use of resources and raising incomes, and not simply through productivity. As such, the Center has developed a research portfolio which benefits access to the means of production, maintenance of a productive resource base, and affordable and sustainable technologies to produce not only edible products but also in some cases, such as cultivation of clams and pearl oysters, high value/low input market items.

Several of ICLARM's projects, including those on integrated agriculture and aquaculture, marine stock enhancement and co-management studies of fisheries, are conducted directly with farmers and fisherfolk affected by project outcomes. For instance, in Bangladesh, the integration of aquaculture into farming systems has been demonstrated to have positive impacts on farm productivity, human nutrition and the involvement of women. For these reasons, ICLARM has maintained this research as a high priority in the Plan period and will extend research to deepwater rice systems and to comparable systems in countries in Indo-China. Other ICLARM projects are focused on the development of new scientific results, information and databases which will optimize the use of developing country fisheries for the benefit of all sectors of society but with the emphasis on reducing the cost of fish for poor people. This has been demonstrated in the case of genetic enhancement for Nile tilapia and has led to concurrent research in the Plan period on carp genetic enhancement.

Improving nutrition is an important component of alleviating poverty. ICLARM will seek, through its various programs, to help in maintaining fish consumption among the poor, not just in fishing communities but more generally in both rural and urban areas. Through the development of position papers and policy research, ICLARM will examine how best to maximize the number of beneficiaries from aquatic resources research.

The gender impact of ICLARM programs will be carefully monitored. In fishing and aquaculture, there is a traditional division of labor between men and women but this is breaking down. In many cultures, fishing is generally a male occupation but women make and mend nets, process and sell the catch.

Women are likely to be engaged in aquaculture, especially in tending the ponds and feeding the fish, after men have dug the ponds and stocked them. Men usually harvest the fish but post-harvest activities are usually dominated by women. ICLARM intends to contract or co-sponsor a desk study with other expert institutes to examine the researchable issues in post-harvest treatment of aquatic products as a key area affecting overall productivity of the sector and women's role within it. ICLARM expects to play a lead role in first Asian, and later global, efforts to highlight women in fisheries and fisheries research issues. A regional conference on this subject was convened by ICLARM and the Asian Fisheries Society in 1999.

1.6.2 Food Security

Food security in poor households may mean growing enough to feed the family, or having enough money to feed the family. ICLARM's "improving productivity" projects provide approaches to both. The genetic improvement of aquaculture strains and the development of integrated aquaculture-agriculture systems provide research outputs that can help poor households grow more of their own fish; the work in the Solomon Islands, on cultivating high-value crop like giant clams, pearl oysters and sea cucumbers, helps poor reef fishers to augment their income substantially, allowing for increased food purchases.

Research for the improved management of tropical marine and freshwater fisheries can not only help to preserve the environment (which is why ICLARM places these activities in this CGIAR category), but can also provide national governments with data and recommendations on how to make their fisheries sector more sustainable, and hence productive over time. Work in biodiversity also will serve to increase food security, by highlighting threatened, useful food species and recommending ways to preserve them. Much of ICLARM's policy work, too, can be seen as supporting this aim and ICLARM intends a renewed focus on "Policy Analysis of the Contribution of Fisheries to Food Security".

1.6.3 Environmental Conservation

In a sense, all ICLARM's research is concerned with the conservation through responsible use of the world's aquatic resources. ICLARM continues to play an important global role in research, data collection and management and as a source of scientific advice on the conservation and sustainable use of aquatic resources at the ecosystem, species and sub-species level. From FishBase, a program that seeks to gather data on the world's finfish species, to coral reef monitoring and assessments for environmental health to the development of fish ponds on small holder farms (that provide water households and vegetable use, as well as for fish); every effort is made to ensure that natural resources (fish, shellfish and water) are managed with a view to sustainable use for future generations.

The development by ICLARM of fish biodiversity and coral reef databases, and ecosystem modeling capacity (e.g. ECOPATH), places the Center in a central position in relation to monitoring the effects of climate change on living aquatic resource systems. The Center will continue to make its expertise available to scientific fora concerned with climate change and anticipates a more focused involvement in this global environmental issue beyond the Plan period.

1.6.4 Collaboration: ICLARM's role in the global forum

Since its inception, ICLARM has worked with an array of international partners and collaborators, principally the national aquatic resources research activities in developing countries. This continues to be both a philosophical and pragmatic *modus vivendi*, as working with NARS is the best way of appreciating the actual problems requiring solution, responding to them, experiencing the practicalities of dissemination and implementation of new findings and sharing results and achievements. In recognition of the importance of partnerships, ICLARM has developed an institutional, Board-approved partnership policy to guide its research and training activities with a wide-range of partner organizations.

ICLARM's tradition of working in partnerships has led it into collaborative consortia of NARS and NGOs. The presence of such consortia has been particularly helpful to the implementation of studies of co-management of coastal fisheries resources and in the extension of integrated resource use for aquaculture/agriculture systems in both Asia and Africa. NGOs are expected to play an especially important technology transfer and feedback role in ICLARM's future IAA work where training in RESTORE software and the introduction of the integrated approach to aquaculture in smallholder farming systems will be provided specifically for appropriate NGOs.

As a small Center with a wide mandate, ICLARM has always been conscious of the need to maximize its links with appropriate advanced scientific institutes or university departments in both developed and developing countries. An excellent example comes from the equitable collaborative arrangements ICLARM has developed for the provision and sharing of data through FishBase and ReefBase. International interest in these two databases has led ICLARM into an enormous network of colleagues and collaborators, from FAO fisheries scientists and through museum curators to divers concerned with reef monitoring. ICLARM's out-posted scientists and time-sharing arrangements with other staff provide linkages to such institutes as the North Sea Center in Denmark and the University of British Colombia in Canada. Collaborative research in, for instance, the Solomon Islands is conducted together with national program staff and scientists from the Australian universities and marine science institutes. ICLARM will conduct research projects with European institutes under "holdback" funding arrangements.

From 1998, and over the Plan period, ICLARM increasingly wishes to capitalize on new technical advances and will be actively seeking further contacts with advanced institutes in the fields of remote sensing of coral reef health, genetic marker technology for aquaculture species, mangrove ecology and fish health, amongst others. ICLARM's strategy will be to establish new links through project contracts (such as with Norwegian collaborators in quantitative genetics) or the secondment of young scientists from advanced institutes globally to augment the rate of research in new areas and information exchange.

ICLARM will continue to take an active part in the CGIAR's System-wide Genetic Resources Program (SGRP) and its System-wide Information Network on Genetic Resources (SINGER). ICLARM contributes its experience in fisheries co-management studies to the system-wide program on common property resources managed by IFPRI. It will pursue a modified version of work first described in the System-Wide Initiative on Coastal Environments (or SWICE), initially by discussions with other natural resource management centers in and associated with the CGIAR, and ICLARM continues to provide input to the System-Wide Initiative on Irrigation Management (SWIM) convened by IWMI.

As the only fisheries Center of the CGIAR, ICLARM's linkages take it outside the traditional partnerships in agricultural research and into marine science, environment and natural resources management research. ICLARM enjoys excellent working relations with central and regional offices of the FAO and with the Asian Fisheries Society. Other partnerships of importance include the IUCN, UNEP, the Global Coral Reef Monitoring Network, the USAID-supported CRSP for Pond Dynamics and Aquaculture and many others. The number and scope of ICLARM's partnerships are certain to grow over the MTP period and beyond.

1.7 Development of the MTP

As part of the preparation for the 1998-2000 Plan period, ICLARM circulated a discussion paper in July of 1996 on likely research areas to approximately 400 leaders in the field of fisheries and aquatic resources from NARS, international research centers, NGOs and donor agencies. The response exceeded expectations; over 100 considered written replies were received, along with much additional informal feedback. The level of interest displayed by ICLARM's stakeholders was warmly welcomed by the Center and its Board. The discussion paper and the responses received formed the basis for a specially convened discussion in September of 1996 with an invited Scientific Advisory Panel, selected to represent a cross section (by subject matter, region, research or development background) of expert opinion. The recommendations of the Advisory panel were discussed by the ICLARM Board immediately afterwards, and the plan for the period 1998-2000 drafted.

Following the Board discussion of the Scientific Advisory Panel recommendations, ICLARM prepared a first draft MTP, which was reviewed and discussed intensively with a TAC Review Panel who visited ICLARM in early January 1997. On the basis of these discussions and a subsequent review by ICLARM's Board, the present plan was finalized. It has been modified following

internal ICLARM discussion to cover the evolution of activities through the period 1999-2001.

Using this substantial and interactive planning procedure as a platform, ICLARM's Board has asked ICLARM to prepare a new Center Strategy that, based in the scientific principles developed in 1991, takes into account both a long term horizon (at least 25 years into the next century) and the new global opportunities provided by institutional arrangements not available to ICLARM previously. This exercise commenced in early 1998 and will take about 1 year.

2. Activity/Project Highlights

Category 1: Increasing Productivity[5].

Improving Productivity research (at 29% of the total portfolio) has grown significantly over the 25% that was allocated at the beginning of the decade. ICLARM seeks to further the successes of the Genetic Improvement of Farmed Tilapia (GIFT) project, about which many Asian countries have expressed strong interest, and which, over the Plan period, will expand to encompass genetic enhancement research for Asian carp species.

Based on results obtained in the past four years, future research has a high potential for success. This is clearly an area in which ICLARM has an international comparative advantage over alternate suppliers. Tilapia improvement is targeted at small scale producers and the development of improved strains should yield higher availability and provides demonstrably lower costs of a nutritious fish, ultimately benefiting poor fish consumers. Higher availability and lower costs should also positively affect food security. As such, the increase in the program allocations, and hence the larger contribution to the CGIAR category is amply justified.

Another reason for growth in improving productivity, is ICLARM's intention to widen the geographic range of its integrated aquaculture-agriculture (IAA) work as the program in Africa develops and socio-economic analyses demonstrate how to capture the resource and human nutritional benefits more widely, IAA is seen as having high potential for improving the income, quality of life, and nutrition of the poorest and smallest farm families. Given the Center's renewed focus on poverty alleviation, especially in Africa, IAA takes on a new priority.

The other main contributor to the Improving Productivity work is the program on coral reef aquaculture and stock enhancement. Again, increased allocations reflect, in part, early successes, and likelihood that further research can have a strong impact on the livelihoods of poor peoples whose livelihoods are dependent on harvesting dwindling stocks in coastal states. Research at

[5] ICLARM assigns aquaculture and stock enhancement activities to the category "Increasing Productivity" and capture fisheries activities to the category "Protecting the Environment".

ICLARM's Coastal Aquaculture Center in the Solomon Islands has been able to demonstrate that poor coastal families can generate significant income from the culture and sale of high-value items to export markets in Asia and the USA. Although this activity does not affect food availability directly, increased income has allowed beneficiaries to improve their diets and means of family support thus benefiting food security. Advice and technologies for the appropriate exploitation of these resources will have a positive impact on environmental protection.

Improving Productivity was also envisaged to include a new ICLARM project on Fish Health, principally on diagnosis and surveillance. The transfer of the Abbassa facility to ICLARM management provides the opportunity to undertake this work integrated into a more holistic view of aquaculture research which will include aspects of genetic enhancement, nutrition and improved management. Research has been initiated and this approach will be further developed in 1999 for full implementation in 2000.

Thus, ICLARM presently conducts three of the four areas of research designed to increase the productivity of aquatic and/or agricultural systems. These are:

IP - 1: The Genetic Improvement of Fish for Tropical Agriculture (ICLARM project #3).

ICLARM and its collaborators have provided evidence that substantial improvement in the growth rate and survival of Nile tilapia can be achieved through selective breeding. The INGA network has aided in the dissemination of the technology, and the impact (in terms of fish production, adaptability and economic returns) of the new germplasm following its introduction to several countries in Asia has been demonstrated. National partners are being assisted in the establishment of their own tilapia breeding programs suited to different national systems and priorities. New traits, such as late maturation, brackish water tolerance and cold tolerance will be carefully considered for research, taking into account possible environmental consequences and equity considerations. Chosen projects will be pursued in collaboration with partners in Asia, and at the Egyptian site starting in 1998. Beginning in 1997, and continuing through the Plan period, ICLARM and partner countries in Asia are identifying regionally important and biologically amenable species and strains of carp for improvement by genetic selection. ICLARM will also explore with ARIs the identification and application of genetic markers to be used in tracing improved strains and in future work on the identification of quantitative trait loci. This research responds directly to the identification by TAC of fish breeding as a topic for increased CGIAR support[6].

[6] TAC Report on CGIAR Priorities and Strategies for Resource Allocation during 1998-2000, TAC Secretariat of the FAO, Rome, Italy 1996 pp77 + Annexes.

IP - 2: Development of Integrated Aquaculture-Agriculture Systems (ICLARM project #9)

Although fish have long been produced as part of mixed farming systems in parts of Asia, the number of farmers adopting this practice is low and it is even less widely known in Africa. ICLARM has conducted research in the Philippines, Bangladesh, Ghana and Malawi and aims to introduce integrated aquaculture-agriculture (IAA) to smallholders in additional sites in Africa and Asia which are appropriate for aquaculture but where it is not yet widely practiced. Research will also examine the use of the technology in differing agro-climatic zones in Africa, and deep water rice/fish systems in Bangladesh and Vietnam. Previous ICLARM research in Bangladesh has shown considerable returns to smallholders, including women, from the increased harvest of fish in integrated systems. In Africa, in contrast, research has shown that the benefits of IAA to overall farm productivity flow rather more from the existence of pond water, the recycling of water and farm resources and the production of vegetables, than from fish production *per se*. Further, case studies in different agro-ecological zones are required to demonstrate the widespread applicability of early apparent benefits. In the future, the project will evaluate the costs and economic and nutritional benefits for the farm family (concentrating on existing relationships in Malawi) and will specifically seek to identify the parameters governing adoption, including gender influences, the institutional requirements for provision of fingerlings and extension to support IAA practices.

ICLARM had developed software (called Research Tools for Natural Resource Systems Monitoring and Evaluation, or RESTORE) for training and evaluation of the approach. During the MTP period, regional training will be conducted with ICLARM's clients and partners, and will target government extension agencies and NGOs which are active in the promotion of appropriate technology for agriculture. RESTORE will be refined during the Plan period and made available to collaborating Centers of the CGIAR and other partners for its application to integrated resource management in other farming systems.

IP - 3: Sustainable Coral Reef Aquaculture and Stock Enhancement (ICLARM project #10)

Coral reefs throughout the world have provided coastal populations with a rich variety of aquatic products. Building on early research successes for giant clams (*Tridacna spp.*), ICLARM is continuing work to develop biotechnical systems for the culture of high-value species by village farmers. The work is conducted in the Solomon Islands and has immediate applicability to other island states in the Pacific and for coastal and coral reef systems in Asia.

Aquaculture is a new concept for many people in the Pacific because natural fish supplies have previously been sufficient. As these supplies are heavily exploited by growing populations, however, ICLARM aims to raise awareness that culture of inshore marine resources can yield benefits to coastal communities. The focus is on high-value species that are (i) easy to collect as fry or spat from the wild, or to propagate in simple hatcheries, (ii) inexpensive to rear and, (iii) readily

marketable through existing infrastructure. The research is being followed with interest by countries in Asia and Africa to which coral reefs are important and which could profit from similar village industry development and the improved welfare of coastal communities.

Past research by ICLARM and other organizations has led to the development of reliable methods for the spawning and land-based larval rearing of giant clams. ICLARM, in conjunction with Australian and national partners are conducting a formal economic assessment of village-level, giant clam farming. However, demand for present production is buoyant in the live aquarium trade and looks promising in the markets for sashimi (raw seafood) and the high-value adductor muscle. Future research will be aimed at the provision of adequate broodstock, the delivery of larvae and grow-out technology to a variety of countries and links between farming and restocking natural populations. This will provide the basis for expansion of giant clam farming throughout the Indo-Pacific.

Work underway on blacklip pearl oysters is aimed at developing viable methods for small-scale commercial production in open coral reef habitats (pearl farming is currently concentrated in "closed" coral atoll lagoons). The project's short-term objectives have been met and include identification of improved methods for the mass collection of wild spat, improved knowledge of prime spat collection sites and seasons, and arrangements for the grow-out of spat in villages to the size where they can be sold to pearl farmers.

Sea cucumbers are in intense demand, especially from China, and there is widespread concern that present levels of catch throughout tropical Asia and the Pacific are not sustainable. ICLARM and its partners are trying to develop methods for the mass rearing of tropical sea cucumbers for the purpose of restoring and enhancing wild stocks. Collaborative research on stock enhancement of other species of high value e.g., *Trochus* and green snail, is also underway. A new initiative in partnership with advanced institutes in Australia and national fisheries partners in the Solomon Islands will be to examine the feasibility of using wild caught juvenile reef fish (principally groupers) for future aquaculture and stock enhancement programs at the village level. This responds to requests from NARS and the advice of ICLARM's Scientific Advisory Panel to extend ICLARM's current expertise and infrastructure for stock enhancement of high value reef fishes. Work will commence in 1998 and continue throughout the MTP period.

IP - 4: Fish Health (ICLARM project # 17)

The links between intensification of fish farming and disease pathologies are critical to the effective use of aquaculture in new environments such as Africa. Subsequent to a review of the field in 1999. ICLARM intends to initiate programs at the new Egyptian facility integrated with other programs of aquaculture improvement. ICLARM will also link with the FAO, where appropriate, in issues relating to appropriate introduction of exotic organisms.

Category 2: Protecting the Environment

Protecting the Environment is expected to receive some 24% of the Center's allocations over the Plan period. This amount, (in addition to the 13% allocated to Biodiversity), is close to the 35% allocation to "Resource Conservation and Management" envisioned in the 1992 Strategy paper. As noted in Table B, however, several aspects of ICLARM's improving productivity work will also have components that contribute directly to protecting the environment. Allocations to the "Environment" category are likely to increase over the Plan period, particularly an increase in project support for the Fisheries Assessment and Management Program over the first years of the Plan.

A recent document by collaborating UN agencies[7] on the identification of scientific needs relevant to the destruction and restoration of coastal habitats reinforces ICLARM's own research approaches reflected in this category. Such research follows directly TAC's recommendation that "Production Systems Development and Management" should dovetail with research into "Protecting the Environment" for sustainable use.

PE - 1: Fisheries Resources Management: Data Acquisition, Methods and Models (ICLARM project #8)

Fisheries management requires information about stocks and their harvest levels and appropriate use of this knowledge by fisheries managers and fishers. In the temperate zones, traditional stock assessment methods are based on age-structured information, usually developed for single species. Due to the great dearth of information on the growth rates of the large number of species that make up tropical fish catches, ICLARM has been instrumental in making alternative methods (based on length-frequency data) available for tropical nations. Many developed nations now use these methods as a guide and cost-effective way of monitoring fish stocks, along with the new experience age-based methods. ICLARM's primary software package (ELEFAN or Electronic-Length Frequency Analysis) has been subsumed in the new FAO-ICLARM Stock Assessment Tools (FiSAT) as a basic training package for stock assessment.

Similarly, ICLARM has developed ECOPATH 3.0 as one of the few methodologies for ecosystem analysis available to scientists working with tropical fisheries. ICLARM will continue to develop methodologies for the analysis of multi-species fisheries to enhance existing software. Major training programs in the use of the ECOPATH software will be conducted with ACP countries and in collaboration with the University of British Columbia, Canada.

[7] The contributions of science to integrated coastal management, IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP. Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), 1996, GESAMP Reports and Studies No. 61.

Commencing within the Plan period will be the collaborative development of resource databases and enhanced management information systems for coastal trawl fisheries based on data collected by Asian nations over many years. It is anticipated that such analyses will yield knowledge of the true species diversity, abundance and dynamics of coastal fish populations, and thus inform management decisions over these important and over-stressed fisheries resources in the future. The collaborative project will strengthen the capabilities of the participating Asian institutions and assist them to develop strategies and action plans to rehabilitate their coastal fish stocks. ICLARM will further collaborate with other institutes and national initiatives on coastal fish stocks (e.g. in West Africa and Latin America) to help unify approaches and information sharing globally.

In Africa, and in partnership with other agencies, particular attention will be paid to the Great Lakes, as these represent a crucial source of fish for many countries. ICLARM's initial efforts, to be carried out at one target site in partnership with the many agencies involved in Great Lakes management, will be devoted to the development of cost-effective methods for the monitoring and assessment of fisheries, the design of resource surveys, and the collection of socio-economic data relevant to improved management. This will involve ICLARM in the wider dissemination of its existing analytical tools and training in their use.

An important activity within ICLARM's Fisheries Resources Management project focuses on the special issues surrounding the establishment of marine protected areas (MPAs). MPAs, within which there are limitations and controls on fishing and other types of economic activity, represent an important potential approach to protecting certain fisheries resources, and the number of MPAs around the world is increasing rapidly. ICLARM has started research at sites in the Caribbean (in Jamaica and the British Virgin Islands) and the Pacific (the Arnavon Islands in the Solomon Islands) aimed at assessing the effectiveness of MPAs as fisheries management tools, identifying criteria for such areas, and developing management strategies based on sound social, economic and ecological evaluations. In accordance with the priority this activity was awarded in ICLARM's MTP review process, ICLARM will continue research on aquatic protected areas throughout the Plan period and will bring together major research groups in this area in 2000 to share knowledge and provide input into identification and resolution of the scientific issues.

ICLARM justifies continued and strengthened emphasis on this project because: (i) of ICLARM's past research and evolving tools; (ii) beneficiaries at the national and regional level express strong interest in the outputs of fisheries assessment and management research as concerns for fish stock depletion grow; (iii) the work generates international public goods of wide applicability; (iv) improved fisheries management can have a profound effect on food security at the macro and micro levels; (v) the objective of the project is the protection of the resource through appropriate and sustainable use; and (vi) the subject is so large, and important, that there is room for the outputs of all working in this area; ICLARM already works closely with FAO, one of the largest alternative suppliers in

fisheries assessment and management research and has strong links with ICES (the International Council for the Exploration of the Sea).

PE - 2: Assessing and Managing Coral Reef Degradation (ICLARM project # 4).

Coral reefs are the most biodiverse ecosystems in the oceans. They are fished by artisanal and subsistence fishers and can provide remarkably large harvests per unit area. However, most reefs are under threat from many factors, including shore-based pollution and destructive fishing practices and perhaps global climate change. In partnership with others around the world, ICLARM is developing ReefBase, a global database of coral reef systems and their resources and profiles of their use by people. ReefBase is designed to provide scientists and resource managers with the data required for the comparison of reef systems, the identification of problem areas, and the prioritization of action. The development of the database will continue for most of the Plan period with efforts in 1999 being directed to socioeconomic factors governing effective reef management and the analysis and incorporation of remotely sensed data on coral reefs. ReefBase will aim to incorporate a set of processed satellite images for each, major, near-surface reef to be used as a basis for management planning and scientific survey design. An associated task of the fieldwork will be to relate changes in ecological community structure associated with anthropogenic stresses to information collection from satellite and aerial sensing capabilities.

This effort will be augmented by (i) a first global assessment of fish catch from reefs, (ii) detailed studies of a small number of selected reefs to derive indicators of sustainability and reef health and (iii) a genetic study of key coral reef species in countries bordering the South China Sea in collaboration with national partners, to establish the degree of inter-connectivity amongst coral reef organisms in a large marine ecosystem. Research will contribute substantially to ICLARM's project (#11) on ecological economics for the sustainable use of aquatic resource systems.

ICLARM has recognized comparative advantage in this area and scientists in the field provide ICLARM with their data to help make the underlying database more complete, and because they are eager users of the database for their own purposes.

PE - 3: Inland Fisheries and Aquaculture: Multi-Sectoral Use of Inland Aquatic Resource Systems (ICLARM Project # 6)

This project does not yet exist, although the need for it has been expressed by both the Scientific Advisory Panel to the preparation of this MTP, and several of ICLARM's partners. These people are concerned that there is considerable potential for research that contributes to the sustainable use of inland water bodies, including lakes, rivers, reservoirs and streams. ICLARM also recognizes the severe limitations now emerging in global supplies of freshwater. Present uses often have serious negative effects on the environment that affects the

well-being of large numbers of people including implications for human health. As with coastal areas, the interactions among activities dependent on inland water bodies are complex and characterized by often conflicting interests. ICLARM realizes that to be effective, it will need to work with multiple partners in this area. Discussions with partners have been held to explore the dimensions of the subject during 1997, with a view to beginning work late in 1998. ICLARM's 1992 strategy paper also identified inland water bodies as a priority, although operationally, work in subsequent years was limited to ponds; the intent now is to broaden this to larger water bodies, especially in Africa. Because of critical mass issues, new projects on rice floodwater, irrigated water and small water bodies for use in aquaculture are collected under the IAAS project IP2. With the possible curtailment of activities under the System-wide program in water management (SWIM) ICLARM will conduct new activities on the evaluation of the aquatic resources of the wetlands of Indo-Chinese countries under Project 11. ICLARM plans to convene a workshop on aquatic life in 1999 at the annual global water symposium in Sweden. These issues are revisited in ICLARM's new draft Strategic Plan for 2000-2020 which confirms the importance of inland waters, especially floodplains to the sustenance of poor communities.

PE - 4: System-wide program on coastal environments (ICLARM Project # 7)

A large part of the world's population lives in the coastal zone. To a great extent, in the tropics, this population concentration has sought to exploit the rich harvestable resources available from many coastal ecosystems. However, as coastal populations rise and coastal resources decline, the pursuit of short-term economic gains leads to destructive forms of fishing and clear cutting of mangroves. Other agricultural and land based practices accelerate the dissipation of the resource base, and cause environmental degradation through pollution, siltation and the elimination of crucial habitats.

Integrated coastal area management has been identified by intergovernmental agreements such as Agenda 21 and the International Convention on Biological Diversity, amongst others, as the appropriate approach for the future. Implementation of this approach, however, on a global scale is inhibited by a lack of fundamental knowledge on ecosystem health and interconnectivity, and how these respond to coastal development activities.

Based on previous experience at San Miguel Bay in the Philippines and other sites in Southeast Asia, and working with partners and institutes associated with the CGIAR, ICLARM developed a system-wide initiative of the CGIAR, the System-Wide Initiative on Coastal Environments or SWICE. TAC 70 considered an early version of the plan for SWICE and indicated interest in reviewing a more detailed version. Recent discussions inside ICLARM and the outcomes of the review and consultation processes for the Medium-Term Plan all suggest that this not be pursued as a system-wide initiative, but as series of projects under ICLARM's general program, including studies involving other CGIAR centers which could supply some of the terrestrial science expertise needed to understand land-sea interactions. ICLARM has recently initiated a study with

New Zealand collaboration of the effects of logging on coral reefs and other aquatic resources in conjunction with its regional activities in the Solomon islands. An internal ICLARM workshop in 1998, identified the following priority areas for future research: (1) legal and institutional analysis of integrated coastal zone management (ICZM) development; (2) development of criteria and indicators of change and biodiversity; (3) economic evaluation of natural resources plus quantification of erosion and sedimentation; (4) development of an ICZM research framework for planning and development of ICZM intiatives at ICLARM; (5) rehabilitation of degraded mangrove habitat and abandoned shrimp ponds, while incorporating the development of alternative livelihood and food security for displaced fishers.

Category 3: Saving Biodiversity

Work in this category will be undertaken through two linked ICLARM projects the second of which also contributes to the strengthening NARS activities.

SB - 1: Assessing Aquatic Biodiversity and Genetic Resources (ICLARM Project #1)

SB - 2: Aquatic Biodiversity and Genetic Resources Training (ICLARM Project #2)

ICLARM plans to contribute to these goals in the field of aquatic resources through the development of relational databases on fish species to assist the improved conservation and productive use of these diverse resources by fisheries managers, scientists, fishers and farmers. Field surveys by selected techniques (including molecular genetic) of intra-specific diversity in key freshwater aquaculture species in West Africa and Asia, will provide general approaches for the selection and conservation of important genotypes by the nations concerned.

In addition, ICLARM will continue to contribute to the CGIAR system-wide program on genetic resources, to provide scientific input and to promote awareness of aquatic resource issues in international biodiversity fora, and to examine the potential threats to aquatic diversity posed for instance by genetic selection, stock enhancement and introductions and transfers of exotic fish.

In partnership with the FAO and with the cooperation of many institutions and individual experts, ICLARM is developing a biological database on fish, known as FishBase. The fourth edition, released on CD-ROM in 1998, contained key information on about 20,000 finfish (from an estimated total of approximately 25,000) including data on the world's food fish. Included data encompass biogeography, ecology, population dynamics, genetics and physiology. Throughout the Plan period FishBase will be expanded and updated as a basic tool for mapping and managing biodiversity. Additions will include data on larval fish and, with the IUCN, an effort to document the conservation status of all the world's freshwater species - which are most at risk from extinction. With support

from the European Union, ICLARM is conducting training at regional nodes for the NARS of 55 countries in the African, Caribbean and Pacific regions in fisheries and biodiversity management, utilizing FishBase. FishBase will be also translated into French and other languages. ICLARM is also collaborating with major institutions responsible for biological systematics in the Species 2000 project which will make available, by electronic means, a checklist of all 1.7 million named living species on Earth.

Aquaculture is foreseen as expanding in the years ahead, partly through genetic enhancement of fish strains, but little has yet been done to accumulate the necessary genetic information needed for such development. In particular, intraspecific strain variation has been very little studied. With national partners and advanced institutes in Europe, ICLARM will conduct two major phenotypic and genetic characterizations of important freshwater aquaculture species and their wild relatives (i) *Sarotherodon melanotheron* (a coastal zone, brackish and freshwater tilapia species) in West Africa and (ii) in Asia a similar study will concentrate on the carp species, *Barbodes gonionotus* whose range has been increased through its popularity as a component of low input and mixed species of aquaculture systems. These studies will provide new methodologies for the characterization of fish genetic resources as well as detailed catalogues of intraspecific variation in these important food species. The study will emphasize participatory research methods through linkages with NARS, NGOs, farmers and fishers.

ICLARM's principal institutional collaborators for these studies will be the Institute of Aquatic Biology in Accra, Ghana, the University of Hamburg, Germany, the University of Swansea, Wales, UK, and national programs in Indonesia and the Mekong basin countries. The results will provide a basis for future action plans applicable to these and related species, targeted at the improvement of fish supply and at providing livelihood opportunities for fisherfolk. ICLARM, through the Genetic Enhancement and Breeding Program, will form contacts with ARIs conducting research on genetic markers in fish. ICLARM intends to build on current and new collaborations to use marker technology for biodiversity studies in 1998/99. More broadly, ICLARM will be attaching major importance to the strategic management of fish genetic resources, including issues of biosafety and intellectual property rights applied to genetic resources.

The Center will continue to participate actively in the System-Wide Genetic Resources Program (SWGRP), contributing an aquatic resources focus, forming an expert link between the CGIAR and aquatic resource interests and learning from policy and technical advancements in other sectors.

Table B. ICLARM Project vs CG Activity Matrix

PROJECT	CG Activity Category				
	Improving Productivity	Protecting the Environment	Saving Biodiversity	Improving Policies	Strengthening National Systems
#1 Assessing aquatic biodiversity & genetic resources	+	+	++	+	+
#2 Aquatic biodiversity & genetic resources training	+	+	+	+	++
#3 Fish germplasm enhancement & breeding	++				+
#4 Assessing & managing coral reef degradation		++	+	+	+
#5 Facilitating decision-making in coastal zone management		++	+	++	+
#6 Multi-sectoral use of inland aquatic resource systems	+	++	+	+	
#7 System-wide initiative on coastal environments		++	+	++	+
#8 Fisheries resources assessment & management	+	++	+	+	+
#9 Aquaculture-agriculture systems analysis & management	++	+			+
#10 Aquaculture & enhanced fisheries on coral reefs	++		+		+
#11 Ecological economics		+	+	++	
#12 Aquatic resources research impact	+	+	+	++	+
#13 Policy analysis				++	
#14 Multilingual scientific information & communication	+	+	+	+	++
#15 New methods & technologies for training					++
#16 Information & research networks & linkages	++			+	++
#17 Fish Health: Baseline Studies & Diagnostics	++			+	+

++ Represents the CG Category which best fits the major focus of each project (and to which it relates in Tables 1a-c).

\+ Represents other activities to which aspects of the projects also contribute.

Category 4: Improving policies

Resource allocation to this category is approximately in line with the earlier targets, especially given the fact that in many projects in other categories, socio-economic research is already integrated as a component of the research.

However, ICLARM envisages a shift in the focus and an increase in the amount of its policy-oriented work in the MTP period. Whilst the final balance of the research in this area is being determined through the review of results of an international workshop held with IFPRI and The North Sea Centre, Denmark in mid 1997, three areas of work can be characterized.

P - 1: Ecological economics for sustainable use of aquatic resource systems (ICLARM Project #11)

This project will examine the linkage between society, economic and natural systems and policy to develop adaptive and flexible solutions for the sustainable use of aquatic resource systems. Current research in this area is conducted as part of a collaborative worldwide project on fisheries co-management strategies focusing on institutional aspects of sustainable governance. The intent over the Plan period will be to extend economic and ecological evaluation techniques to other aquatic resource systems, concentrating on coral reefs in the first instance. A new staff position in resource economics will be established to lead this work.

P - 2: Aquatic Resources Research Impact: Methods and assessment (ICLARM Project #12)

ICLARM will conduct research to evaluate the impact of technological research completed by the institute (*ex post* analysis) and later, where appropriate, other technological impacts on the aquatic resources sector. ICLARM has already conducted such analyses of the impact of fisheries co-management initiatives and the potential benefit of farm-level introduction of genetically improved tilapia. The project will increasingly provide *ex ante* analysis of research areas of potential importance to developing country fisheries e.g. in relation to the carp improvement project and to augment ICLARM's strategic planning process. ICLARM is strongly persuaded of the need for continual in-house assessment of the impact of its own research, and that of others which affects sustainable productivity and management issues in aquatic resources.

P - 3: Policy analysis of the contribution of fisheries to food security (ICLARM Project #13)

Thirdly, with IFPRI and other partners, research will be conducted on the effect of macro-level policy developments on the contribution which living aquatic resources make to food security. Detailed planning for this latter research is in progress following the holding of an international workshop on this topic in June 1997 in conjunction with IFPRI and the North Sea Centre, Denmark.

There are relatively few social scientists working in the area of fisheries policy research and ecological economics specifically addressing developing country concerns. ICLARM is increasingly called upon to augment national capacity in these areas. For these reasons, the social science/improving policies projects will expand during the Plan period, although specifics of the projects' activities will be worked out in collaboration with alternate suppliers, notably IFPRI from within the CG system.

Category 5: Strengthening national programs

In this category, ICLARM also organizes its work around three projects:

SN - 1: Dissemination and Communication of Scientific Information (ICLARM Project # 14)

SN - 2: New Methods and Technologies for Training in Living Aquatic Resources Management (ICLARM project # 15)

SN - 3: Information and Research Networks and Linkages (ICLARM Project # 16)

ICLARM almost invariably works with and through national programs, even where it has its own research facilities (as in the Solomon Islands). This policy will continue when research offices and laboratory facilities are added at Abbassa in Egypt and, potentially, at Penang in Malaysia. In a broad sense, therefore, all ICLARM activities are serving to strengthen NARS. ICLARM considers itself a part of the global aquatic resource research system and related enterprises. As such, the Center continues to place a priority on forming additional productive partnerships with research and other groups including NARS, ARIs, NGOs, the private sector and development assistance agencies. ICLARM intends to make use of existing regional groupings of NARS (where this satisfactorily includes the national aquatic research system representatives) or will establish regional nodes for the channeling of appropriate information. Such regional groupings will enhance the traditional value of networks for cooperation with the NARS.

In recognition of the importance of this function within ICLARM, a new Director of International Relations was appointed in 1996 to manage NARS interactions and to coordinate the INGA network. ICLARM continues to cosponsor the Asian Fisheries Social Science Network (AFSSRN), and will investigate the possibility of setting up an African chapter. The activities of two information networks: the Network of Tropical Fisheries Scientists (NTFS) and the Network of Tropical Aquaculture Scientists (NTAS) will continue during the MTP period.

Training is an integral part of many of ICLARM's activities. For instance, ICLARM has played a major role with the UNDP and Philippine agencies in developing procedures, manuals and training programs for user-oriented decision analysis in coastal zone management. Although substantially complete, ICLARM will continue to contribute its expertise to global training in this area as required. Training will continue to receive a high priority within projects. Similarly, the publication of technical reports and the presentation of ICLARM's scientific results at meetings will remain an important part of the Center's work. ICLARM views the provision of information and awareness of fisheries and aquatic resources science as a cross cutting theme in all its work. The Center will evolve strategies for raising public awareness about the work of ICLARM and key issues in the field of aquatic resources in the scientific and donor communities and amongst our client NARS and the general public. ICLARM is already making use of the new media such as CD-ROM and the Internet, and will continue to exploit developments in communications technology.

The justification for ICLARM's strengthened partnership and collaboration programs has been discussed in Section 1.6.4, above. Given the breadth of its mandate, ICLARM is convinced that only through strengthening national systems and working through partnerships, can it make a substantial impact on the major subjects in fisheries and aquaculture development and management required by developing countries under present circumstances.

3. Center Outputs (including estimated timetable)

Category 1: Increasing Productivity

In germplasm enhancement and breeding, work on the genetic enhancement of carps started in 1997 with international workshops to identify appropriate species and breeding approaches amongst its partner-countries. In 1998, work will concentrate on the identification and exchange of appropriate strains between partner-countries. The presently supported project runs until 1999 when breeding schemes for carp of local and regional importance will be underway in different countries of Asia, but evidence of genetic gains from this project may not be available until after the plan period given the relatively long generational time of these species. Additional studies of growth in, and related production and stress resistance traits (e.g. cold tolerance) for Nile tilapia will be initiated in Egypt in 1998 and are expected to continue beyond 2000. Work to characterize and document tilapia genetic resources for aquaculture in Africa was initiated in 1997. In 1999, ICLARM will assess the potential for improved breeding practices including monosex and genetic marker studies, initially of tilapia, and will commence work in collaboration with ARIs seeking to apply markers for tilapia strains of interest in 2000.

A program to increase and sustain the productivity of fish and rice in seasonally flooded ecosystems in Bangladesh will be completed by 1999. Throughout the plan period ICLARM will seek to compare and contrast experiences of integrated aquaculture-agriculture practices in different agro-ecological zones with its partners so as to gain insights into research requirements and technology packages appropriate to different regions. Other CGIAR Centers will use RESTORE software for integrated natural resource management studies in different production systems

Work on the scaling up of production of giant clams was completed by the end of 1998. Methods for the mass rearing of tropical sea cucumbers will be finalized by the end of 1999. New research on the practicality of utilizing wild-caught, juvenile reef fish for grow-out and enhancement of wild stocks will be started in 1999. If the results are encouraging, it is anticipated that the technology will be used for the establishment of village level, sustainable enhancement programs for high value fish for the aquarium and live food fish trades beyond the year 2000.

Category 2: Protecting the Environment

Research on the management of multi-species fisheries continues to refine ecosystem modelling tools and new software in collaboration with ARIs to increase the dynamic predictive capacity of such models. Research to establish rehabilitation strategies and action plans for coastal fish stocks in tropical Asia will commence with the utilisation of new analytical software in 1999 and the analysis and recommendations will be complete by mid-2000.

The first stages of the evaluation of marine protected areas both in the Caribbean and in the Arnavon Islands will be completed in 1999 and early indications have been obtained of key species whose population dynamics are affected by the installation of MPAs. In the case of the Caribbean, a future phase will begin in 1999 of works to examine the effects of selected marine closures on coral reefs, fish recruitment and effects on local fisheries. This and socioeconomic analysis of the fisheries concerned will lead to improved fisheries management protocols in the region beyond the Plan period.

The improvement and distribution of ReefBase is anticipated to be complete in four years with yearly updates being available on CD-ROM. First global estimates of fish catch from reefs will be available in 1999. ICLARM will develop sampling protocols for the establishment of criteria of reef health by comparing protected, managed coral reefs with those where destructive fishing practices are still carried out. Subject to project support, reefs will be compared within the Philippines or more globally. Early criteria for reef health monitoring will be available in 1999 and assessed for utility in a long term project extending beyond the plan period. Detailed analysis of approximately 100 reefs through remotely sensed images will be available in 1999, and further images were provided by NASA for analysis and inclusion in ReefBase in 1999. These activities add

information to ReefBase and enhance the general utility of such imagery for mapping parameters of reef health.

Work on reef population interconnectivity in the South China Sea ecosystem started in 1997 and will be complete by the end of 1999 providing evidence for future management approaches to this large marine ecosystem. ICLARM will not pursue the SWICE proposal but held training workshops in 1998 to examine the general needs and examine the Center's approach to coastal zone management, including mangrove ecosystems. External reviews of ICLARM's programs have reinforced the center's intention to place coral reef protection and rehabilitation at the center of projected coastal zone management approaches likely to extend beyond the Plan period.

Category 3: Saving Biodiversity

Genetic studies underlying the diversity, conservation and sustainable use of black chinned tilapia in West Africa will be completed in 1999, and similar studies of population of silver barb in Southeast Asia will be complete by 2001. As well as documenting the degree of diversity and aquaculture potential of strains of these two fish species, the study will provide general approaches and methods for NARS to undertake similar evaluations of important aquaculture species in their own countries. Updates of FishBase will be published on CD-ROM yearly throughout the Plan period. Five training courses in the use of FishBase will be conducted (courses for the Pacific region, the Caribbean and Southern Africa have already been held). Two further courses will be held for Africa, during 1999, to ensure the appropriate use of this biodiversity assessment tool by NARS in these regions. For this reason the budget for this activity is attributed to strengthening NARS rather than strictly to the Saving Biodiversity category in which the FishBase development activity falls. The two are integrally related.

Category 4: Improving Policies

ICLARM will seek to initiate new research on the socio-economic constraints to aquaculture adoption which will be complete by the end of 1999 and will inform future research choices and guide national governments in the feasibility of aquaculture implementation and extension.

ICLARM's global research on co-management of fisheries completed its first phase in 1998, resulting in publications and advice drawn from wide-ranging case studies and a few pilot studies for the improved implementation of this form of fisheries management. A further phase of research investigating the socio-economic advantages and impacts of successful examples of co-management will be continued. Also in 1998, ICLARM has conducted an initial analyses on the legal and institutional arrangements governing fisheries in the Mekong River Basin countries. Within the Plan period, ICLARM will conduct a series of studies on the impact of institute technologies and begin natural resources evaluation research. *Ex post* evaluation of ICLARM's giant clam research and the GIFT

project started in 1997, and *ex ante* evaluation of the benefit from carp genetic improvement is being conducted from 1997 to 1999. Additional policy work on food security has been developed particularly of the demand and supply of fish for the poor on the recommendations of the international workshop held in 1997.

Category 5: Strengthening National Systems

ICLARM will seek multi-year funding for the support of the aquaculture genetics network, INGA, as this is both of practical assistance to national programs in Asia, the Pacific and in Africa, but also because it serves as a technology dissemination conduit for ICLARM and partners' work in genetic enhancement and biodiversity of fish species. The Network will link with new FAO/IAEA joint program initiatives globally to speed the application of new genetic technologies to both tilapia and carp in different regions. In 1998, ICLARM will examine the possibility of establishing an African coastal fisheries scientist network to integrate biological and social approaches and to enhance continental research in this area.

ICLARM's projects for information dissemination will continue to support and publish ICLARM's research and to inform ICLARM's stakeholders and fisheries scientists about progress in the sector. As ICLARM's work in Africa intensifies, ICLARM will provide more translations in French and Arabic of its own research and in French of key components of the francophone aquatic resources literature. ICLARM also envisages additional outputs in terms of publication and distribution of software materials to enhance management decisions by national programs on biodiversity, fisheries and aquatic resource management issues. In collaboration with ISNAR, and drawing on the results of policy studies, ICLARM intends to develop training courses in fisheries information management and priority setting for research, in response to requests from national program leaders in the field of aquatic resources research development. Although constrained by limited resources, ICLARM seeks, over the Plan period to increase its contributions to public awareness and to publicizing the work of ICLARM to the donor community and the general public. The institute will be seeking additional project funds to do this.

4. Resources

For a discussion of personnel inputs and financial and capital resources, see the relevant sections of the Finance discussion below.

ICLARM's current rented accommodation in Manila is inadequate to house the increased number of research staff and types of projects anticipated to be resident at ICLARM Headquarters in the plan period. ICLARM is therefore actively seeking to relocate its Headquarters within the region and is pursuing the establishment of facilities at Penang in Malaysia. Planning is at an early stage to adequately house the Institute's research and administrative staff and to

provide for laboratory facilities both for marine science and to capitalize on the emerging genetic technologies for characterization, genetic enhancement and fish health. A major fund-raising drive will need to be initiated to pay for the move .of staff and the adjustment of existing facilities. ICLARM's Board of Trustees has chosen the lower-cost option out of two available sites. The Penang site has sound existing buildings suitable for refurbishment. A move to the new headquarters is anticipated to begin in the year 2000 subject to finalisation of arrangements with the host government. Several projects will remain in the Philippines in the short term and others will be developed so as to ensure a long term Philippine presence.

5. General Statement

Through 1999 and at the beginning of the Plan period, ICLARM will (i) consolidate its existing research portfolio to develop globally relevant strategic research methods and technologies in the identified resource systems and will concentrate more applied research and development activities on the poorer nations of Asia and the Pacific; (ii) use unrestricted funds and seek additional support for wider activities in genetic enhancement of important aquaculture species, and a socio-economic evaluation of the uptake of integrated aquaculture/agriculture technologies by poor rural farmers, methods for the improved management of developing country coastal fisheries, and strengthen capacity for assessing the impact of ICLARM-derived aquatic resources technologies and for conducting relevant policy research, including environmental economics of key resource systems; (iii) develop its new hub for Africa and West Asia in Egypt and initiate concurrent research programs focused on fish health, the conservation of aquatic biodiversity and the sustainable use of inland waters of the region; and (iv) finalize preparations for a move of the headquarters site.

Although some (but not all) of the new staff support for these initiatives will be sought from project- or program-restricted sources, reduction in the provision of unrestricted funds will retard the initiation or affect the efficiency of all new activities. ICLARM will preferentially support work on the genetic enhancement of carp, improved stock assessment and management methodologies for coastal fisheries including co-management, the completion of relational data bases for fish biodiversity and the conservation of coral reefs with which it is currently working.

ICLARM is already constrained by staff shortages in responding to the calls from its stakeholders to catalyze an inter-Center initiative in Coastal Zone Management and would be unable to proceed with this research if additional resources were not forthcoming. Underfunding would also reduce the amount and scope of new socio-economic and policy research, prevent initiation of further studies of freshwater biodiversity and the capitalization by ICLARM of new genetic technologies supporting genetic enhancement, biodiversity and diagnostic research.

ICLARM, as a Center which is largely project-funded with a relatively small proportion of core resources, also finds itself in need of major investments in support systems. Project funds would usually not permit such investments.

Importantly, whilst the refurbishment and development of ICLARM's new facility in Egypt has been substantially completed with already committed funds, a shortfall in overall funding would retard the development of a critical mass of international scientists at that site and therefore the start of programs of importance and collaborative activities for the wider African region beyond those conducted from the present Headquarters.

B. FINANCE

1998 Results and 1999 Development

The 1998 expenditure level was US$10.75 million of gross expenditures and US$10.42 million net of overhead recoveries; 68% of 1998 resources was utilized for programmatic activities. ICLARM ended the year with a positive balance of US$0.44 million.

The 1998 income from donors amounted to US$10.55 in addition to US$0.31 million of earned income and US$0.33 million of recovery of overheads from restricted projects.

1999 expenditures are estimated at US$14.39 million (including US$0.2 million of earned income) compared to actual spending of US$10.42 million for 1998.

Allocation to programs for 1999 is around 76 % of total resources.

Table: Comparison of 1998 performance and 1999 current estimate

	1998 Actual US$(M)	1999 Estimate US$(M)
Sources of funds		
Donor funding	10.55	14.19
Earned income	0.31	0.20
Total	**10.86**	**14.39**
Applications of funds		
Programmatic	7.31*	11.35
General management	2.79	2.79
General operations	0 .41	0.53
Depreciation	0.24	0.29
Less: Overhead Recoveries	(0.33)	(0.57)
Net Expenditures	**10.42**	**14.39**
Unexpended balance	**0.44**	**0.00**

*Spending level on restricted projects was below donor-approved restricted grants for 1998.

1998 Expenditures and 1999 Plans by Projects

Compared to the 1999 Financing Plan and current estimate, the 1998 spending at the project level is reflected in the table below:

Project No.	Project	US$(M) 1998 Actual	1999 Fin. Plan	1999 Current
1	Assessing Aquatic Biodiversity and Genetic Resources	1.04	1.61	1.79
2	Aquatic Biodiversity and Genetic Resources Training	0.60	1.03	1.01
3	Germplasm Enhancement and Breeding	1.41	0.99	1.19
4	Assessing and Managing Coral Reef Degradation	0.53	0.74	1.68
5	Facilitating Decision-Making in Coastal Zone Management		0.00	0.00
6	Multi-Sectoral Use of Inland Aquatic Resource Systems	0.00		0.00
7	Coastal Environment Initiative		0.00	0.00
8	Fisheries Resource Management	1.30	1.77	1.88
9	Integrated Aquaculture-Agriculture Systems	1.19	2.76	2.20
10	Aquaculture and Stock Enhancement on Coral Reefs	1.13	1.40	1.37
11	Ecological Economics for Sustainable Use of Aquatic Resource Systems	1.28	0.79	0.72
12	Aquatic Resource Research Impact Methods and Assessments	0.01		
13	Policy Analysis of the Contribution of Fisheries to Food Security	0.45	1.37	1.14
14	Communication and Dissemination of Scientific Information	0.70	0.61	0.64
15	New Methods and Technologies for Training in Living Aquatic Resource Management	0.20	0.21	0.20
16	Information and Research Networks and Linkage	0.58	0.57	0.57
	TOTAL	10.42	13.85	14.39

The 1998 spending and 1999 current plans by undertaking are summarized below:

	US$(M)		
	1998 Actual	1999	
		Fin. Plan	Current
Increasing Productivity	3.44	4.46	4.21
Protecting the Environment	1.83	2.51	3.56
Saving Biodiversity	1.04	1.61	1.79
Improving Policies	2.03	2.85	2.41
Strengthening NARS	2.08	2.42	2.42
TOTAL	10.42*	13.85	14.39

*Spending level on restricted projects was below donor approved restricted grants for 1998.

Funding Trends

The resource mobilization strategy coupled with concerted efforts in fund raising and greater awareness of the seriousness of fisheries issue amongst donors have consistently increased ICLARM's share in the CGIAR System resources since 1993. Focusing the research projects and programs has revitalized research and its impact driven outputs. Funding has increased, in nominal terms, from US$6.6 million in 1994 to US$14.2 million in 1999 (expected), an increase during the five-year period of over 115%. In real terms (in 1999 US$ at 4% price change) the increase has been from US$8.0 million in 1994 to US$14.2 in 1999, an increase of around 77%.

Funding (US$-M)	1994	1995	1996	1997	1998	1999	% increase 99 over 94
Nominal	6.6	7.8	9.6	9.0	10.4	14.2	115
Real*	8.0	9.1	10.8	9.7	10.8	14.2	77

*(99$ at 4% price change).

Inflation and Exchange Rates

In the Philippines, local inflation in 1998 reached 10.6% in December, averaging to approximately 9.4% for the year. The Philippine Peso (PHP) was stable for the second half of 1998. The PHP is stabilizing at around PHP 38.00 to a US Dollar. In 1999, inflation is expected to edge up, but projections indicate that it will not exceed 10-11%.

1998 operations were affected by the impact of exchange rates on non-US dollar contributions. Exchange losses have reached US$0.21 million. The exchange losses prompted ICLARM management to implement cost cutting measures and delay activities to contain these losses.

The expected continuing strengthening of the US Dollar in 1999 will also have major impact on the non-US dollar denominated donor contributions. ICLARM's modest financial base and low reserves will not absorb such impacts without resorting to short-term borrowing and further curtailing of operations.

Depreciation of Fixed Assets

The actual depreciation of existing ICLARM fixed assets for 1998 was US$0.24 million. Depreciation for 1999 is projected to be at the level of US$0.29 million. Annual deprecation charges are used to finance the Center Capital Fund.

Capital Fund

The Purpose of the Capital Fund is to finance all Center core capital requirements. The balance of the Capital Fund to 31 December 1998 was US$0.89 million, financed through the annual depreciation charges. For 1999, the fund is expected to increase by US$0.29 million, which is equivalent to the budgeted depreciation for 1999.

Operating Fund

The operating fund has increased from the equivalent of 7 days in 1994 to 52 days in 1998. The operating fund was at the level of US$1.49 million on 31 December 1998. Owing to the Center's low cash position (due to long delays in receipt of core contributions from some donors), building the Operating Fund to a higher target level is crucial for maintaining a stable operating environment for the Center.

Liquidity

The Center liquidity position has slightly improved due to remittances of long outstanding donations by some major donors. However, delays are expected and will stress the cash position of the center. To cope with the low liquidity position for 1997 and 1998 due to long delays in grant remittances, ICLARM management resorted to low level borrowing coupled with streamlining and delaying of some research activities.

We hope that the delayed contributions for 1998 are remitted as early as possible in 1999 and that donors will accelerate remittances of their 1999 contributions, as most of them have done in 1998.

2000 - 2002 PLANS

Funding Requirements and Financing Plans

The 1999 Financing Plan level, approved at MTM-98, has been used as the basis for developing the plans for 2000 to 2002. The Financing Plan level has been adjusted to reflect the actual level of ICLARM's operations for 1999.

The expected level of donor funding for 1999 is US$14.19 million, in addition to earned income and overhead recoveries from restricted projects. ICLARM operating levels (net of overhead recoveries) for 2000 to 2002 will be:

	US$ (M)			
	1999*	2000	2001	2002
Projected Donor Funding	14.19	15.01	15.87	16.76
Percent of System Resources	3.8	4.0	4.1	4.3

***1999 Operating Level.**

A 5.5% combined growth and inflation rate has been incorporated in the annual plans.

Earned income. Delayed remittances of 1998 and prior years grants, and the inability of ICLARM to build up the necessary level of operating fund and proper reserves have affected earned income. Starting in 1998, steps were taken starting 1998 to gradually build the operating fund and legal reserves to provide a buffer to the center against delayed contributions. It is expected that earned income for 1999 will be at the level of US$0.2 million.

Overhead. Donors are changing their policies and often are resistant to meeting real overheads. Overhead is an essential component of ICLARM's cost recovery and finances research support and non-research activities and operations that are an essential for research. ICLARM's overhead is expected to be at the level of approximately US$0.58 million over the plan period. The indirect costs pool and administrative expenses are now under review by an outside consultant to determine the appropriate level of overhead of the Center.

OPERATING BUDGET 2000-2002

The focus of research activities and allocation of resources were determined by a review of ICLARM projects and activities by program leaders and a Center-wide review by management. The nine programs were allocated 79% of total resources consistent with Center priorities. The allocation of funds to the projects, source of funding, and linkage with the CGIAR research agenda are reflected in the main budget tables.

Resource allocation to Center activities for specified years.

	1999		2000		2001		2002	
	US$ (M)	%	US$(M)	%	US$(M)	%	US$ (M)	%
Programs *	11.35	79	12.05	79	12.77	79	13.53	80
General administration	2.33	16	2.43	16	2.53	16	2.63	15
General operations	0.42	3	0.43	3	0.46	3	0.48	3
Depreciation	0.29	2	0.30	2	0.31	2	0.32	2
Total	14.39	100	15.21	100	16.07	100	16.96	100

*** Inclusive of all direct costs**

Allocation of resources by object of expenditures (cost structure). ICLARM's cost structure has been under annual review to ensure that fixed costs are kept within a reasonable proportion of the annual budget. Approximately 45% of the resources is allocated to personnel costs over the plan period.

Resource by object of expenditures, 1999-2002 (US$ millions)

	1999	2000	2001	2002
Personnel	6.48	6.77	7.08	7.39
Supplies and Services	6.60	7.03	7.49	7.96
Operating travel	1.02	1.11	1.19	1.29
Depreciation	0.29	0.30	0.31	0.32
Total	**14.39**	**15.21**	**16.07**	**16.96**

Allocation of resources by CGIAR undertaking: The allocation of resources to CGIAR undertakings is in accordance with ICLARM's research directions and consistent with CGIAR strategies and priorities.

Allocation of resource by CGIAR undertakings (%)

	1999	2000	2002
Increasing productivity			
Germplasm enhancement and breeding	13.1	12.8	13.7
Production systems development	16.2	15.9	15.7
Protecting the environment	24.7	24.2	23.3
Saving biodiversity	12.4	12.6	12.2
Improving policies	16.8	18.0	19.2
Strengthening NARS	16.8	16.5	15.9

In 2000, approximately, 29% of resources are allocated to increasing productivity, 24% to protecting the environment, 13% to saving biodiversity, 18% to improving policies and 16% to strengthening NARS.

Allocation of resources by region. Approximately, 50% of resources are allocated to Asia and Pacific; 38% is allocated to Sub-Saharan Africa; allocation to West Asia and North Africa will reach 8%; allocation to Latin America and the Caribbean will reach a target of 4%. See budget Table 5.

Personnel input: Center hired Internationally Recruited staff (IRS) level will be around 29 positions including post-doctoral fellows. Additional positions may be added, subject to funding.

Nationally Recruited Staff (NRS) level will be around 291 positions including a small number of staff who will be retained for the Regional Center for Africa and West Asia (Egypt).

Staffing summary (positions)

	1999	2000	2001	2002
Internationally-recruited staff *	30	29	29	29
Nationally-recruited staff	291	291	291	291
Total Center Hired	**321**	**320**	**320**	**320**

*** Including post-doctoral fellows**

CAPITAL BUDGET

The capital requirements of ICLARM will be modest during the plan period, while the remaining refurbishment cost of the Regional Center for Africa and West Asia is reaching completion in 1999. Resources for the refurbishing of the regional center have been secured from specific donor/s (Japan, World Bank and the Netherlands).

ICLARM will be relocating to a Headquarters site in Malaysia in 2000. Resources requirement for the establishment and infrastructure of the headquarters are being determined.

For the plan period, (excluding Headquarters capital needs and the Regional Center for Africa and West Asia), the yearly capital expenditures will range from US$0.50 million to US$ 0.70 million. This is in addition to the resources committed by specific donors for the refurbishing of the regional center in Egypt.

Capital fund. The capital fund is the only source for financing ICLARM's core capital purchases. The balance in the capital fund to 31 December 1998 was US$0.89 million. The capital fund will modestly increase from the 1998 level.

When the Headquarters site is established the level of the capital fund will be reviewed and increased accordingly.

FINANCIAL RATIOS

Liquidity. ICLARM's operating fund has not been increasing to the targeted level of 60 days of operation. The balance as of 31 December 1998 was US$1.49 million, which was equivalent to 52 days of the 1998 spending level. ICLARM will be attempting to gradually increase the fund level to enable the Center to bridge the delays in funding.

Sustainability. The liquidity position of ICLARM is shown in the table below.

Financial ratio analysis 1997-2002

	1997	1998	1999	2000	2001	2002
Current ratio-times	1.25	1.33	1.42	1.51	1.58	1.65
Quick ratio-times	1.25	1.33	1.41	1.48	1.54	1.60
Working capital-%	35	37	39	42	44	45
Cash/current assets-%	47	54	55	56	56	59
Operating fund-days	38	52	46	53	52	54
Working capital-days	76	88	75	87	92	94

ICLARM will make all efforts to strengthen the liquidity position over the plan period by improving the financial reporting to donors, streamline budgeting, increasing working capital and exploring better investment opportunities.

INFLATION AND EXCHANGE RATES

Combined annual weighted inflation in developed countries is projected to be around 3% while local inflation in ICLARM's host countries is estimated to fluctuate between 9% to 11% during the plan period. The Philippines Peso has stabilized at the exchange rate of 38.00 against the US$.

The US dollar is expected to fluctuate against most currencies, which will make it difficult to predict the impact on non-US dollar denominated contributions. A major unknown at this stage is the likely rate of the Euro against the US dollar.

We have incorporated an annual price change of 3.5% to partially maintain the purchasing power of ICLARM's budget over the plan period. Additionally, we have incorporated a modest growth factor of 2% in the plan.

SUMMARY OF FINANCING PLAN

The resource requirements over the plan period are based on the Financing Plan level approved at the MTM-98 adjusted to reflect the actual operational level for 1999. The adjusted level is increased by an annual inflationary factor of 3.5 %. We have also projected that ICLARM will grow in real terms by 2% for each of the years 2001-2002.

LIST OF ACRONYMS

ACP	African, Caribbean and Pacific countries
AFSSRN	Asian Fisheries Social Science Research Network
APAARI	Asia Pacific Association of Agricultural Research Institutes
ARIs	Advanced Research Institutes
CGIAR	Consultative Group on International Agricultural Research
CIDA	Canadian International Development Agency
CIFOR	Centre for International Forestry Research
CRSP	Collaborative Research Support Program
ECOPATH	A software for ecosystem modeling
ECOSIM	Ecopath Simulation
ELEFAN	Electronic Length-Frequency Analysis
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FiSAT	FAO-ICLARM Stock Assessment Tool
GIFT	Genetic Improvement of Farmed Tilapia
GoFAR	Group on Fisheries and Aquatic Resources
IAA	Integrated Aquaculture-Agriculture
IAAS	Integrated Aquaculture-Agriculture Systems
IAEA	International Atomic Energy Agency
ICES	International Council for the Exploration of the Sea
IBSRAM	International Board for Soil Research and Management
ICLARM	International Center for Living Aquatic Resources Management
IDRC	International Development Research Institute
IFM	Institute of Fisheries Management
IFPRI	International Food Policy Research Institute
IIMI	International Irrigation Management Institute
INGA	International Network on Genetics in Aquaculture
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
IUCN	International Union for the Conservation of Nature
LARM	Living Aquatic Resources Management
MPAs	Marine Protected Areas
MTP	Medium-Term Plan
NARS	National Agricultural Research Systems
NGOs	Non-Governmental Organizations
NTAs	Network of Aquaculture Scientists
NTFS	Network of Tropical Fisheries Scientists

RESTORE	Research Tools for Natural Resource Systems, Monitoring and Evaluation
SINGER	System-Wide Information Network on Genetic Resources
SWGRP	System-Wide Genetic Resources Program
SWICE	System-Wide Initiative on Coastal Environments
SWIM	System-Wide Initiative on Irrigation Management
TAC	Technical Advisory Committee
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
WANA	West Asia and North Africa

BUDGET TABLES FOR 2000-2002

Table 1. ICLARM -- Research Agenda Requirements, by Undertaking, 2000 (in US$ million)

Center Projects	Increasing Productivity	Protecting Environment	Saving Biodiversity	Improving Policies	Strengthening NARS	Project Totals
001. Assessing Aquatic Biodiversity and Genetic Resources			1.93			1.93
002. Aquatic Biodiversity and Genetic Resources Training					1.05	1.05
003. Germplasm Enhancement and Breeding	1.23					1.23
004. Assessing and Managing Coral Reef Degradation		1.74				1.74
005. Facilitating Decision-Making In Coastal Zone Management						0.00
006. Multi-Sectoral Use of Inland Aquatic Resource Systems						0.00
007. Coastal Environments Initiative - (SW)						0.00
008. Fisheries Resources Management		1.94				1.94
009. Integrated Aquaculture-Agriculture Systems	1.71			0.57		2.28
010. Aquaculture and Stock Enhancement on Coral Reefs	1.42					1.42
011. Ecological Economics for Sustainable Use of Aquatic Resource Systems				0.74		0.74
012. Aquatic Resources Research Impact: Methods and Assessment						0.00
013. Policy Analysis of the Contribution of Fisheries To Food Security				1.42		1.42
014. Communication and Dissemination of Scientific Information					0.67	0.67
015. New Methods and Technologies for Training in Living Aquatic Resources Management					0.20	0.20
016. Information and Research Networks and Linkages					0.59	0.59
Undertaking Totals	4.36	3.68	1.93	2.73	2.51	15.21

Table 2. ICLARM RESEARCH AGENDA - BY CGIAR ACTIVITY, 1998-2002 (expenditure in US$ million)

	1998 (actual)	1999 (est)	2000 (proposal)	2001 (plan)	2002 (plan)
Increasing Productivity	**3.44**	**4.21**	**4.36**	**4.83**	**4.99**
of which:					
Germplasm Enhancement & Breeding	*1.98*	*1.88*	*1.94*	*2.25*	*2.32*
Production Systems Development & Management	*1.46*	*2.33*	*2.42*	*2.58*	*2.67*
Protecting the Environment	**1.83**	**3.56**	**3.68**	**3.82**	**3.96**
Saving Biodiversity	**1.04**	**1.79**	**1.93**	**2.00**	**2.07**
Improving Policies	**2.03**	**2.41**	**2.73**	**2.83**	**3.25**
Strengthening NARS	**2.08**	**2.42**	**2.51**	**2.59**	**2.69**
of which:					
Training and Professional Development	*0.80*	*1.21*	*1.25*	*1.29*	*1.34*
Documentation, Publications, Info. Dissemination	*0.70*	*0.64*	*0.67*	*0.69*	*0.72*
Organization & Management Counselling	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Networks	*0.58*	*0.57*	*0.59*	*0.61*	*0.63*
Total	**10.42**	**14.39**	**15.21**	**16.07**	**16.96**

Illustrative Allocation of Resources by Outputs, Logical Framework Format

Outputs:	1998 (actual)	1999 (est)	2000 (proposal)	2001 (plan)	2002 (plan)
Germplasm Improvement	1.98	1.88	1.94	2.25	2.32
Germplasm Collection	1.04	1.79	1.93	2.00	2.07
Sustainable Production	3.87	6.46	6.69	7.01	7.26
Policy	2.03	2.41	2.73	2.83	3.25
Enhancing NARS	1.50	1.85	1.92	1.98	2.06
Total	**10.42**	**14.39**	**15.21**	**16.07**	**16.96**

Table 3. ICLARM RESEARCH AGENDA PROJECT & UNDERTAKING COST SUMMARY, 1998-2002 (in US$ million)

	1998 (actual)	1999 (est)	2000 (proposal)	2001 (plan)	2002 (plan)
001. Assessing Aquatic Biodiversity and Genetic Resources	1.04	1.79	1.93	2.00	2.07
002. Aquatic Biodiversity and Genetic Resources Training	0.60	1.01	1.05	1.08	1.12
003. Germplasm enhancement and breeding	1.41	1.19	1.23	1.43	1.47
004. Assessing and Managing Coral Reef Degradation	0.53	1.68	1.74	1.80	1.87
005. Facilitating Decision-Making In Coastal Zone Management	0.00	0.00	0.00	0.00	0.00
006. Multi-Sectoral Use of Inland Aquatic Resource Systems	0.00	0.00	0.00	0.00	0.00
007. Coastal Environments Initiative - (SW)	0.00	0.00	0.00	0.00	0.00
008. Fisheries Resources Management	1.30	1.88	1.94	2.02	2.09
009. Integrated aquaculture-agriculture systems	1.19	2.20	2.28	2.36	2.45
010. Aquaculture and stock enhancement on coral reefs	1.13	1.37	1.42	1.63	1.69
011. Ecological Economics for Sustainable Use of Aquatic Resource Systems	1.28	0.72	0.74	0.77	0.80
012. Aquatic Resources Research Impact: Methods and Assessment	0.01	0.00	0.00	0.00	0.00
013. Policy Analysis of the Contribution of Fisheries To Food Security	0.45	1.14	1.42	1.47	1.83
014. Communication and dissemination of scientific information	0.70	0.64	0.67	0.69	0.72
015. New Methods and Technologies for Training in Living Aquatic Resources Management	0.20	0.20	0.20	0.21	0.22
016. Information and Research Networks and Linkages	0.58	0.57	0.59	0.61	0.63
017. Fish Health Baseline Studies and Diagnostics	0.00	0.00	0.00	0.00	0.00
Total	**10.42**	**14.39**	**15.21**	**16.07**	**16.96**

Summary by Undertaking:

	1998 (actual)	1999 (est)	2000 (proposal)	2001 (plan)	2002 (plan)
Increasing Productivity	3.44	4.21	4.36	4.83	4.99
Protecting the Environment	1.83	3.56	3.68	3.82	3.96
Saving Biodiversity	1.04	1.79	1.93	2.00	2.07
Improving Policies	2.03	2.41	2.73	2.83	3.25
Strengthening NARS	2.08	2.42	2.51	2.59	2.69
Total	**10.42**	**14.39**	**15.21**	**16.07**	**16.96**

Table 4. ICLARM Allocation of Project Costs to CGIAR Activities, 1998-2002 (in US$ million)

Project	Activity	1998 actual	1999 estimate	2000 proposal	2001 plan	2002 plan
001. Assessing Aquatic Biodiversity and Genetic Resources	Saving Biodiversity	1.04	1.79	1.93	2.00	2.07
002. Aquatic Biodiversity and Genetic Resources Training	Strengthening NARS--Training	0.60	1.01	1.05	1.08	1.12
003. Germplasm enhancement and breeding	Enhancement and Breeding (Fish)	1.41	1.19	1.23	1.43	1.47
004. Assessing and Managing Coral Reef Degradation	Protecting the Environment	0.53	1.68	1.74	1.80	1.87
008. Fisheries Resources Management	Protecting the Environment	1.30	1.88	1.94	2.02	2.09
009. Integrated aquaculture-agriculture systems	Production Systems (Fish)	0.90	1.65	1.71	1.77	1.83
	Improving Policies	0.29	0.55	0.57	0.59	0.62
		1.19	2.20	2.28	2.36	2.45
010. Aquaculture and stock enhancement on coral reefs	Enhancement and Breeding	0.57	0.69	0.71	0.82	0.85
	Production Systems (Fish)	0.56	0.68	0.71	0.81	0.84
		1.13	1.37	1.42	1.63	1.69
011. Ecological Economics for Sustainable Use of Aquatic Resource Systems	Improving Policies	1.28	0.72	0.74	0.77	0.80
012. Aquatic Resources Research Impact: Methods and Assessment	Improving Policies	0.01	0.00	0.00	0.00	0.00
013. Policy Analysis of the Contribution of Fisheries to Food Security	Improving Policies	0.45	1.14	1.42	1.47	1.83
014. Communication and dissemination of scientific information	Strengthening NARS--Information	0.70	0.64	0.67	0.69	0.72
015. New Methods and Technologies for Training in Living Aquatic Resource Management	Strengthening NARS--Training	0.20	0.20	0.20	0.21	0.22
016. Information and Research Networks and Linkages	Strengthening NARS--Networks	0.58	0.57	0.59	0.61	0.63
Total		**10.42**	**14.39**	**15.21**	**16.07**	**16.96**

Summary by Undertaking	1998 actual	1999 estimate	2000 proposal	2001 plan	2002 plan
Increasing Productivity	3.44	4.21	4.36	4.83	4.99
Protecting the Environment	1.83	3.56	3.68	3.82	3.96
Saving Biodiversity	1.04	1.79	1.93	2.00	2.07
Improving Policies	2.03	2.41	2.73	2.83	3.25
Stengthening NARS	2.08	2.42	2.51	2.59	2.69
Total	**10.42**	**14.39**	**15.21**	**16.07**	**16.96**

Table 5. ICLARM RESEARCH AGENDA, 1998-2002, Investement by Sector, Commodity and Region (In US' million)

PRODUCTION SECTORS & COMMODITIES	1998 (actual)	1999 (est)	2000 proposa	2001 (plan)	2002 (plan)
Germplasm Enhancement & Breeding					
Fish	1.98	1.88	1.94	2.25	2.32
Production Systems Dev. & Management					
Fish	1.46	2.33	2.42	2.58	2.67
Sub-total	3.44	4.21	4.36	4.83	4.99
Total Research Agenda					
Fish	10.42	14.39	15.21	16.07	16.96

Region	1998 (actual)	1999 (est)	2000 proposa	2001 (plan)	2002 (plan)
Sub-Saharan Africa (SSA)	3.13	5.04	5.78	6.11	6.44
Asia	6.46	7.91	7.60	8.03	8.48
Latin American and the Caribbean (LAC)	0.31	0.58	0.61	0.64	0.68
West Asia and North Africa (WANA)	0.52	0.86	1.22	1.29	1.36
TOTAL	10.42	14.39	15.21	16.07	16.96

Table 6. ICLARM RESEARCH AGENDA, 1998-2002, Expenditure by Functional Category & Capital Investments (in US'million)

OBJECT OF EXPENDITURE	1998 (actual)	1999 (est)	2000 (proposal)	2001 (plan)	2002 (plan)
Personnel	5.20	6.48	6.77	7.08	7.39
Supplies and Services	3.84	6.60	7.03	7.49	7.96
Operational Travel	1.14	1.02	1.11	1.19	1.29
Depreciation	0.24	0.29	0.30	0.31	0.32
TOTAL	10.42	14.39	15.21	16.07	16.96

CAPITAL INVESTMENTS	1998 (actual)	1999 (est)	2000 (proposal)	2001 (plan)	2002 (plan)
Physical Facilities					
Research					
Training					
Administration					
Housing					
Auxiliary Units					
sub-total	0.00	0.00	0.00	0.00	0.00
Infrastructure & Leasehold	0.66	0.00	0.00	0.00	0.00
Furnishing & Equipment					
Farming					
Laboratory & Scientific	0.02	0.34	0.25	0.30	0.27
Office	0.02				
Housing					
Auxiliary Units					
Computers	0.36	0.20	0.15	0.20	0.15
Vehicles	0.09	0.16	0.10	0.10	0.10
Aircraft					
sub-total	0.49	0.70	0.50	0.60	0.52
TOTAL	1.15	0.70	0.50	0.60	0.52

CAPITAL FUND CASH RECONCILIATION	1998 (actual)	1999 (est)	2000 (proposal)	2001 (plan)	2002 (plan)
Balance, January 1	**0.89**	**0.89**	**0.93**	**1.17**	**1.36**
plus: annual depreciation charge	0.24	0.29	0.30	0.31	0.32
plus /: other		0.25	0.24	0.18	0.08
minus: asset acquisition costs	0.24	0.50	0.30	0.30	0.32
equals: Balance, December 31	**0.89**	**0.93**	**1.17**	**1.36**	**1.44**

Table 7. ICLARM RESEARCH AGENDA FINANCING SUMMARY, 1998-1999 (in US$ million)

Member Unrestricted Contributions	1998 (Actual)	(Nat.Currency)	1999 (Est)	(Nat.Currency)
ARAB FUND	0.25	KD 0.075	0.25	KD 0.075
Australia	0.21	A$ 0.330	0.22	A$ 0.350
Canada	0.19	C$ 0.285	0.19	C$ 0.285
Denmark	1.12	DKr 7.315	0.91	DKr 6.000
European Union	0.85	ECU 0.720	0.91	ECU 0.800
Egypt	0.35	US$ 0.350	0.35	US$ 0.350
Germany (BMZ)	0.35	DM 0.600	0.29	DM 0.500
India	0.04	US$ 0.037	0.04	US$ 0.037
Japan	0.43	YEN 58.560	0.44	YEN 50.000
Netherlands	0.80	NGL 1.500	0.77	NGL 1.500
Norway	0.27	NOK 2.000	0.26	NOK 2.000
Philippines	0.07	PHP 2.709	0.07	PHP 2.709
Sweden	0.32	SKR 2.500	0.38	SKR 3.000
USA	0.42	US$ 0.425	0.42	US$ 0.425
World Bank	1.10	US$ 1.100	1.40	US$ 1.400
sub-total	6.77		6.90	
Targeted Contributions				
ADB	0.84		0.72	
Australia	0.16		0.23	
Canada	0.01		0.04	
Denmark	0.02		0.01	
DFID	0.14		0.93	
European Union	0.98		1.51	
Egypt	0.00		0.36	
FAO	0.05		0.08	
Ford Foundation	0.28		0.02	
Germany (BMZ)	0.03		0.20	
IADB	0.00		0.00	
IDRC	0.09		0.01	
IFAD	0.10		0.18	
MacArthur Foundation	0.10		0.12	
Mekong River Commission	0.01		0.00	
New Zealand	0.00		0.17	
Norway	0.11		0.16	
Others	0.16		0.05	
Sweden	0.35		0.64	
UNDP	0.13		0.00	
UNF/UNFIP	0.00		0.88	
USA	0.21		0.96	
World Bank	0.01		0.02	
sub-total	3.78		7.29	
Total Contributions	10.55		14.19	

TOTAL AGENDA FINANCING	1998 (Actual)	1999 (Est)
Member Contributions	10.55	14.19
+ Center Income	0.31	0.20
= Total Financing	10.86	14.39

Table 8a. ICLARM ALLOCATION OF 1998 MEMBER FINANCING TO PROJECTS BY UNDERTAKING (In US million)

Project	Member	Total	Undertakings: Increase Productivity Breeding	Increase Productivity Systems	Protect Environ	Saving Biodivers	Improve Policies	Strengthen NARS Training	Strengthen NARS Other
001. Assessing Aquatic Biodiversity and Genetic Resources	Germany	0.02				0.02			
	FAO	0.03				0.03			
	EU	0.52				0.52			
	DfID	0.01				0.01			
	Others	0.02				0.02			
	unrestricted + center inc	0.44				0.44			
	Total Project Cost	1.04	0.00	0.00	0.00	1.04	0.00	0.00	0.00
002. Aquatic Biodiversity and Genetic Resource Training	EU	0.46						0.46	
	unrestricted + center inc	0.14						0.14	
	Total Project Cost	0.60	0.00	0.00	0.00	0.00	0.00	0.60	0.00
003. Germplasm Enhancement and Breeding	ADB	0.45	0.45						
	UNDP	0.13	0.13						
	unrestricted + center inc	0.83	0.83						
	Total Project Cost	1.41	1.41	0.00	0.00	0.00	0.00	0.00	0.00
004. Assessing and Managing Coral Reef Degradation	MacArthur Found.	0.10			0.10				
	Sweden	0.03			0.03				
	World Bank	0.01			0.01				
	Others	0.03			0.03				
	unrestricted + center inc	0.36			0.36				
	Total Project Cost	0.53	0.00	0.00	0.53	0.00	0.00	0.00	0.00
008. Fisheries Resources Management	Denmark	0.01			0.01				
	DFID	0.13			0.13				
	Australia	0.01			0.01				
	ADB	0.39			0.39				
	Others	0.05			0.05				
	unrestricted + center inc	0.71			0.71				
	Total Project Cost	1.30	0.00	0.00	1.30	0.00	0.00	0.00	0.00
009. Integrated Aquaculture-Agriculture Systems	IFAD	0.10		0.07			0.03		
	USA	0.21		0.15			0.06		
	Germany	0.01		0.01					
	Denmark	0.01		0.00			0.01		
	unrestricted + center inc	0.86		0.67			0.19		
	Total Project Cost	1.19	0.00	0.90	0.00	0.00	0.29	0.00	0.00
010. Aquaculture and Stock Enhancement on Coral Reefs	Australia	0.15	0.07	0.08					
	Canada	0.01	0.01						
	Others	0.01	0.01						
	unrestricted + center inc	0.96	0.48	0.48					
	Total Project Cost	1.13	0.57	0.56	0.00	0.00	0.00	0.00	0.00
011. Ecological Economics for Sustainable Use of Aquatic Resource Sytems	Sweden	0.32					0.32		
	unrestricted + center inc	0.96					0.96		
	Total Project Cost	1.28	0.00	0.00	0.00	0.00	1.28	0.00	0.00
012. Aquatic Resources Research Impact: Methods of Assesment	unrestricted + center inc	0.01					0.01		
	Total Project Cost	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
013. Policy Analysis of the Contribution of Fisheries to Food Security	Others	0.01					0.01		
	Ford	0.27					0.27		
	unrestricted + center inc	0.17					0.17		
	Total Project Cost	0.45	0.00	0.00	0.00	0.00	0.45	0.00	0.00
014. Communication and Dissemination of Scientific Information	Others	0.02							0.02
	unrestricted + center inc	0.68							0.68
	Total Project Cost	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.70
015. New Methods and Technologies for Training in Living Aquatic Resource Management	MRC	0.01						0.01	
	Others	0.02						0.02	
	unrestricted + center inc	0.17						0.17	
	Total Project Cost	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.00
016. Information and Research Networks and Linkages	FAO	0.02							0.02
	IDRC	0.09							0.09
	Ford	0.01							0.01
	Norway	0.11							0.11
	unrestricted + center inc	0.35							0.35
	Total Project Cost	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.58

Center Totals	Total	Undertakings: Increase Productivity Breeding	Increase Productivity Systems	Protect Environ	Saving Biodivers	Improve Policies	Strengthen NARS Training	Strengthen NARS Other
Total Targeted Funding	3.78	0.67	0.31	0.76	0.60	0.70	0.49	0.25
Total Unrestricted Funding + Center Income	6.64	1.31	1.15	1.07	0.44	1.33	0.31	1.03
Total	10.42	1.98	1.46	1.83	1.04	2.03	0.80	1.28
Operating Fund	0.44							
Total Agenda Financing	**10.86**							

Table 8b. ICLARM ALLOCATION OF 1999 MEMBER FINANCING TO PROJECTS BY UNDERTAKING (in US million)

Project	Member	Total	Undertakings: Increase Productivity: Breeding	Increase Productivity: Systems	Protect Environ	Saving Biodivers	Improve Policies	Strengthen NARS: Training	Strengthen NARS: Other
001. Assessing Aquatic Biodiversity and Genetic Resources	Germany	0.20				0.20			
	FAO	0.03				0.03			
	EU	0.80				0.80			
	Others	0.02				0.02			
	unrestricted + center inc	0.74				0.74			
	Total Project Cost	1.79	0.00	0.00	0.00	1.79	0.00	0.00	0.00
002. Aquatic Biodiversity and Genetic Resource Training	EU	0.71						0.71	
	unrestricted + center inc	0.30						0.30	
	Total Project Cost	1.01	0.00	0.00	0.00	0.00	0.00	1.01	0.00
003. Germplasm Enhancement and Breeding	ADB	0.25	0.25						
	FAO	0.05	0.05						
	DfID	0.15	0.15						
	unrestricted + center inc	0.74	0.74						
	Total Project Cost	1.19	1.19	0.00	0.00	0.00	0.00	0.00	0.00
004. Assessing and Managing Coral Reef Degradation	MacArthur Found.	0.12			0.12				
	Sweden	0.25			0.25				
	World Bank	0.02			0.02				
	UNF/UNFIP	0.88			0.88				
	unrestricted + center inc	0.41			0.41				
	Total Project Cost	1.68	0.00	0.00	1.68	0.00	0.00	0.00	0.00
008. Fisheries Resources Management	ADB	0.47			0.47				
	DFID	0.31			0.31				
	Egypt	0.36			0.36				
	unrestricted + center inc	0.74			0.74				
	Total Project Cost	1.88	0.00	0.00	1.88	0.00	0.00	0.00	0.00
009. Integrated Aquaculture-Agriculture Systems	Denmark	0.01		0.01			0.00		
	USA	0.96		0.72			0.24		
	IFAD	0.11		0.09			0.02		
	unrestricted + center inc	1.12		0.83			0.29		
	Total Project Cost	2.20	0.00	1.65	0.00	0.00	0.55	0.00	0.00
010. Aquaculture and Stock Enhancement on Coral Reefs	Australia	0.23	0.12	0.11					
	Canada	0.04	0.02	0.02					
	New Zealand	0.17	0.08	0.09					
	unrestricted + center inc	0.93	0.47	0.46					
	Total Project Cost	1.37	0.69	0.68	0.00	0.00	0.00	0.00	0.00
011. Ecological Economics for Sustainable Use of Aquatic Resource Systems	Sweden	0.30					0.30		
	unrestricted + center inc	0.42					0.42		
	Total Project Cost	0.72	0.00	0.00	0.00	0.00	0.72	0.00	0.00
013. Policy Analysis of the Contribution of Fisheries to Food Security	IFAD	0.07					0.07		
	DFID	0.44					0.44		
	Sweden	0.09					0.09		
	unrestricted + center inc	0.54					0.54		
	Total Project Cost	1.14	0.00	0.00	0.00	0.00	1.14	0.00	0.00
014. Communication and Dissemination of Scientific Information	Others (Oxfam)	0.03							0.03
	unrestricted + center inc	0.61							0.61
	Total Project Cost	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.64
015. New Methods and Technologies for Training in Living Aquatic Resource Management	DfID/FAO	0.03						0.03	
	unrestricted + center inc	0.17						0.17	
	Total Project Cost	0.20						0.20	
016. Information and Research Networks and Linkages	IDRC	0.01							0.01
	Ford	0.02							0.02
	Norway	0.16							0.16
	unrestricted + center inc	0.38							0.38
	Total Project Cost	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.57

Center Totals	Total	Undertakings: Increase Productivity: Breeding	Increase Productivity: Systems	Protect Environ	Saving Biodivers	Improve Policies	Strengthen NARS: Training	Strengthen NARS: Other
Total Targeted Funding	7.29	0.67	1.04	2.41	1.05	1.16	0.74	0.22
Total Unrestricted Funding + Center Income	7.10	1.21	1.29	1.15	0.74	1.25	0.47	0.59
Total Allocations	14.39	1.88	2.33	3.56	1.79	2.41	1.21	1.21

Table 9. ICLARM RESEARCH AGENDA STAFF COMPOSITION, 1998-2002

	1998 (actual) Hired by:		1999 (est) Hired by:		2000 (proposal) Hired by:		2001 (plan) Hired by:		2002 (plan) Hired by:	
	center	other	center	other	center	other	center	other	center	other
Internationally-Recruited Staff (IRS)										
Research and Research Support	24	2	24	1	23	1	23	1	23	1
of which:										
Post-doctoral Fellows										
Associate Professionals	*2*		*1*		*1*		*1*		*1*	
Training / Communications	1		1		1		1		1	
of which:										
Post-doctoral Fellows										
Associate Professionals										
Research Management	5		5		5		5		5	
of which:										
Post-doctoral Fellows										
Associate Professionals										
Total IRS	**30**	**2**	**30**	**1**	**29**	**1**	**29**	**1**	**29**	**1**
Support Staff	**261**		**291**		**291**		**291**		**291**	
TOTAL STAFF	**291**	**2**	**321**	**1**	**320**	**1**	**320**	**1**	**320**	**1**

Note:

Internationally-Recruited Staff (IRS)

This category includes staff who carry out highly technical/senior functions, as defined by the center, and they may include personnel hired in the local or regional labor market. Included in this group, but shown separately, are post-doctoral fellows and associate professionals (who may have other titles in different centers), and who often are staff provided by donors as part of a project or other institutional arrangement. Costs for consultants engaged for specific tasks are not personnel expenses and the individuals are not staff; their costs should be calculated in the "supplies and services" category.

Support Staff

This category includes the numerical majority, in many cases, of personnel at a center. These are usually, but not necessarily always, individuals hired in the local labor market. They carry out functions which require less demanding skills than for the IRS category. The support staff category does not include seasonal field labor or other individuals engaged on a purely contract basis, for example when a center contracts with an employment agency to provide security, janitorial, and other services. Such costs should be calculated in the "supplies and services" category.

Table 10. ICLARM CASH REQUIREMENT, REVENUE FLOW & CURRENCY SHARES, 1998-1999 (in US$ '000)

MONTHLY CASH USES AND SOURCES

1998	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cash Requirement	676	725	758	567	694	734	821	1,084	674	1,565	903	567
Member & Center Income	964	14	351	1,440	1,786	838	200	342	159	1,616	62	1,825
Net Monthly Position	288	-711	-407	873	1,092	104	-621	-742	-515	51	-841	1,258
Accumulated Position	288	-423	-830	43	1,135	1,239	618	-124	-639	-588	-1,429	-171

1999	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cash Requirement	880	770	790	870	1,000	800	1,026	1,050	900	970	1,200	1,300
Member & Center Income	1,538	14	470	2,063	1,366	941	254	363	231	1,108	482	2,306
Net Monthly Position	658	-756	-320	1,193	366	141	-772	-687	-669	138	-718	1,006
Accumulated Position	658	-98	-418	775	1,141	1,282	510	-177	-846	-708	-1,426	-420

CURRENCY STRUCTURE OF EXPENDITURES (in US$ million)

Currency	1998 (actual)			1999 (est)		
	Amount	$ value	% share	Amount	$ value	% share
US Dollar		7.61	73		10.79	75
Philippine Peso	115	2.81	27		3.60	25
Other						
TOTAL		10.42	100		14.39	100

Table 11. ICLARM STATEMENT OF FINANCIAL POSITION, 1998-2002 (in US$'000)

Assets	1998 (actual)	1999 (est)	2000 (proposal)	2001 (plan)	2002 (plan)
Current Assets					
Cash and Cash Equivalents	5,511	5,590	5,950	6,130	6,555
Accounts Receivable					
Donors	2,816	2,500	2,600	2,700	2,400
Employees	158	200	220	230	250
Others, net	865	900	700	700	700
Supplies Inventory	10	40	270	300	350
Prepaid Expenses	169	175	190	220	200
Other Current Assets	611	700	720	750	700
Total Current Assets	10,140	10,105	10,650	11,030	11,155
Fixed Assets					
Center Owned					
Property, Plant and Equipment	2,054	2,554	2,854	3,154	3,474
Less: Accumulated Depreciation	1,315	1,605	1,905	2,215	2,535
	739	949	949	939	939
In Custody					
Property and Equipment	3,606	3,800	4,000	4,300	4,500
Total Fixed Assets - Net	4,345	4,749	4,949	5,239	5,439
Total Assets	**14,485**	**14,854**	**15,599**	**16,269**	**16,594**
Liabilities and Net Assets					
Current Liabilities					
Bank Indebtedness					
Accounts Payable					
Donors	3,949	3,200	2,900	2,600	2,400
Employees	375	430	450	460	480
Others	120	100	160	200	210
In-Trust Accounts	1,025	1,100	1,125	1,215	1,080
Accruals and Provisions	2,147	2,300	2,400	2,500	2,600
Total Current Liabilities	7,616	7,130	7,035	6,975	6,770
Net Assets					
Capital Invested in Fixed Assets					
Center Owned	739	949	949	1,039	1,019
In Custody	3,606	3,800	4,000	4,300	4,500
Capital Fund	885	925	1,165	1,355	1,445
Operating Fund	1,485	1,850	2,200	2,300	2,500
Other Funds	154	200	250	300	360
Total Net Assets	6,869	7,724	8,564	9,294	9,824
Total Liabilities & Net Assets	**14,485**	**14,854**	**15,599**	**16,269**	**16,594**

ICLARM Project # 1

1. Title

Assessing Aquatic Biodiversity and Genetic Resources: Attributes and Status of Aquatic Biota for Conservation and Sustainable Use

2. Objectives

The objective is to assist the characterization and evaluation of aquatic biota for their conservation and sustainable use, through acquiring, generating and providing information, in relational databases, and developing research tools and methods. Conservation and sustainable use of aquatic biota require robust methods and accurate, up to date, globally accessible information at the molecular genetic, species, population and ecosystem levels. Laboratory and field methods for the characterization and evaluation of aquatic biodiversity and genetic resources will be developed through partnerships with other IARCs, NARS and ARIs. Relational databases for use by researchers, teachers and planners will be established through multiple partnerships and linkages: initially for all finfish species and, depending upon comparative advantage, for the other major groups of exploited aquatic organisms. Databases and methods will be available globally as CD-ROM products and through the Internet. Countermeasures to the threats to aquatic biodiversity (for example, to the world's freshwater fishes) and to adverse genetic impacts of human interventions will be emphasized.

3. Outputs (Results)

Global biological databases, provided as CD-ROMs and through the Internet, and laboratory and field methods for assessing living aquatic resources and their vulnerability to human interventions; the end-users will be NARS researchers and policymakers and, through their research, extension services and policies, the resource-poor fishers and farmers, and consumers of aquatic produce.

4. Gains (*Impact*)

The project will assist the identification of the positive attributes that confer actual or potential 'resource' status on aquatic biota for use in providing food (in fisheries and in breeding programs for aquaculture), income, employment, recreation and a healthy environment. The gains can be measured in terms of the successful conservation of living aquatic resources for sustainable use and the use of the project's outputs by NARS in pursuing their national biodiversity strategies.

5. Duration

Years 3 years of intensive activity with subsequent updating.

Milestones

1998 - FishBase 98 released under Access 97, with 20,000 species, over 100,000 point data, new biodiversity maps and books and help systems in English and French.

1999 - New methods developed for assessing genetic variability of fish and conservation status and potential for sustainable aquaculture, defined for *S. melanotheron* in West African regional case study.

- FishBase 99 released with 22,500 species listed, over 300,000 occurrence points, a functional link to Ecopath, and books and help systems in English, French, Spanish and Portuguese.
- FishBase made available on the Internet.
- Implementation (anticipated) of "Fishes for the Future" project to document the status of all freshwater finfish species, especially those under threat.

2000 - FishBase 2000 released, with all extant finfish species covered (about 25,000), 1 million occurrence points, new analytical routines for biodiversity data, substantial integration with Ecopath, new routines for ecosystem analysis and comparisons, analysis of global fisheries, other global statistics and new routines.

- Published documentation of the genetic resources of *Borbodes gonionotus* – a fish species newly under domestication – including conservation status and availability for breeding programs.
- Guidelines published for the conservation and sustainable use of widely distributed and genetically diverse tilapia species in the coastal zone of West Africa, based on *Sarotherodon melanotheron* as an example.
- Guidelines and decision-support tools for policymakers on aquatic genetic resources published as a result of the Bellagio conference.
- First analysis of the global status of finfish species in freshwater systems published.

2001 - New methods for genetic differentiation and assessment of suitability of *Barbodes gonionotus* carp species for aquaculture in Asia.

- FishBase 2001 released, with update and consolidated coverage of all finfishes, 2 million occurrence points, consolidated and new analytical routines, and improved interface for use in education and by the general public.
- A consolidated analysis of the global status of finfish in freshwater systems published, with selected Regional Action Plans.
- Implementation and evaluation of action plans and guidelines started with other species and ecosystems.

6. Cost

Proposal 2000	US$1.93 million
Plan 2002	US$2.07 million

7. Users

The users will be the researchers, national resources decision-makers and policymakers concerned with living aquatic resources and their environments and, through them, the beneficiaries will be the fishers and farmers and consumers of aquatic produce in the developing regions. The geographical scope is global.

8. Collaborators

World Conservation Union (IUCN); FAO; museums and centers of taxonomic expertise worldwide [for example; the British Museum (Natural History), London; the Museé National d'Histoire Naturel, Paris; the Museé Royale de l'Afrique Centrale, Tervuren]; all IARCs participating in the SWGRP, especially IPGRI (SINGER) and CIFOR; NARS in all developing regions, individually as research partners (e.g., the Institute of Aquatic Biology, Ghana) and through international and regional networks (e.g., the INGA); ASIs (e.g., the University of Hamburg, the University of Perpignan, the University of Wales, Swansea); other Global projects such as Species 2000.

New partners to be identified during 1997 design phase of Africa and West Asia program.

9. System Linkages

Largest linkage	System-wide Genetic Resources Program, IPGRI
Other Program Linkages	Saving Biodiversity

10. Financing Plan

ICLARM[1], EU support for FishBase (4 years), BMZ-GTZ (3 years), ODA, UK, FAO, UBC, initiative.

[1] Here and elsewhere in this section, ICLARM's contribution refers to major allocations of unrestricted core funds.

ICLARM Project # 2

1. Title

Aquatic Biodiversity and Genetic Resources Training: Strengthening Capabilities for Characterization, Evaluation and Information Management

2. Objectives

The objective of the project is to train scientists and national resource managers for the sustainable management of aquatic biodiversity and genetic resources. The training materials and information needed by NARS scientists and national resource managers to manage aquatic biodiversity and genetic resources sustainably are not widely available. This will be addressed by regional training courses for the appropriate utilization of FishBase supported by workshops, organized for NARS through five regional centers in Africa, the Caribbean and the Pacific (ACP). Fifty-five ACP NARS will receive training materials and the necessary computer hardware and software. The training will emphasize finfish as indicator species for achieving conservation with sustainable use. The geographical scope is global, emphasizing the ACP countries.

3. Outputs (Results)

Outputs will be training course materials (computer software and manuals, CD-ROMs) and trained personnel.

4. Gains (Impact)

Over a four-year period, 55 NARS institutes from the ACP countries will receive training and computer hardware and software, to assist their characterization and evaluation of aquatic biodiversity and genetic resources and management of information for conservation and sustainable use of these resources. This relates directly to the CGIAR's goals of capacity building for conservation and sustainable use of natural resources.

5. Duration

Years 4 years

Milestones

The project will involve a series of national and regional courses and workshops with the Pacific regional workshop completed in 1997, one in the Caribbean and one in Southern Africa completed in 1998, and further cover Far East and West Africa planned for 1999.

1998 - NARS Training curriculum on Fisheries and Biodiversity Management completed with workshops held in the Caribbean and southern Africa including guidelines for national biodiversity databases and ecosystem-based management tools and establishments of networks of NARS fisheries trainees in these regions.

1999 - NARS Training curriculum on fisheries and biodiversity management completed including workshops held in west Africa and east Africa, including guidelines for national biodiversity databases and ecosystem-based management tools, and establishments of a network of NARS Fisheries Trainees.

2000 - NARS fisheries trainees thrusts in Africa, the Caribbean and the Pacific conceptualized and initiated.

2001 - NARS fisheries' trainees' collaboration on fisheries and biodiversity management operative in three regions (Asia and the Pacific, Caribbean and Africa).

6. Cost

Proposal 2000	US$1.05 million
Plan 2002	US$1.12 million

7. Users

Beneficiaries will be NARS scientists and national resource managers, and, through their efforts, the farmers and fishers and consumers of aquatic produce in the ACP countries.

8. Collaborators

Regional organizations, networks and NARS in the ACP countries; IUCN; FAO; IARCs participating in the SWGRP, especially IPGRI and museums and other centers of taxonomic expertise which contribute to the development of FishBase.

9. System Linkages

Largest linkage	--
Other Program linkages	Strengthening National Agriculture Research Systems

10. Financing Plan

EU support to the FishBase Project of ICLARM (4 years).

ICLARM Project # 3

1. Title

Fish Germplasm Enhancement and Breeding: Methods for Development of Improved Strains and Monitoring Their Adoption and Impact

2. Objectives

Application of genetics to aquaculture has so far, been limited; most aquaculture stocks in current use are similar to wild, undomesticated stocks whose potential for improvement is virtually untouched.

The project focus is on tilapias and carps which, together, form the mainstay of many resource-poor small scale farmers throughout the developing world. The project will develop research methods and strategies for domestication and genetic improvement of tilapia and carp germplasm, assess their potential socioeconomic and environmental impacts, and contribute to initiation of national fish breeding programs. The project will continue to develop breeding plans for tilapia genetic enhancement in Africa and Asia and to document and prioritize carp genetics resources in Asia *ex ante*. Socioeconomic impact studies, choice of farming system and selection of traits for research will be combined to provide genetically improved carp for agriculture, and to help transfer technology to collaborating country scientists and to farmers.

3. Outputs (Results)

- (GIFT) strain of *O. niloticus* (Nile tilapia) improved in growth rate and survival characteristics;
- national tilapia breeding program in at least 3 Asian countries initiated; knowledge base for wider research in tilapia germplasm improvement established;
- options for operation of a model national tilapia breeding program in Philippines developed;
- plans and strategies for genetic improvement developed and systematic characterization and evaluation of existing farmed stocks initiated;
- identification of key carp species and strains for genetic improvement in Asia;
- extension of tilapia improvement research to Africa;
- carp genetics resources book
- carp genetics improvement book
- genetically improved carp lines
- develop reports on status of tilapia genetic improvement

4. Gains (*Impact*)

Provision of better breeding materials to world's major carp and tilapia farming countries, hence a more stable increase in fish productivity and consequently improved income of small-scale enterprises; the gains will be measured by investigation of potential socioeconomic and environmental impacts in collaboration with developing countries.

5. Duration

Years 6 - 10 years

Milestones:

1998 - Initiation of research on genetic improvement of Asian carps in six Asian countries.

- Analysis of constraints and user-perspectives to determine species, breeding goals and potential sites undertaken.
- Constraints to carp productivity improvement in different ecological and socioeconomic environments identified.
- Breeding plans for tilapia genetic enhancement in Africa developed for implementation at ICLARM's regional centre for Africa and West Asia

1999 - Completion of baseline surveys to understand the existing farming practices, marketing and consumption patterns and care of carp species in six Asian countries.

- Prioritization and selection of carp species, choice of farming system and selection of traits for research carried out.

2000 - Published documentation of carps genetic resources in Asia

- Published documentation of genetic improvement of carps in Asia

2001/2 - Transfer of breeding technology to scientists in selected African countries from ICLARM's Egyptian sites commenced

- Plans developed for the introduction of biotechnology into breeding programs concurrent with environmental risk assessments
- Phase II of carp genetic enhancement programs initiated focusing on improvement of key traits in one or a few selected species in collaborating Asian countries

6. Cost

Proposal 2000	US$1.23 million
Plan 2002	US$1.47 million

7. Users

Scientists in national institutions, in particular those participating in the International Network on Genetics in Aquaculture; Fish farmers in developing countries.

8. Collaborators

NARS: specifically Bangladesh, China, India, Indonesia, Philippines, Thailand, Vietnam, Egypt, and other INGA centres and additional African counterparts anticipated over the period.
ARI: Norwegian Institute of Aquaculture Research (AKVAFORSK), other European and US institutes concerned with genetic marker development for fish species.

9 System Linkages

Largest linkage	--
Other Program linkages	Improving Productivity (Enhancement and Breeding)

10. Financing Plan

1996-1997: Technology and Private Sector Division, UNDP
1997-1999: Asian Development Bank, ICLARM, DfiD UK, USAID Constraints program, UNDP TCDP program, FAO

ICLARM Project 4

1. Title

Assessing and Managing Coral Reef Degradation

2. Objectives

This project aims to combine global assessments of the causes, rates and consequences of reef degradation with studies on the nature of coral reef responses to human disruptions, the development of criteria and cost-effective diagnostic approaches for assessing coral reef ecosystem integrity, and the development of effective management strategies to ensure the sustainability of coral reef resource systems.

3. Outputs (Results)

- Sustainable management procedures for coral reefs
- Cost-effective resource evaluation criteria and protocols
- National, regional and global assessments of coral reefs
- Data exchange, networking, assimilation and dissemination on a user friendly database and analytical software

4. Gains (Impact)

- Improved management of coral reefs at local, national, regional and global scales
- Increased dissemination of information which would otherwise be limited to the scientific community
- Facilitate prioritization of funding, research, development and policy efforts
- Heightened public awareness of the status and importance of coral reefs
- Move towards a sustainable production/ fisheries of coral reef species

5. Duration

Years Long term (at least 5 years)

Milestones

1998 - ReefBase (updated repository of coral reef information) 3.0 CD-ROM and manual published
- Train-Sea-Coast Coastal Management Training Package completed
- Global Study on "Reefs at Risk" published with WRI and WCMC

1999 - Workshop on the integration of results from the PISCES project - genetic studies on target coral reef species to examine reef interconnectivity - held with partner institutions
- GIS database incorporating satellite and remotely sensed images of coral reefs and tropical surface layer parameters incorporated into ReefBase
- Existing data on biology and taxonomy of coral reefs (CoralBase) incorporated into ReefBase
- ReefBase 4.0 CD-ROM and manual published and Version 3.0 available on the Internet
- Completion and publication of RAMP (Rapid Assessment of Management Parameters) coral reef study in the Philippines with the University of Rhode Island

2000 - Publication of the PISCES results and management implications for the South China Sea
- Publication of ReefBase 5.0 CD-ROM and Manual
- Report on the valuation of coral reef services published
- Publication of SCOR report on the Environmental Effects of Coral Reef Fishing
- Detailed Reefs at Risk report published for Southeast Asia

2001 - Publication of ReefBase 6.0 CD-ROM and Manual
- Publication of Global Assessment of Coral Reef Status and Its Implications for People (Book in print and on Internet)

2002 - International network linking research and awareness of coral reef health initiated with global partners, including monitoring activities through UNEP regional seas program

6. Cost

Proposal 2000	US$1.74 million
Plan 2002	US$1.87 million

7. Users

- People dependent on coral reefs for food and livelihood now and in the future
- Coral reef coastal zone and other complex ecosystem managers and researchers
- Global policy makers and the general public in need of information on coral reefs

8. Collaborators

- NARS in Indonesia, Malaysia, Philippines, Republic of China, Solomon Islands, and Vietnam
- World Conservation Monitoring Centre
- World Resources Institute
- National academic and administrative institutions in the Philippines (e.g. UP Marine Science Institute; Silliman University)
- Subic Bay Management Authority
- Other research agencies or networks on coral reefs worldwide (e.g., Global Coral Reef Monitoring Network/ICRI, NOAA/USA)
- National Center for Atmospheric Research (NCAR), Colorado, USA
- US Geological Survey

9. System Linkages

Largest linkage	--
Other Program linkages	Protecting the Environment

10. Financing Plan

ICLARM, Swedish SIDA, MacArthur Foundation, World Bank, UNF/UNFIP

ICLARM Project # 5

1. Title

Facilitating Decision-Making in Coastal Zone Management

2. Objectives

The development of user-oriented decision analysis and optimization modeling tools based on interdisciplinary studies of the consequences of various management decisions in a variety of situations.

3. Outputs (Results)

- Technical and non-technical publications with policy makers, resource managers community leaders as primary target audience
- Procedure manuals, training programs and supportive software for use by the target end users

4. Gains (Impact)

- Improved management of coastal zones at local, regional and global scales through the use of the decision analysis tools and optimization models
- Sustainable use of coastal environments
- Improved quality of life for coastal dwellers

5. Duration

Years: Subsumed under Project #7 in 1998

Milestones:

1998 - ICLARM has minimized this project activity (see initiatives instead in relation to project 004 and 007) but will continue to interact with partner institutions in the Philippines in the provision of training, material and advice in coastal zone management

6. Cost

Estimated annual cost closed in 1999

7. Users

- Coastal dwellers and local community leaders
- Coastal zone managers, policy makers and development workers
- Researchers and academic institutions

8. Collaborators

- Coastal development, policy makers and management agencies
- Philippine Department of Agriculture
- Subic Bay Management Authority
- Local Government Units and management councils

9. System Linkages

Largest linkage --

Other Program linkages --

10. Financing Plan

ICLARM in 1997, Consortium funding for a new Program on Coastal Environments beyond 2000.

ICLARM Project # 6

1. Title

Multi-sectoral Use of Inland Aquatic Resource Systems

2. Objectives

This project addresses the need to provide decisions regarding the optimal use of inland water for development options including the productive use of aquatic resources. This will be done through examination of scenarios and conflicts involving inland water and its use for aquatic resources and the development of appropriate analytical approaches and management strategies to ensure sustainable, equitable use of these resources, in partnership with others.

3. Outputs (Results)

- Cost-effective evaluation criteria and protocols on the use of inland water
- Management strategies for the sustainable use of inland aquatic resources in relation to other, conflicting calls on the use of water
- Manuals, training programs and user-friendly analytical software

4. Gains (Impact)

- Improved management of inland aquatic resources
- Sustainable supplies of water especially for people dependent upon its use for livelihood from aquatic resources

5. Duration

Years: Long term (at least 5 years)

Milestones

- This project is not yet functional but ICLARM continues to hold talks with IWMI (SWIM), and representatives of the Global Water Partnership, and the World Water Council
- Development of research activities on African great lakes concentrating on Lake Nasser are continuing in conjunction with project 008

6. Cost

Estimated annual cost US$100,000 to cover ICLARM start-up activities and research development (not budgeted for a given year)

7. Users

- People dependent on inland aquatic resources for basic human needs
- Managers and researchers concerned with inland aquatic resources

8. Collaborators

IWMI and other CGIAR institutes
Other aquatic research institutions
National and international development, policy and resource management institutions

9. System Linkages

Largest linkage SWIM

Other Program linkages --

10. Financing Plan

To be planned.

ICLARM Project # 7

1. Title

Program on Coastal Environments

2. Objectives

This project will aim to facilitate the management of coastal system through investigations into the interrelationships among aquatic and land-based coastal ecosystems and the development of analytical approaches and effective strategies for the sustainable management of these ecosystems.

3. Outputs (Results)

- Integration of research efforts in coastal zone management
- Selection of site(s) for extended multidisciplinary studies, of the coastal zone.
- Evaluation of the effects of deforestation and mangrove depletion on aquatic biota and coral reefs in the coastal zone.

4. Gains (Impact)

- Evidence of practices affecting ecology and productivity of the coastal zone
- Improved management of tropical coastal ecosystems
- Sustainable use of coastal environments
- Improved quality of life for coastal dwellers

5. Duration

Years Long term (at least 5 years)

Milestones

1998 - ICLARM has continued informal discussions with institutes interested in coastal zone management through soils management and mangrove rehabilitation. No research project has yet been formulated.

- Planning workshop held with advisory partners and proposals developed for initiation of research on coastal environments utilizing cross project inputs

6. Cost

Proposal 2000	US$0.00 million
Plan 2002	

7. Users

- Coastal dwellers throughout the tropics
- Coastal zone managers and researchers
- Development agencies

8. Collaborators

CIFOR, (potentially) IWMI, other Aquatic Research Institutions in Southeast Asia
Linkages to ARIs on multivariate analyses.

9. System Linkages

Largest linkage	ICLARM will not pursue SWICE and will develop alternative development of a project in coastal zone management
Other Program linkages	--

10. Financing Plan

Consortium of partners to define funding requirement and strategy in 1998.

ICLARM Project # 8

1. Title

Fisheries Resources Management: Data Acquisition, Methods and Models

2. Objectives

Because of their complexity, small-scale, multi-species, multi-gear fisheries for tropical fishes and invertebrates are extremely difficult to assess and manage. Several hundred species of fishes or invertebrates are often regular components of the catches in a diverse array of fishing gears. Catches are often landed at widely scattered villages, beaches and docks from where they are distributed by vendors throughout the adjacent countryside. There is seldom any centralized marketing and distribution system. Conventional fisheries assessment methods are unable to cope with this complexity. Consequently, very few small-scale fisheries in tropical developing countries have been assessed in terms of their potential yields and virtually none are managed in order to optimize yields. Most are overexploited and yield less than their potential.

3. Outputs (Results)

Outputs will include analytical tools, models, cost-effective data acquisition systems and databases relevant to living aquatic resources and their supporting ecosystems, upon which management systems can be based, for the benefit of fishing communities and fish consumers in tropical developing countries.

4. Gains (Impact)

Importance is proportional to the importance of fish and fish production in regional economies and diets, with the greatest production in Asia and LAC and the greatest unfilled demand in SSA. Implementation of fisheries management systems in LDCs will lead to sustained or increased fish production and stable food supplies, employment, export earnings and the conservation of aquatic biodiversity.

5. Duration

Years 15 years

Milestones

1998 - Asian regional workshop held with national partners to initiate collaborative work on data assessment of trawl data from coastal fisheries
- Collaborative research activities designed for improved data collection and management of Lake Nasser as an example of an African great lake
- Release of two literature compilations on CD-ROM providing "Materials for the Study of Tropical Fisheries and Aquaculture"

1999 - Release of Ecopath (ecosystem modeling tool) version 4.0 incorporating dynamic simulation module, EcoSim
- Fully functional model of TrawlBase, computerized database for collecting and analyzing trawl data, distributed to all partner countries

2000 - Asian regional workshop held to analyze fisheries and socioeconomic data on trawl fisheries in partner countries
- Scientific evidence published of the consequences of implementation of MPAs in selected areas (Caribbean, Pacific)

2001 - Action plans for management systems for coastal fisheries implemented in selected LDCs in Asia
- Action plans published for the implementation of MPAs for both fish and aquatic invertebrate fisheries in selected areas (Caribbean, Pacific)

6. Cost

Proposal 2000	US$1.94 million
Plan 2002	US$2.09 million

7. Users

Fisheries managers will benefit from training in the use of analytical methods and improved understanding of the status of stocks and improved ability to communicate results to fishing communities and politicians. The principal users will be the fishers who should benefit from more stable and improved incomes and the consumers who will have better assurance of adequate fish supplies.

8. Collaborators

- Centre for Marine Sciences, University of the West Indies
- Conservation and Fisheries Department of the Ministry of Natural Resources and Labour, British Virgin Islands
- North Sea Centre, Denmark
- Fisheries Centre, University of British Columbia
- FAO
- Environment and Conservation Department, Solomon Islands
- The Nature Conservancy, USA
- CARICOM Fishery Resources Assessment and Management Project, Belize
- New partners to be identified during 1998 design plan of Africa & West Asia Program

9. System Linkages

Largest linkage	ICLARM specific activity
Other Program linkages	Protecting the Environment (e.g., ecosystem modeling)

10. Financing Plan

UK-DfID - 3 years
ADB - 4 years
Egypt/UNDP/AfDB

ICLARM Project # 9

1. Title

Aquaculture-Agriculture Systems Analysis and Management: Catalyzing, Monitoring and Evaluating the Sustainability of Smallholder Systems with Farm Ponds and Rice Floodwaters

2. Objectives

Farming systems in developing countries frequently have low production due to low levels and inefficient use of nutrients together with an unavailability of water when needed, leading to a net loss of soil nutrients. These unsustainable traditional practices have, coupled with smaller plot sizes due to population increase, led to widespread degradation of the natural resource base. There is an urgent need for improvement of productivity and efficiency of a large proportion of farm household operations.

The potential number of smallholder farmers who could benefit is considered to be very large, but remains underexploited. The target group in Africa are the large number of smallholder farmers who presently are not performing any form of IAA.

The objectives are to provide data about (a) the types of farming systems and agroecological zones in which integrated aquaculture-agriculture (IAA) can be sustainably incorporated into existing farming systems; (b) the impact of IAA on farm productivity, economics, ecology, human nutrition and the socio-cultural context; (c) which types of IAA are viable on which farming systems (in many cases, these need to be developed); and (d) what socio-economic criteria govern adoption and which strategies and mechanisms for widespread adoption of IAA are required.

Research will be conducted in partnership with farmers, NARS, NGOs and extensionists. Farmer-participatory technology development, evaluation and dissemination are key elements for success.

3. Outputs (Results)

New knowledge, tools and protocols will be created for (a) the assessment and characterization of agroecosystems, including the human communities as to their potential for sustainable adoption of IAA technologies and approaches (to enable decisions to embark on large-scale IAA development activities or not); (b) the quantification of the impact of IAA on smallholder farming systems (including dynamic and steady-state simulation models) and households in terms of bioproductivity, economics, ecology, human nutrition and social context factors; (c) assessing the viability of IAA systems themselves and optimizing them, depending on the farming system, based on alternative approaches to aquaculture research on small farm sites; and (d) the definition of the appropriate, efficient and cost-effective mechanisms and strategies for widespread adoption.

4. Gains (Impact)

(a) Enhanced household nutrition and income, proven sustainability for IAA farming systems;
(b) Protocol for the assessment of IAA potential in a given area
(c) Higher productivity (i.e., intensification) through IAA systems and greater enterprise diversity and nutrient recycling, leading to improved soil nutrient conditions and reduced pressure on natural resource base.
(d) Ability of NARS, NGOs and extensionists to facilitate widespread IAA adoption and monitor its impact through proven strategy and tools.

5. Duration

Years 10 years

Milestones

1998 - Farmer-participatory research tool package (RESTORE) improved, and tested
- Training courses in IAA methods for NARS (including NGOs and extension agencies) conducted (Malawi and Bangladesh)
- Planning workshops held and new project activities designed based out of African center, including on-station and laboratory aquaculture research

1999 - Definition of socio-economic variables governing successful adoption of IAA in selected sites in Africa and Asia
- Publication of results of IAA trials and impact on farm economics in Ghana
- New research in integrated aquaculture agriculture using irrigation water and the use of communally owned water bodies in southern Africa (anticipated to be) implemented

2000 - Publication of results of study on productivity enhancement and equitable management of floodprone ecosystems in Bangladesh and Vietnam
- Publication of recommendations for improved IAA systems designed for different farming systems in Bangladesh

2002 - Study of country-wide IAA assessment and extension methodology in Malawi completed
- Extension and monitoring models established and provided to selected NARS through workshops
- Ecological and economic benefits characterized for widespread IAA adoption in larger areas (catchments) in avenues of research

6. Cost

Proposal 2000	US$2.28 million
Plan 2002	US$2.45 million

7. Users

- Farmers in tropical developing countries with adequate site characteristics for IAA adoption.
- NARS and NGOs with mandate for enhancement of aquatic protein availability for nutrition of the poor, or for improved natural resource management of traditional farming systems under population pressure.
- Extensionists and Agencies - for defining appropriate areas for IAA dissemination and for planning effective action towards sustainable implementation reaching large numbers of poor smallholders including women.

8. Collaborators

IARCS: IRRI (for Bangladesh/Vietnam projects); and CIAT, IFPRI, IRRI, ICRAF, IITA, IBSRAM, AVRDC, (largely through utilization and extension of RESTORE)
NARS: Including institutes in Bangladesh, Philippines, Vietnam and Malawi and others to be selected in West and East Africa
NGOs: Including AIT, IIRR and NGOs in countries of operation
ASIs: University of Kassel; institute members of PD/A CRSP; (others yet to be identified)
New partners to be identified during 1998 design plan of Africa and West Asia program

9. System Linkages

Largest linkage --
Other linkages Increasing Productivity (farming system resource management tools) and Improving Policies

10. Financing Plan

ICLARM, USAID, IFAD, Denmark, (other proposals under consideration)

ICLARM Project #10

1. Title

Aquaculture and Enhanced Fisheries on Coral Reefs

2. Objectives

Coral reefs support a rich variety of animals of value to human societies, including fish, spiny lobsters, sea cucumbers, giant clams, pearl oysters and shells such as trochus, conch and green snail. Traditionally, these animals were harvested at subsistence levels. More recently, development of lucrative export markets has also provided coastal villagers with opportunities to earn money from coral reef species. These earnings are now an important source of income for many coastal communities. Unfortunately, the transition from a subsistence to a market economy has usually been far from ideal: chronic overfishing has often occurred and, on may reefs, there are now too few of the most prized animals to sustain reasonable harvests. Destructive fishing methods have compounded the problem by degrading some reefs to the point where they cannot support valuable species. Tragically, many coral reefs in developing nations no longer provide benefits to the people who live near them.

The productivity of coral reef fisheries can be regained and maximized by restoring damaged habitats, restocking fish and shellfish populations to the carrying capacity of the ecosystem, and then managing them to obtain optimum yields on a sustainable basis. Productivity can also be increased by developing aquaculture methods for various species.

The object of this project is to improve the productivity of coral reef fisheries through development of biotechnical systems for the culture of high value species by village farmers and cost-effective methods for propagating and releasing juveniles to restore and enhance inshore fisheries. Once these methods have been demonstrated to be economically viable and environmentally sustainable, they will be transferred to NARS in the Asia-Pacific region through reports, manuals and workshops.

3. Outputs (Results)

The outputs will be (a) methods to reduce the cost of "seed" giant clams produced in hatcheries; (b) identified sources of wild spat (seed) of blacklip pearl oysters; (c) improved methods for collecting pearl oyster spat; (d) robust estimates of growth and survival of giant clams and pearl oysters at village farms; (e) market information (prices, demand) for farmed giant clams; (f) establishment of village farms for pearl oysters, and (g) methods for spawning sea cucumbers and rearing their larvae; (h) data on the survival of wild caught juvenile reef fish relevant to the development of enhanced fisheries

The beneficiaries of this research will be the coastal villagers who will have greater opportunities to derive income from coral reef species on a sustainable basis, either through small-scale farming operations or by improved harvests from enhanced fisheries.

4. Gains (Impact)

(a) Increased and diversified opportunities for coastal villagers to earn income through the sale of farmed products and improved catches from wild fisheries that have been restored or enhanced through release of cultured juveniles. Gains based on culture of pearl oysters and sea cucumbers will benefit growers in remote areas, however, sale of giant clams to live seafood markets will only be possible for villagers close to adequate transport links.

(b) Improved knowledge of the value of coral reef habitats leading to greater care of the ecosystem and increased productivity from wild stocks.

5. Duration

Years Ongoing, 10+ years

Milestones

1998 - Documentation of the viability of village-based farming of giant clams to supply the marine aquarium market and live seafood trade, including (a) cost of producing seed in hatcheries; (b) survival and grow-out of clams at village farms; (c) cost of grow-out in villages; (d) market prices and scope; and (e) models for adoption of farming technology by NARS to ensure that benefits of the research are transferred to villagers.

1999 - Research implemented on methods for capture and rearing of juvenile reef fish with Australian partners
- Documentation of the viability of village-based culture of pearl oysters (and pearls) based on the collection of wild spat; development of cost-effective methods for the mass propagation of juvenile sea cucumbers and publication of results

2000 - Report on the feasibility of black-lipped oyster pearl production in open water systems of the Pacific Islands utilizing wild caught spat. Cost effective methods developed for the mass propagation of juvenile sea cucumbers.

2001 - Report published on the feasibility of two capture methods for juvenile reef fish to establish reef fish grow out
- Report published on the effects of alternative logging practices on coral reef areas.

2004 - Assessment of optimum strategies for releasing hatchery-reared juveniles to enhance wild stocks of sea cucumbers carried out

6. Cost

Proposal 2000	US$1.42 million
Plan 2002	US$1.69 million

7. Users

NARS in the Asia-Pacific region who will use the results of the research to identify opportunities to establish viable, village-based aquaculture industries, or enhanced wild fisheries. The main beneficiaries will be growers and fishers, who will have substantial, and sustainable opportunities to derive income from coral reef habitats. The farming of giant clams is as suitable for women as it is for men. Growing pearl oysters includes activities that can be similarly shared. The local companies (e.g., exporters, governments) will also benefit from the increased volume of commodities. The project will have an immediate benefit to the western Pacific and has potential for impact in tropical coastal areas throughout Asia and WANA.

8. Collaborators

Ministry of Agriculture and Fisheries, Solomon Islands
Overseas Fishery Cooperation Foundation (Japan)
South Pacific Forum Fisheries Agency
South Pacific Commission
James Cook University, Australia
AIMS, Australia
University of Notre Dame, Canada
NIWA, New Zealand

9. System Linkages

Largest linkage	Increasing productivity
Other Program linkages	--

10. Financing Plan

ACIAR, NZODA, ICLARM, CIDA

ICLARM Project #11

1. Title

Ecological Economics for Sustainable Use of Aquatic Resource Systems

2. Objectives

The project aims to examine the linkage between society, economic and natural systems, and policy with a view to developing adaptive and flexible ways of achieving sustainable use of aquatic resource systems.

3. Outputs (Results)

Methods and models will be developed for (a) providing an economic value of goods and services from coastal resources; (b) addressing the relationship between natural ecosystems and economic systems as an integral part of the policy and management process; and (c) sustainable, equitable and efficient institutions for sustainable governance of coastal resources.

4. Gains (Impact)

- Improved coastal resource management policies and systems;
- More participatory coastal resources management
- Improved quality of life for fishers
- Strengthening of NARS

5. Duration

Years 4 years

Milestones

1998
- Conceptual framework for Valuation of Coral Reefs developed
- Scope of work in coastal areas determined
- Workplan for second phase of co-management project
- Co-management case studies and legal, policy and institutional studies on coastal and fisheries resources completed for Asia, including summary and synthesis

1999/2000	- Publication of the proceedings of Asian and African workshops on results from co-management case studies and commencement of pilot testing of optimal co-management arrangements in countries in South East Asia - Case studies on coral reef valuation in Asia, Pacific and Africa implemented; and policy analysis and recommendation provided - Plans for research on mangrove and coastal resources finalized - Pilot testing of co-management arrangements initiated - Research framework on fisheries co-management reviewed and case studies revisited to determine long-term progress - Legal, policy and institutional analysis of co-management expanded to at least one African country
2001	- Ecological and economic assessment of selected coastal and coral reef resources completed; policy analysis and recommendation provided - Pilot testing of co-management arrangements completed; policy guidelines for co-management developed

6. Cost

Proposal 2000	US$.74 million
Plan 2002	S$0.80 million

7. Users

Resource managers, fishers, policymakers, NGOs, development workers, scientists in Asia, Sub-Saharan Africa, Caribbean

8. Collaborators

- NARS and NGOs in Bangladesh, Benin, Cambodia, Cote d' Ivoire, Indonesia, Malaysia, Malawi, Mozambique, Philippines, South Africa, Thailand, Vietnam, Zambia, Zimbabwe.
- ARIs in Canada, Caribbean, Denmark, and US

9. System Linkages

Largest linkage: --

Other Program linkages Improving Policies

10. Financing Plan

DANIDA, SIDA, Bilateral funds from participating countries

ICLARM Project #12

1. Title

Aquatic Resources Research Impact: Methods and Assessment

2. Objectives

To evaluate and assess the results and impacts of completed aquatic resources research activities, initially undertaken only by ICLARM, but possibly in later years including research by others.

3. Outputs (Results)

Assessment of the impact of long-term research, ex-ante and ex-post assessments of return on research investment, and priority setting and achievement monitoring of research.

4. Gains (Impact)

Meet accountability requirements or gain support for research, to contribute to internal decision-making and the research management process, and to contribute to knowledge in a more general sense.

5. Duration

Years 4 years

Milestones

1998 - Ex-ante studies of the impact of the genetically improved farmed tilapia in five Asian countries published as report including methodology for conducting ex-ante impact assessment in this field

- Project for the ex-ante assessment of carp genetic improvement research (concurrent with project 003) initiated with Memoranda of Agreement effected with all participating Asian countries and institutes
- Assessment of impact from giant clam research conducted with Australian university collaborators

1998/1999	-	Methods and selection of indicators for assessing research impacts, particularly in natural resources research developed
1999/2000	-	Impact of FishBase and other ICLARM fisheries software evaluated
	-	Impact of ICLARM's San Miguel Bay research evaluated
2001	-	Ex-post assessment of carp genetic/breeding research completed
	-	Impact of co-management research evaluated

6. Cost

Involves minimal cost in 2000 and 2002

7. Users

ICLARM scientific staff, Board and management, donors and NARS

8. Collaborators

ISNAR, ASIs, and ICLARM research programs

9. System Linkages

Largest linkage: System Impact Assessment Group

Other Program linkages Improving policies

10. Financing Plan

Possible financing by ACIAR and Asian Development Bank

ICLARM Project #13

1. Title

Policy Analysis of the Contribution of Fisheries to Food Security

2. Objectives

To examine the range of policy issues and measures by which governments might strive to increase the supply of fish for human consumption and the economic benefits which are available from the fisheries sector.

3. Outputs (Results)

Macro- and micro-level policy analysis of global problems affecting fisheries, particularly resource overexploitation and environmental degradation, technology, markets and structure of the economy, linkages between fisheries and other sectors, food security and nutrition, trade and macroeconomic policies and gender.

4. Gains (Impact)

Improved government policies to provide an enabling environment for the fisheries sector to make the optimum contribution to economic and social welfare.

5. Duration

Years 5 years

Milestones

1997 - ICLARM has held an international workshop together with IFPRI and the North Sea Centre/DANIDA, Denmark on priorities for policy research on the contribution of fisheries to food security

1998 - On the basis of the outcomes of the Workshop, a new global and African program for ICLARM designed for conduct out of Manila and the African center

- Proposal developed for the assessment projection of demand, supply, trade and consumption of fish and seafood in Asia and the Pacific
- Policy analysis of food security and management issues in small-scale fisheries (rice fields, wet lands, rivers and reservoirs) in Indo-China initiated (in Vietnam)

1998/1999
- Following on the outcome of the International Consultation in Denmark in 1997, scope of ICLARM's work vis-à-vis other agencies determined.
- Global and African program for research on key policy issues/problems developed.
- Research on the following initiated:
  - Assessment and projection of demand, supply, trade and consumption of fish and seafood in Asia and Pacific – proposal prepared.
  - Policy analysis of food security and management issues in small-scale fisheries in Indo-China and greater Mekong countries identified.
    - Household food security studies in Vietnam initiated (1998).
    - Workplan and research framework for Indo-China country developed.
- Workshop in Africa organized; research topics identified.
- Database on policy variables and key indicators of the fisheries sector in developing countries developed.

1999
- Demand and supply study implemented with national and international partners in Asia
- Policy analysis of food security and management issues in small-scale fisheries (rice fields, wet lands, rivers and reservoirs) in Indo-China extended to institutional and legal issues in other Indo-China countries (Cambodia)
- Establishment of a database on economic fisheries statistics for use in institute planning
- African workshop held to prioritize fisheries policy research issues for the continent

2000/2001
- Integration and publication of results of policy analysis of food security and management issues in small-scale fisheries in Indo-China
- Integration of fish as a commodity in the World Food Model
- Proposals for Africa prepared (2000)
- Fish integrated into world food model (2000 – 2001).
- Global and regional synthesis of policy variables provided and actions recommended (2000 – 2001).
- Projects on inland aquatic wetlands in the Mekong Basin sub-region implemented and analysis and recommendations (2000 – 2001).

2002/2004
- Regional results of the effects of supply and demand of seafood and aquatic produce on availability for the poor published, starting with Asia.

6. Cost

Proposal 2000	US$1.42 million
Plan 2002	US$1.83 million

7. Users

Policymakers, government agency managers, NARS, NGOs

8. Collaborators

- FAO, IFPRI, NARS, ASIs including the North Sea Centre
- New partners to be identified during 1997 design phase of Africa and West Asia program but including the countries of Indo-China.

9. System Linkages

Largest linkage	IFPRI
Other Program linkages	Improving policies

10. Financing Plan

ICLARM, bilateral or regional funds from participating countries. SIDA, DFID, IFAD
To be determined mid-1997 following DANIDA supported workshop.

ICLARM Project #14

1. Title

Communication and Dissemination of Scientific Information

2. Objectives

The objective of the project is to provide continually improving access to scientific information, through publications in various media, translations and sharing of resources and training. This will increase public awareness of global living aquatic resources issues and of ICLARM's role in resolving them.

Many researchers of tropical living aquatic resources, especially those in LDCs, are isolated from the literature and new developments in their fields of expertise. Under the project, ICLARM seeks to overcome this problem by publishing, translating and disseminating information generated by its own scientists and others.

ICLARM wishes to make its publications, including computer software more widely available, and will place increased emphasis on translation of its products in other languages, principally French, as ICLARM takes up new programs in Africa.

ICLARM believes that one reason for the continuing crises in global fisheries is a lack of public awareness of the problems and of the need for research. The Center within its available resources will publicize the issues and thereby seek additional support for their solution and the work of ICLARM.

3. Outputs (Results)

Outputs will include: (a) globally disseminated information on aquatic research results and publications in paper and electronic media, including research news and library databases; and (b) more efficiently disseminated material in different languages.

4. Gains (Impact)

- Wider and more efficient use of information on aquatic resources
- Improvements in national fisheries management and research methods
- Raised awareness of fisheries and aquatic resources issues to inform policy and public debate.
- Better informed ICLARM and NARS scientists, who, along with aquatic resource managers, educators and students are the main recipients and users of the Center's information products.

5. Duration

Years Long-term

Milestones

1988 onwards - The information dissemination will be continuous; comprehensive strategy for including scientific, institutional and public awareness materials in project planning developed

6. Cost

Proposal 2000	US$0.67 million
Plan 2002	US$0.72 million

7. Users

Global community concerned with aquatic resources research and management, ICLARM and collaborating scientists;
NARS scientists and managers, educators and students
Policy makers and donors

By being better informed, these users can better assist the beneficiaries, the users and consumers of aquatic resources in developing countries.

8. Collaborators

Other data sources such as FAO, regional aquaculture on fisheries information repositories etc. Researchers from NARS and ARIs worldwide.

9. System Linkages

Largest linkage	--
Other Program linkages	Strengthening National Agricultural Research Programs

10. Financing Plan

ICLARM, Oxfam and by selective cost recovery. Costs may be reduced by possible support from FAO, IDRC and EU.

ICLARM Project #15

1. Title

New Methods and Technologies for Training in Living Aquatic Resource Management

2. Objectives

The objective of the project is to increase the capacity of NARS scientists to undertake and report on relevant aquatic resources research. Scientists in developing countries often have difficulty in carrying out and reporting their work. The project seeks to assist them by developing appropriate training courses and materials, using and adapting the latest available materials and methods and to provide guidance to senior NARS managers in priority setting.

3. Outputs (Results)

Project outputs include: (a) tailored courses and training packages in a variety of research and related areas for NARS scientists and managers worldwide; and (b) a network of trainers and training centers; (c) support to other ICLARM programs. The beneficiaries are national scientists whose skills in research methods and reporting will be improved, thus streamlining the research process by eliminating poor methodology and lack of reporting.

4. Gains (Impact)

Better informed NARS scientists and managers and thus improved aquatic resources management.

5. Duration

Years 2 years in the current format. Project-associated training can be expected to continue as an institute function beyond 1998.

Milestones

1998 - Long term strategy for ICLARM's program-associated training developed as part of institute's strategic plan development

1999-2000 - Implementation of strategy and proposals for restricted donor support for training events associated with ICLARM Program development

6. Cost

Proposal 2000	US$0.20 million
Plan 2002	US$0.22 million

7. Users

NARS scientists globally, who can then better assist the beneficiaries - the users and consumers of aquatic resources in developing countries.

8. Collaborators

- NARS scientists will help ICLARM to identify training needs and design and implement training courses.
- ASIs may also provide trainers, materials, methods and participants.

9. System Linkages

Largest linkage	--
Other Program linkages	Strengthening NARS, possibility for linkage with regional Inter-Center training programs

10. Financing Plan

DfiD/FAO
ICLARM funds during startup. Self-financing through courses eventually.

ICLARM Project #16

1. Title

Information and Research Networks and Linkages: INGA, AFSSRN and others

2. Objectives

To establish new research partnerships and strengthen existing partnerships with NARS, ARIs, IARCs and NGOs, for better management of living aquatic resources worldwide; improved capabilities of NARS scientists in genetic resource conservation and improvement through the International Network on Genetics in Aquaculture (INGA) and in social science research through the Asian Fisheries Social Science Research Network (AFSSRN); continuation of two information networks: the Network of Tropical Fisheries Scientists (NTFS) and the Network of Tropical Aquaculture Scientists (NTAS); provide assistance to NARS in research planning and prioritization for aquatic resource management.

3. Outputs (Results)

Enhanced knowledge and research capabilities of NARS scientists from international cooperation developed through genetics and social science research networks and other information networks; improved research methodologies for conservation and management of living aquatic resources; a network for genetic evaluation and enhancement of carps; improved breeds of fish and other aquatic organisms.

4. Gains (Impact)

- human resources development in networking and collaborating countries;
- strengthening NARS;
- increased production of aquatic organisms through improved breeds developed;
- improved farming systems;
- conservation and improved management of aquatic resources;
- food security for small farmers/fishers through increased incomes and nutrition.

5. Duration

Years Long-term (10 + years)

Milestones:

1998 - INGA/NARS scientists trained iin quantitative genetics and selective breeding research methods

1999 - Regular use established of current iinformation technologies (e.g., through the Internet) to facilitate information (literature/news on aquaculture, fisheries, genetics, etc.) dissemination and exchange (discussion for a) among members of information networks

2000 - Training of Asia-Pacific NARS partners in research priority setting accomplished through workshop

2001 - Characterization of tilapia genetic resources in Malawi and Côte d'Ivoire completed

6. Cost

Proposal 2000	US$0.59 million
Plan 2002	US$0.63 million

7. Users

NARS scientists, planners and administrators involved in aquatic resources management research

8. Collaborators

NARS (presently 13 INGA member countries in Asia, Africa and the Pacific; and five member countries in AFSSRN), IARCs and NGOs involved in living aquatic resources management worldwide.

9. System Linkages

Largest linkage	--
Other Program linkages	Strengthening NARS, contacts with regional NARS groupings

10. Financing Plan

ICLARM, IDRC, Ford, Norway

ICLARM Project #17

1. Title

Fish Health:

2. Objectives

The objective is to help prevent and manage future outbreaks of diseases in African aquaculture and stock enhanced fisheries by developing an international approach to fish diseases and genetic resistance.

3. Outputs (Results)

In the first instance, ICLARM will identify and link with scientific agencies in Africa and developed countries, which are concerned with fish health to discuss forming appropriate consortia and to identify the key needs and sources of expertise and information. Needs-based studies would then be designed, with emphasis on countries already producing significant quantities of aquaculture products, such as Egypt, Nigeria, Kenya, Ghana, Zimbabwe and the Republic of South Africa. Programs of genetic enhancement targeted on biotic stresses including diseases.

4. Gains (Impact)

This project would help prevent some severe impacts on fish production by disease outbreak through providing links to developed country expertise and in devising a better base of knowledge for management and by forging links with existing national systems. The gains will eventually be measurable in terms of (i) improved quarantine and fish transfer regulations, and (ii) production losses prevented in specific countries and production systems.

5. Duration

Years 10 years

Milestones

1998 - Workshop held for the development of an integrated program of fish health and management research conducted at Abbassa. Disease and other stresses on tilapia monitored. General refurbishment of the Abbassa facility researches phase II and individual programs of research including genetics of resistance to biotic and abiotic stresses planned for start up in 1999.

6. Cost

Estimated annual cost program	Funds may be allotted to genetics project (003) as is implemented

7. Users

Farmers, government fisheries and quarantine agencies, trade partners (national and occasionally international) and other scientists.

8. Collaborators

Partners will be identified during 1999 in the design phase.

9. System Linkages

None, although the development or adoption of diagnostic analysis and policy formulation for fish transfer may lead to links with ILRI, IPGRI, FAO and other bodies.

10. Financing Plan

Collaborative project support from other developed countries, with expertise in Fish Health.