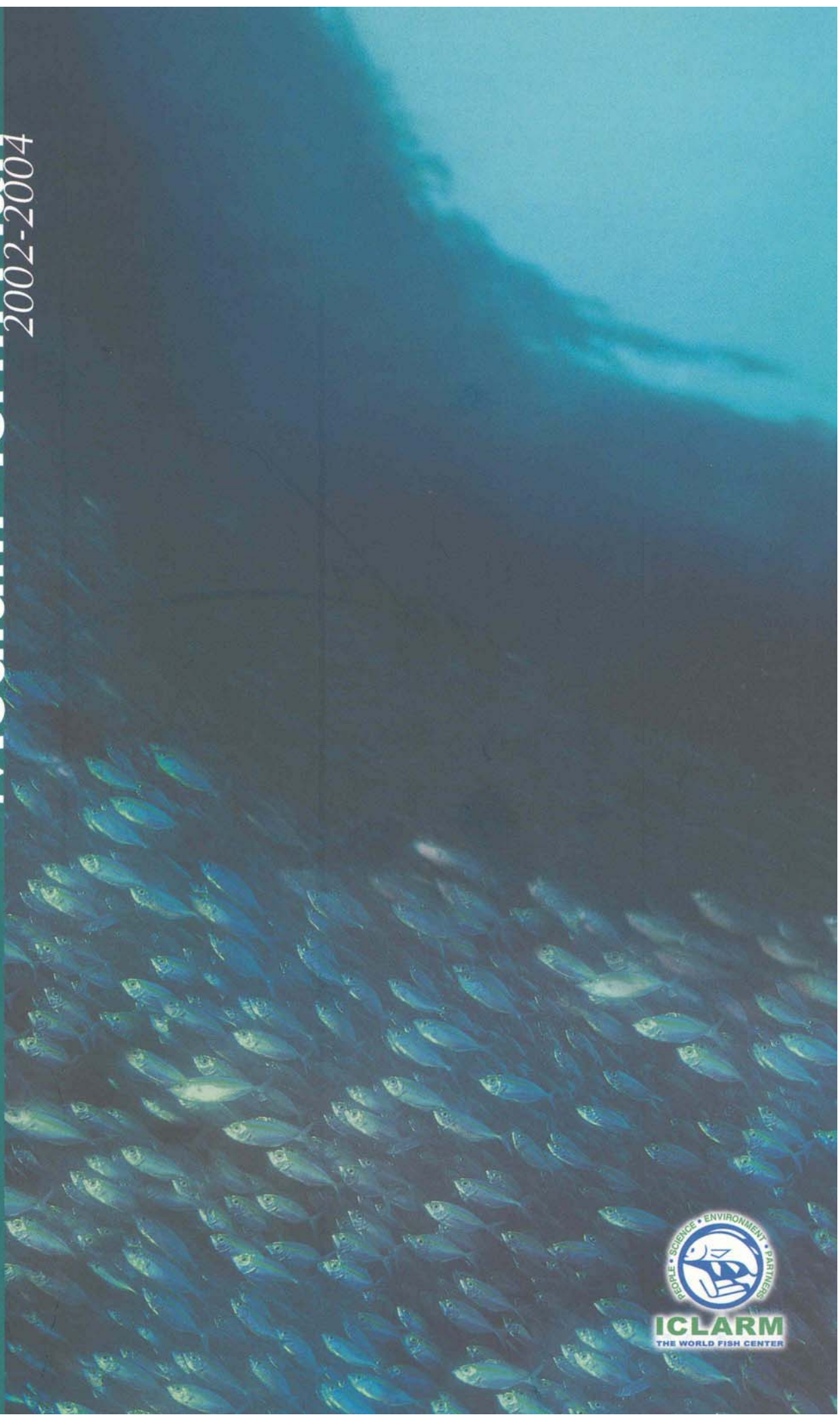


Medium-Term Plan 2002-2004



ICLARM
THE WORLD FISH CENTER

ICLARM MEDIUM TERM PLAN 2002 – 2004



ICLARM Medium Term Plan 2002-2004

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ICLARM – The World Fish Center is one of the 16 international research centers of the Consultative Group on International Agricultural Research (CGIAR) that has initiated the public awareness campaign, Future Harvest.

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EXECUTIVE SUMMARY

The International Center for Living Aquatic Resources Management (ICLARM) presents its Medium Term Plan (MTP) for 2002-2004 for the consideration by TAC and members of the CGIAR. The Plan has been developed in a period when there is growing public discontent 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 in large part an annual update of earlier plans. New directions have been developed in accordance with ICLARM's Strategic Plan 2000-2020. The plan expands our research thrusts from ponds, coral reefs and coastal waters to freshwater systems, namely lakes, small water bodies (SWBs) and floodplains. This strategy will emphasize the development of aquaculture in ponds and SWBs, the sustainable exploitation of coral reefs within integrated coastal zone management (ICZM), and generic contributions to tools and knowledge to augment the performance of developing country fisheries. The Center will also continue its focus on Asia, while enhancing its activities in Africa and the small island developing states (SIDS) of the Indo-Pacific and Caribbean. Work in mainland Latin America will not be a principal priority. An analysis of resource allocation by region shows that ICLARM allocates approximately 58% of resources to Asia, 30% to Sub-Saharan Africa, 4% to the Caribbean and Latin America and 8% to West Asia and North Africa.

The Center was reviewed by an External Program and Management Review completed in early 1999. The review confirmed the appropriateness of ICLARM's work in living aquatic resources management and the adoption of a new internal program structure described in the rolling Medium Term Plan for 2001-2003. This program structure has been in place since the move of ICLARM's Headquarters to Penang, Malaysia in February of 2000. The transition period has been the biggest single influence on the institute involving the transfer of the majority of senior staff to new working and living conditions, the establishment of new staff cadres, particularly in support and administrative areas, the set up of temporary offices and the implementation of a building schedule which will see ICLARM in new long term premises from mid 2001. Despite this and the extra duties demanded of staff, the effects on program performance have been limited. This is so because ICLARM is a decentralized institute with 79% (223 out of a total of 282 in 2001) of its staff posted to outreach sites relatively unaffected by the transition of the HQ.

Ethnic strife in the Solomon Islands has curtailed ICLARM's activities in the Pacific, with some activities delayed or foregone. However, utilizing ICLARM's field site in the Western Province, a reduced staff complement has successfully maintained an important focus of giant clam brood stock, continued the program of work on the trial black pearl oyster farm and the larval reef fish project. ICLARM is working with partners in the region – including other states and donors – to identify new sites from which to coordinate a program of work in the plan period, based on coastal aquaculture initiatives, which will be of widespread utility to the island states of the Pacific.

ICLARM has continued the development of the log frame approach within the Center, constructing project log frames in line with the ICLARM institutional log frame published earlier. Although the former are not included in this plan, the project portfolios for the plan period have utilised the logframe planning and include these purposes, outputs and milestones.

The current program portfolio maintains an emphasis on productivity enhancement in natural and culture systems, and appropriate conservation and use of aquatic resource systems, particularly those providing direct benefits to the poor. Strong weight is given to NARS strengthening, and to improving policies to augment management of living aquatic resources.

There are few specific changes from last year's MTP as the projects have been conserved in number and focus. Current progress suggest that in 2002, work under each of the CGIAR activity categories will be as follows:

Genetic Enhancement and Breeding: For tilapia ICLARM will have active programs of selection research being conducted on Nile tilapia in Malaysia and in Egypt. Additional countries in Africa will be using ICLARM's selection procedures to enhance related indigenous species (e.g. *O. shiranus* in Malaŵi). A new project will be initiated with the University of Wageningen to evaluate the benefits of selection for Nile tilapia in high and low input environments. For carps, work will move from the description of existing genetic resources to the exploitation of common carps and silver barb. ICLARM will assist in the development of national breeding plans with a focus on the traits of growth and disease resistance. Efforts to enhance the breeding and inclusion of other species into farming systems will be continued in Africa. Breeding and stock enhancement of invertebrate species of importance to the Pacific will be focused on commercially valuable sea cucumber species. The scientific feasibility of establishing village level grow out trials for key reef fish species will be established.

Germplasm collection: ICLARM does not undertake activities for which the collection of germplasm is a major goal or output and the institute has not established germplasm collections, except transiently, to support individual research activities. Small collections of tilapia are held for germplasm improvement projects, mostly as live fish. The establishment of hatchery procedures for conservation and stock enhancement purposes of invertebrate species (giant clams, sea cucumbers) has involved the collection of broodstock and their maintenance in land based hatcheries. Experimental procedures for the collection of juvenile reef fish for grow out procedures or of adult reef fish for genetic studies are continuing. Collectively these studies result in the relatively small percentage allocation of resources to this output. These activities do not result in permanent collections of germplasm and in instances where germplasm transfers are arranged ICLARM shares germplasm under specific Material Transfer Arrangements.

Sustainable production: ICLARM's work in five major project areas contributes to the sustainability of production of fisheries, coral reefs and coral reef organisms, and fresh water aquaculture. For freshwater systems, ICLARM will complete surveys on the heterogeneity of *Sarotheradon melanotheron*, a tilapia species widely used in fisheries and aquaculture in West Africa. A project will be initiated to evaluate the genetic impacts of the introduction of improved species for aquaculture in the collaborating countries of INGA. Now working as a member of the FishBase Consortium ICLARM will complete the updating of species lists and provide training courses in the use of LarvalBase for collaborators.

ICLARM's freshwater aquaculture enhancement encompasses rice-fish systems and the introduction of aquaculture as a new enterprise into farming systems in Asia and Africa.

ICLARM will publish its particularly successful studies on the management of deepwater rice-fish research, including recommendations for productivity enhancement and equitable management of flood prone ecosystems in Bangladesh and Vietnam. ICLARM will continue to evaluate the best agroecologies and practices for the introduction of aquaculture, with major projects in Bangladesh in humid South Asia and in Cameroon, Malaŵi and Zambia in Africa. Research has been conducted on the relationship between river flow, flooding and fish productivity of the flood plains of the Mekong basin in collaboration with IWMI and the Mekong River Commission. Extension of this modeling work to additional biodiversity analysis and the development of management support systems taking into account the different data requirements is being planned with these and other partners.

For fisheries, ICLARM will release an upgraded version of the FiRST database which allows the accumulation and analysis of fisheries resource data particularly from trawl fisheries. The project will conduct cross-site analyses in the Philippines to evaluate the management and fishing practices that have led to resource changes. With partners at the University of British Columbia, Canada, ICLARM is applying new developments in Ecopath to the ecosystem analysis of Asian and other developing country fisheries. A management program for a coral reef fishery site in Jamaica will be implemented including development of alternative fisheries and the stock enhancement of key trial species. Marine protected area monitoring of invertebrate fauna will be continued in the Pacific with an emphasis on assessing the time required for recovery of sea cucumbers.

ICLARM has revised the make up and accessibility of ReefBase, the major database on coral reefs globally and will have incorporated new data and risk assessments, particularly focused on the Caribbean. Training needs assessments for the management of the coastal zone will be carried out in Vietnam and Indonesia. Quantitative data will be available determining the genetic linkage amongst reefs in six Asian countries, illustrating the specific needs for transboundary management and approaches to be pursued.

In coastal aquaculture ICLARM's programs, despite the interruption of work in the Solomon Islands will have trained regional staff in the Pacific in the hatchery production of pearl oyster spat. The third crop of pearls from an experimental pearl farm in the Solomon Islands will have been harvested and evaluated and the farm handed over to the Government. Establishing further research sites in the Pacific, ICLARM anticipates that it will complete preliminary field experiments to optimize release strategies for cultured juvenile sea cucumbers in New Caledonia, Vietnam, and Indonesia.

Policy research: ICLARM conducts research in three project areas which contribute to the theme of providing scientific and policy advice on aquatic resource issues in developing countries. These areas and plans were reviewed by a Center Commissioned External Review in early 2001 which supported the areas to which ICLARM's policy research is committed. ICLARM is initiating research in the economic monitoring and evaluation of developing country fisheries. Trends in demand and supply for fish and seafood products in relation to food security, employment, income, consumption, trade, and resource production and management will be measured for indicator countries in Asia. In the Mekong region, ICLARM will have developed critical indicators of livelihood for communities with varying dependence on the aquatic resources of the river Basin as well as determining the economic values of the resources themselves.

ICLARM conducts research on the legal and institutional governance of fisheries and wetlands. ICLARM will have completed extensive descriptions of fisheries co-management practices in Asia and Africa with partners from the North Sea Center. Research is under way to evaluate the issues of legitimacy and compliance in successful examples of co-managed fisheries in Asia. In the Mekong the institutional policy analysis focus is on the region's wetlands. Involvement in action research and analysis will raise awareness of wetlands values and governance. In the Bangladesh floodplain areas ICLARM will have developed and initiated networks and community organisation (including NGOs and local users) for addressing fisheries management and policy issues for community-based fisheries. This marks the second phase of a long-standing and successful project on community organisation.

ICLARM will continue to evaluate the impacts of aquaculture, new aquaculture technologies and extension methods. By 2002, the impacts of research and technology development for giant clam mariculture in the Indo-Pacific will have been assessed. More generally a set of recommendations that includes a comprehensive framework and guidelines towards assessment of the impact of aquatic resources research will be provided.

Enhancing NARS: In 2001 ICLARM will establish and move to its permanent headquarters site in Batu Maung, Penang, Malaysia that will entail the reestablishment of library and information services. These will expect to be fully functional in 2002 and increased use of virtual services will be implemented both for the Center and for national program enquiries. ICLARM provides coordination and technical backstopping to INGA, the International Network for Genetics in Aquaculture and an information network for tropical aquaculture and fisheries scientists. These will continue. ICLARM will continue to seek out appropriate partnerships with NARS and ARIs to augment the efficiency and dissemination of best practices in aquatic resources research and management. ICLARM expects to raise the level of research training and of public awareness activities in the new facility.

Although many of ICLARM's projects and programs have continuing goals beyond the period of this plan, the anticipated program highlights by 2004 are expected to include:

Genetic Enhancement and Breeding: The outcomes of current activities in the final year of the plan are expected to include the completed analysis of three generations of combined family and individual selection of *O. niloticus* for increased growth in different environments in Malaysia. This will include correlated trait analysis and pave the way for multitrail selection and the inclusion of other methods to potentially augment selection procedures. Similar outputs will be expected from work currently under way with *O. niloticus* in Egypt with the focus on growth and cold tolerance. Early indications from the selection experiments in high and low input environments will govern the transfer of improved fish into integrated farming systems. Work on carp improvement through selection in common carp and silver barb will be in progress in Asia.

Germplasm collection: ICLARM does not anticipate developing germplasm collections. ICLARM expects aspects of its work to contribute to the development of legislation on fish transfers and the introduction of improved genotypes of fish and invertebrates.

Sustainable production: ICLARM will continue to focus on resource assessments and the provision of fisheries management advice. Resource databases will be shared with

countries more widely and across site comparisons, for example in the Philippines, will be used to assess the implications of alternative management strategies on sustainable resource use. Stock enhancement procedures will have been assessed as a means of accelerating recovery of stocks in protected areas. ReefBase will be substantially updated for ease of use by partners and Reefs at Risk analyses will have been published with the World Resources Institute for the Pacific Ocean. Coral reef valuation and policy studies will have been completed as one of ICLARM's contributions to the international coral reef conservation project, ICRAN. ICLARM will have assessed and made recommendations about the feasibility of culturing wild postlarval coral reef fish for export through the marine aquarium trade. This aims to protect adult fish of reproductive age and to provide potential livelihood opportunities to coastal dwellers in developing island states. Pilot scale mass-release of sea cucumbers will have been assessed using the optimal release strategy for stock enhancement in the Asia Pacific region.

Policy research: Trends in supply and demand for fish as they affect households, markets and the opportunity for exploiting enterprises based on aquatic resources will be assessed for target developing countries in Asia. ICLARM expects to be able to publish policy guidelines for policy makers implementing co-management arrangements. Community-based fisheries management in Bangladesh will be improved through action research and social studies of community management. Also in Bangladesh, livelihood opportunities and future income opportunities for the next generation of fishing communities will have been assessed.

ICLARM's impact studies will assess the response of farming systems and the national aquaculture production of the introduction of improved carp species in Asia. Methodologies for integrated natural resource management will be tested in Bangladesh, Cameroon and Malawi.

Enhancing NARS: ICLARM views its information and network support services to be of continuing high priority throughout the plan period. The project will also contribute materials to ICLARM's overall public awareness campaign to raise the profile and knowledge about the critical role of aquatic resources in meeting the food security and livelihood aspirations of the poor in developing countries. Awareness and valuing the resource base are critical to efforts to sustain production in the future.

The relative balance of funds committed to these activities in 2001 is USD 1.11 million (7%) to Germplasm Improvement; USD 0.23 million (1%) to Germplasm Collection; USD 8.12 million (51%) to Sustainable Production; USD 4.53 million (29%) to Policy; and USD 1.86 million (12%) to Enhancing NARS. There has been a marked increase in support for ICLARM's socioeconomic and policy-related work on aquatic resource issues. However the overall balance will be expected to fluctuate somewhat in dollar terms over the plan period (e.g. through ICLARM's participation in the multiagency ICRAN project) although the staff balance committed to these areas is expected to remain similar or to increase in the fisheries area following ICLARM's transitional period. This may be enhanced by the hosting of the directorate of the Millennium Ecosystem Assessment from mid-2001.

Interactions with other CGIAR centers are increasing through membership of the system-wide initiatives such as the System-wide Genetic Resources Program (SGRP), the system-wide initiative on common property and community management (CAPRI), and discussions

in many other fora related to the Integrated Natural Resource Management Group, the deliberations for the System-wide Initiative on Water Management (SWIM II – building on ICLARM and IWMI's successful collaboration in the Mekong), and participation in the formation of new global challenge programs, regional priority setting and Public Awareness. The ICLARM Director General currently chairs the Board of the Gender and Biodiversity Program. There are collaborative program activities with IFPRI (incorporating fish into the World Food model), IITA (introducing aquaculture into the farming systems of humid West Africa), and IWMI amongst others.

The plan describes research and research-associated activities amounting to USD 15.85 million in 2001 rising to USD 16.36 million in 2002 and USD 17.62 million in 2004.

Around 37 positions for center-hired Internationally Recruited Staff (including post-doctoral fellows and visiting scientists) are anticipated. ICLARM has recruited 24 staff since its establishment in Malaysia and overall support service staff are expected to remain below earlier levels. However, following the move to the permanent headquarters in mid-2001 staff numbers may increase slightly and additional positions are planned subject to funding availability in 2002 and beyond. All ICLARM Nationally Recruited Staff are expected to number around 235 by 2004. The cost of renovation and setting up the headquarters facility is USD 3.35 million which will be defrayed before the plan period – ICLARM is allocating USD 2.29 million to the refurbishment of the headquarters in 2001.

Interactions with the new host government and national institutes contributing to the aquatic resources sector are progressing very well and new collaborative research opportunities have been forged in genetic enhancement research, species characterization, the development of fisheries indicators and information exchange.

A. THE RESEARCH AGENDA

(a) *Introduction, Context, and Program Discussion for 2000/2001:*

a.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 mmt¹, representing approximately 89% of total production. Although total world fishery production is continuing to show annual increases², capture fisheries had declined to 74% of total production in 1999 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 and including aquatic plants) has more than doubled in the decade since 1984 and in 1999 is 32.2 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 it 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: 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:

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 1999 are also from FAO statistics.

- 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.

a.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. Asia currently (FAO 1998) produces 45% of the world's capture fisheries and 68% of the world's combined fisheries and aquaculture production. The continent is estimated 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 eleven countries (including Egypt) reporting production of over 500 tons per annum by 1998. Tilapia production in Africa registered an estimated 11% annual growth rate towards the end of the millennium and an annual production of 14,000 metric tons/yr. 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 establishment 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 of 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.

a.3 Establishing Priorities and Evolving Programs

As can be seen from the general conservation of research effort during recent years (Table E a-c) ICLARM's projects have shown a steady evolution over the years rather than dramatic changes of direction. This MTP is based in part of the preparation for the 1998-2000 Plan period, prefaced by an extensive interaction with stakeholders in July of 1996 on likely research areas. 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, and discussions with a TAC panel were also included in the development of the plan for the period 1998-2000.

More recent events which have shaped the modifications in the current plan were (i) the development of a new strategic plan in a year long exercise (1998/1999) involving ICLARM staff and stakeholders, (ii) a review of ICLARM's future view and new research areas with the External Program and Management Review Panel (amongst many important considerations this modified, for instance, the target for ICLARM's involvement in the work on the African Great Lakes), (iii) institute and Board involvement with the development of a Center logframe with a more explicit focus on beneficiaries and means of delivery of outputs, and (iv) new collaborative and logistical opportunities following the transfer of the ICLARM Headquarters to Penang, Malaysia.

A draft of this plan was prepared in February of 2001 and discussed by ICLARM's Board prior to its submission to TAC in March 2000.

These substantial priority setting exercises were necessary because ICLARM's mandate potentially could have been broadly interpreted - there are for instance approximately 25,000 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 approach³, 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 1998/99 ICLARM undertook an institutional and stakeholder analysis of the situation of developing country fisheries and aquaculture. This followed a decade in which there was greater public awareness of the state of fisheries and the environment and in which aquaculture had become the fastest growing sector in agriculture. The Center adopted the resource system approach to setting priorities used earlier. Geographic emphasis was determined by an analysis of the needs of poor people who benefit most from living aquatic resources in developing countries (as seven regional groupings). Aquatic resource systems are defined as the zone of convergence of the resources, their aquatic environment and the human users.

The priority setting evaluated production and resource and environmental management needs, the ability of science of all types to address the constraints, feasibility, definition of benefits and beneficiaries, likelihood of adoption and comparative advantage. This approach and the outcomes for ICLARM's strategy entering the next decades are laid out in detail in the ICLARM Strategic Plan 2000-2020 and in a related supplement.⁴ The outcomes confirm the needs and priorities for research on pond (and rice-field) aquaculture, coral reefs and coastal fisheries established earlier and expand ICLARM's focus on floodplain and other inland water fisheries. ICLARM confirms that it has a role to play in developing globally applicable models and drawing attention to issues of wide strategic relevance for developing countries and the sector, and will limit its action research to Asia, Africa and the small island developing states of the Caribbean and the Pacific. (See Table A)

³ 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.

⁴ ICLARM Strategic Plan 2000-2020, ICLARM, Manila 1999 27pp, and Aquatic resources research in developing countries: data and evaluation by region and resource system. Supplement to ICLARM's Strategic Plan 2000-2020. ICLARM Manila, 102pp + tables

Table A. ICLARM's priority research thrusts (2000 - 2020) by aquatic resource system and regional focus.

AQUATIC RESOURCE SYSTEM	PRIORITY STATUS*	RESEARCH THRUSTS	REGIONAL FOCUS
Ponds	Very high	Introduce integrated aquaculture systems and impact analysis Enhance genetic techniques	Asia, Sub-Saharan Africa (SSA)
Small water bodies, reservoirs and lakes	Medium	Develop knowledge base Enhance productivity Integrate management	SSA
Floodplains, streams and rivers	High	Enhance yields Develop appropriate research methods and data to evaluate the resources and improve policy decisions and institutional framework	Mekong Basin, South Asia
Coastal waters (including estuaries and lagoons)	High	Co-manage coastal and fisheries resources Plan for integrated resource use Introduce sustainable coastal aquaculture and stock enhancement	Southeast Asia (SEA) (including Mekong Basin), SSA, SIDS
Coral reefs	Very high	Integrate data on coral reefs to determine parameters of reef health Practice better management within ICZM context Encourage sustainable exploitation of coral reef resources through aquaculture and marine protected areas (MPAs)	SIDS (Pacific, Caribbean), SEA, East Africa
Soft bottom shelves	Medium	Conduct analysis and study policy implications of changes in coastal fisheries	Asia, Africa
Upwelling shelves	Low	Keep watching brief on productivity and influences of catch on trade and other aquaculture development	--
Open oceans	Low	Monitor world catch statistics and trade for their effects on ICLARM's target beneficiaries and other resource systems and global patterns	--

*Very high' represents the heartland of ICLARM's research; it will be allotted between 15-30% each of ICLARM's total financial and human resources and preferentially protected from budget shortfalls. 'High' priority research will be pursued by ICLARM, but usually covering not more than 15% of resources. 'Medium' priority research will be pursued by ICLARM, normally covering not more than 7.5-10% of resources. 'Low' priority indicates that extant data will be used from these systems to contribute to generic research (e.g., fisheries models) and any additional research will generally be conducted by collaborators.

ICLARM then reviewed the planned areas for research and the structure of programs and projects reported in earlier MTPs (including discussions with ICLARM's External Program and Management Review Panel). Three major observations arose relating to the increasing spread of projects, the potential for dispersing disciplinary skills and the complexity of research management of a large number of programs and projects in a small institute. Noting that the majority of problems in aquatic resources management require multidisciplinary, integrated solutions, the programs have therefore been organized into a smaller number of two disciplinary and two resource system programs, with a fifth program providing institutional support to partners through information, training and networking. The new program structure will be implemented commensurate with ICLARM taking up its new headquarters arrangements in Malaysia in March 2000. The intention is that (i) the programs will increase critical mass in areas for specific topic research and maintaining global scientific contacts, and (ii) the programs themselves be linked so that larger more integrated institutional project activities call on the various biological, socioeconomic and management expertise required for individual problem solving.

Secondly, ICLARM's earlier project portfolio developed in 1995, although then addressing issues of high importance differed in implementation in some cases from the actual evolution of priorities and active projects foreseen for 2000 and beyond. The grouping of projects described in this and the previous Plan was therefore consolidated (see Table B). These changes also have the effect of simplifying research management and concentrating financial resources on larger project entities.

Table B. Relationship between ICLARM's consolidated program structure (2002-2004) and the CGIAR project portfolio (2002-2004).

ICLARM's Consolidated Program Structure (2002-2004)	"CGIAR" Project (2002-2004)
Biodiversity and Genetic Resources Research	#1- Conservation of Aquatic Biodiversity #2- Genetic Enhancement and Breeding
Freshwater Resources Research	#3- Improvement of Freshwater Aquaculture
Coastal and Marine Resources Research	#4- Fisheries Resources Assessment and Management #5- Assessing and Limiting Coral Reef Degradation #6- Coastal Aquaculture and Stock Enhancement
Policy Research and Impact Assessment	#7- Economic Monitoring and Evaluation of Developing Country Fisheries #8- Legal and Institutional Analysis for Fisheries Management #9- Aquatic Resources Research, Planning and Impact Assessment
Partnerships, Information and Training	#10- Information and Capacity Building for Aquatic Resources Research in Developing Countries

Table C. Relationship between ICLARM projects and CGIAR outputs (2002-2004).

#	Project Title	Germplasm improvement ^a	Germplasm collection ^b	Sustainable production ^c	Policy ^d	Enhancing NARS ^e
1	Conservation of Aquatic Biodiversity	- (+) [†]	- (+)	65%	10%	25%
2	Genetic Enhancement and Breeding	80%	5%	- (+)	- (+)	15%
3	Improvement of Freshwater Aquaculture	- (+)	- (-)	100%	- (++)	- (++)
4	Fisheries Resources Assessment and Management	- (-)	- (+)	100%	- (++)	- (++)
5	Assessing and Limiting Coral Reef Degradation	- (-)	5%	85%	- (++)	10% (++)
6	Coastal Aquaculture and Stock Enhancement	10%	5%	85%	- (+)	- (+)
7	Economic Monitoring and Evaluation of Developing Country Fisheries	- (-)	- (-)	- (-)	100%	- (+)
8	Legal and Institutional Analysis for Fisheries Management	- (-)	- (-)	- (-)	100%	- (++)
9	Aquatic Resources Research Planning and Impact Assessment	- (-)	- (-)	- (-)	100%	- (+)
10	Information and Capacity Building for Aquatic Resources Research in Developing Countries	10%	- (-)	- (-)	- (+)	90%

^a Germplasm improvement includes breeding and the genetic enhancement of finfishes, and the hatchery rearing and stock enhancement of marine invertebrates.

^b Germplasm collection is only carried out on an experimental basis for biodiversity or enhancement research. ICLARM does not possess any long-term gene banks.

^c The bulk of ICLARM's research portfolio is considered to be the management of living aquatic resources in their natural environment or in agriculture and is thus allotted under this heading.

^d A number of ICLARM's projects have policy implications but only those addressed specifically from a policy (or socioeconomic) stand point are included under this heading. The Aquatic Resources Research Planning and Impact Assessment activities could contribute to all categories of activities but are listed here because of the way they are managed within ICLARM.

^e The majority of ICLARM's projects are conducted in partnership with NARS partners and contain substantial elements of training through research. However, only those projects with discrete training activities, information exchange and networks are included under this activity category.

^f Figures represent financial allocations, while plus/minus in parentheses represent direct and indirect contributions of project activities to each CGIAR category.

The relationship between ICLARM's projects and the contribution to the CGIAR categories is illustrated in Table C. The relative attribution of funds to the different CGIAR categories is given in Section B, Table F

a.4 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.

The expansion of activities to encompass floodplain research as highlighted in the ICLARM Strategic Plan is implemented through projects in Bangladesh and the Mekong basin. Millions of poor people utilize these flood prone regions for household food security and would have few other means of support should these freshwater habitats be degraded or lost. ICLARM's approach is both socio-economic and biological. Work focuses on valuation of aquatic resources and their use by households, improved governance of communal water bodies and the wetlands as a whole and biological modelling of the fish resources (in the Mekong) and their production in relation to annual flooding cycles.

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. The coastal zone is home to large numbers of artisanal fishers 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. ICLARM anticipates that the contribution of mangroves to coastal protection and productivity will also be included in ICLARM's approach to coastal environments and ICLARM will seek to work with other centers of expertise to integrate approaches to the coastal zones.

Definition of the state of health of coral reefs, and appropriate mechanisms for the protection and productive exploitation of reefs and the organisms they harbor, are being tackled by ICLARM on several fronts. 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, proper resource accounting of the roles played by aquatic resources in contributing to food security and environmental and other functions in key aquatic resource systems, and on technology impact assessment. Much of the extended focus under the new Strategic Plan on floodplains and other freshwater bodies will profit from the integration of social and biological research to optimize the exploitation of these resources. 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. New opportunities are being explored for productive links with philanthropic Foundations and the private sector. 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 decades, and supply and demand issues in developing country fisheries

Similarly ICLARM will continue to provide input to the Species 2000 project, 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 will continue to remain abreast of issues such as ecolabelling of aquatic produce, intellectual property rights and bioprospecting legislation on behalf of itself and partners. 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.

a.5 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.

a.5.1 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 fishers 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, adding research on 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 new initiatives in tilapia and carp genetic enhancement research.

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 and the proceedings were published in 2001.

a.5.2 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 projects recognize both these objectives. 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 crops 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, 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 through the economic monitoring and evaluation of developing country fisheries.

a.5.3 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 with EcoSim), 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.

a.5.4 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. The Center has been instrumental in developing GoFAR, a fisheries chapter of the Asian regional organization APAARI to provide a voice to aquaculture and fisheries NARS in fora otherwise dominated by agricultural concerns.

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. ICLARM will provide training in RESTORE software and the introduction of the integrated approach to aquaculture in smallholder farming systems will be explained through NGOs and other forms of scientist/ farmer partnerships.

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 World Resources Institute in the USA and the University of British Columbia in Canada. Collaborative research in, for instance, the Pacific Islands has been conducted together with national program staff and scientists from the Australian universities and marine science institutes. ICLARM will also conduct research projects with European institutes under "holdback" funding arrangements.

ICLARM increasingly wishes to capitalize on new technical advances and will benefit through the Plan period from contacts made 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 UK 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 (CAPRI) managed by IFPRI. Further work with IFPRI will be conducted on the inclusion of fish into the World Food model. ICLARM continues to collaborate with IWMI, the Mekong River Commission and other partners from the riparian countries to model the flooding patterns and fish productivity of the Lower Mekong Basin countries. Collaborative research on the introduction of aquaculture into the farming systems of humid west Africa is being carried out in a new project in the Cameroon with IITA.

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 for aquatic systems. ICLARM enjoys excellent working relations with central and regional offices of the FAO and with SEAFDEC, the Mekong River Commission and 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.

a.6 Highlights of Achievements 2000/Expected 2001

The following section lists ICLARM's research and related achievements by CGIAR output, citing those projects which contribute to each output (see Table C).

Category 1: Germplasm Improvement

ICLARM pursues activities under three projects which contribute principally or in part to the goal of germplasm improvement. These are *Genetic Enhancement and Breeding*, *Improvement of Freshwater Aquaculture*, and *Coastal Aquaculture and Stock Enhancement*.

Project # 2. Genetic Enhancement and Breeding This Program aims to develop techniques for improving breeds of fish, the dissemination of these techniques and the training of staff in their use. The Program focuses on carp and tilapia species that are important for aquaculture systems prevalent in developing countries. In the case of carps, the project is carrying out a combined genetics and socioeconomic evaluation of the appropriate species, farming systems and breeding goals that will yield the highest potential impact on increased protein production, efficiency, equity, sustainability and environmental issues. The Asian countries collaborating in this project are Bangladesh, the People's

Republic of China, India, Indonesia, Thailand and Vietnam and the African countries are Egypt, Ghana, Côte d'Ivoire and Malaŵi. Work is also conducted on the genetic enhancement of tilapia species in Asia and Africa. The collaborating countries are Egypt, Ghana, Côte d'Ivoire, Malaŵi and Malaysia. The focus of this Program is the development and application of breeding methods to improve strains of fish for aquaculture, the training of scientists in the use of these methods and the dissemination of this technology to NARS. The Program includes projects on tilapia and carp species that are important for aquaculture in developing countries in Asia and Africa.

Results in 2000

- Transfer of offspring from the sixth generation of the GIFT fish to Malaysia in a project funded by the Department for International Development (UK) (DFID). These fish will provide the base for further selective breeding to improve growth rate and other economically important traits.
- The development of microsatellite markers, in cooperation with Auburn University, to aid in selective breeding of tilapias.
- Completion of the first phase of carp breeding and consumer evaluation projects in Bangladesh, the People's Republic of China, India, Indonesia, Thailand and Vietnam to help increase fish quality and production. Gains in growth through selective breeding and crossbreeding were demonstrated.
- Held two workshops with carp breeders and socio-economists in Penang, Malaysia and Wuxi, China to synthesize information on patterns of household consumption and the choice of traits for genetic improvement.
- Developed selective breeding plans for experiments in Egypt, Malaŵi and Malaysia.
- Prioritization and selection of carp species, choice of farming system and selection of traits for research carried out.
- Published a comprehensive special report on SocioEconomics of Tilapia Cultures in Asia.

Expected outputs in 2001

- Training courses will be conducted and breeding programs have been initiated in Egypt and Malaŵi to transfer the GIFT technology to African countries.
- Published documentation of carps genetic resources in Asia.
- Published documentation of genetic improvement of carps in Asia.
- Established a base population of 70 families of *O. niloticus* with breeders from 4 localities in Egypt.
- Created a base population of *O. shiranus* with breeders from 4 localities in Malaŵi.

- Completed national breeding plans for tilapias in Côte d'Ivoire and Ghana.
- Published the breeding plan for *O. shiranus* in Malaŵi.
- Conducted practical training course in selection methodologies and quantitative genetics and workshop on statistical analysis of data from breeding programs at ICLARM Egypt for African scientists in the Philippines in a project funded by the Technical Cooperation Among Developing Countries (TCDC) of the United Nations Development Programme (UNDP).
- Publication of complete review of methods available for genetic improvement of aquatic organisms.

Project # 3. Improvement of Freshwater Aquaculture The project develops approaches to integrated management of aquaculture and major outputs contribute to the Sustainable Production output. However, on the African continent the project 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.

Results in 2000

- A study on the relationships between catchment degradation and the success of fish reproductive migrations from Lake Chilwa, Malaŵi was completed and highlights the importance of the relationship between land and water management.
- A selective breeding program was initiated for *Oreochromis shiranus* in Malaŵi in collaboration with the National Aquaculture Centre (NAC), Domasi.
- A first trial of system engineering and testing for the development of improved hatchery management methods in Egypt was completed. Oxygen limitation has been hypothesised as being a critical factor in eliciting the more altricial life history strategy that widely constrains small-scale commercial tilapia farming.
- A database on 22 diseases found at Abbassa was compiled for the Aquatic Animal Quarantine and Pathogen Information System (AAQPIS).
- Data analysis has been completed for the first generation of mass selected *O. niloticus* and *O. aureus* in Egypt. Growth rates of the first generation were not statistically different from their parents (85.2g at harvest versus 84.7g in *O. aureus* and 72.3g versus 71.2g in *O. niloticus*). Possible reasons for these are low heritability values, dominance effects, and unsynchronized spawning.
- A study has been designed in Egypt to understand the potential impact of tilapia escapees in the region.

Expected outputs in 2001

- A regional network in Africa and a database for fish health information with FAO - Aquatic Animal Quarantine and Pathogen Information System (AAQPIS) will be established.
- Expansion of the catchment work in Lake Chilwa, Malaŵi to include other river catchments, valuation of the fisheries resource within the river system as well as the lake, and measurement of the impact of fishponds in reducing erosion in subcatchments.
- The feasibility of brushparks as a technique for fisheries enhancement in Lake Chilwa, Malaŵi will be assessed as well as their potential environmental consequences.
- Manipulation of fish stocking rates, and varying fertilizing and feeding regimes of tilapia in Egypt will be carried out to optimize production.
- Selection regimes and breeding programs will be developed for tilapia in Egypt. Combined selection of seventy families of tilapia from four populations of tilapia (3 from the Nile delta and one from Aswan) to produce and measure growth in the F3 population of *O. niloticus* and *O. aureus* in Egypt.

Project # 6. Coastal Aquaculture and Stock Enhancement

Information for the project is now presented in Category 3 (Sustainable Production).

Category 2: Germplasm collection

ICLARM does not undertake activities for which the collection of germplasm is a major goal or output and the institute has not established germplasm collections, except transiently, to support individual research activities. Small collections of tilapia are held for germplasm improvement projects, mostly as live fish. The establishment of hatchery procedures for conservation and stock enhancement purposes of invertebrate species (giant clams, sea cucumbers) has involved the collection of broodstock and their maintenance in land based hatcheries. Experimental procedures for the collection of juvenile reef fish for grow out procedures or of adult reef fish for genetic studies are continuing. Collectively these studies result in the relatively small percentage allocation of resources to this output. These activities do not result in permanent collections of germplasm and in instances where germplasm transfers are arranged ICLARM shares germplasm under specific Material Transfer Arrangements

Category 3: Sustainable Production

Project # 1. Conservation of Aquatic Biodiversity This project pursues strategic research on biodiversity and genetic resources and contributes to the development of research methods and policy.

ICLARM continues to develop a global database finfishes. It is also linked to updated tools useful for fisheries management. FishBase now provides direct Internet access. The project also provides training in 55 African, Caribbean and Pacific (ACP) NARS, emphasizing the use of biodiversity databases (learning from FishBase), ecosystem-based management and electronic networking. A new LarvalBase project which commenced in 1998 contains additional information on the identification of fish larvae to the main database, to expand its utility for fisheries and aquaculture managers.

Work is conducted 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.

The project contributes to the work of the Convention on Biological Diversity and the Clearing House Mechanism; Global Biodiversity Fora; Species 2000;FAO Fisheries Division and Commission on Genetic Resources for Food and Agriculture (CGRFA); IUCN; the CGIAR's System-wide Genetic Resources Program (SGRP) and the CGIAR System-wide Information Network for Genetic Resources (SINGER).

This project plans and implements research on the conservation and sustainable use of genetic diversity and contributes to the development of research methods and resource management policies

Results in 2000

- Hydrographic and available fishery data were incorporated into a semi-quantitative model to help predict the effect altered water flows would have on fishery production in the Mekong River.
- FishBase now includes information on 25,000 species of fish, including most of the described fishes in the world.
- FishBase now provides automated access to listings of country-specific information, including lists of species, endangered species and international conventions on fish diversity.
- A LarvalBase web site was implemented in 2000 and provides information on the morphology and biology of larvae of over 600 species.
- A geographical survey of genetic variability in black-chinned tilapia in West Africa indicates this species is fragmented into three geographical groups corresponding to subspecies.
- Surveys of mitochondrial DNA control region and microsatellite DNA variability in silver barb populations in Southeast Asia revealed three distinct groups, Dong Nai River, lower Mekong River and middle Mekong River, that should be used as management units.

Expected outputs in 2001

- Complete model of fish production in the Mekong River Basin with an emphasis on the fishery in the Great Lake of Cambodia.
- Extend systematic and zoogeographical studies (genetic and morphometric analyses) on black-chinned tilapia (*S. melanotheron*) by focusing on populations in Sierra Leone, Liberia and the eastern range of West Africa to determine its conservation status and potential for the sustainable use.
- Develop and test specific antisera for the identification of commercially important tilapiine species including a field test-phase in Ghana (field kit for species identification).
- Continue black-chinned tilapia culture trails at WRI, Ghana.
- Convene international workshop on the biodiversity, conservation and sustainable use of black-chinned tilapia and related species in West Africa at WRI, Accra.
- Complete data analysis of molecular genetic data for silver barb in Southeast Asia and prepare results for publication.
- FishBase will further consolidate data relevant to ACP countries and create a computer routine to construct trophic (Lindeman) pyramids for large ecosystems, to compare and classify, better understand, and better manage these systems.
- LarvalBase will continue to collate information on fish larvae and has set a goal to include information on larval morphology and biology for about 1000 species and to produce 25 detailed profiles of larval biology for cultivated species.
- Funding will be sought for a workshop on mangrove ecosystems in S.E. Asia to identify important questions for research to determine the importance of mangroves in coastal fishery production.

Project # 3. Improvement of Freshwater Aquaculture ICLARM is developing new approaches to integrate biological, climatic and socio-economic variables in the evaluation of best practices for the introduction of aquaculture into farming systems. ICLARM links its own field experience in Asia and southern Africa with those of others in the evaluation of the development impact of the introduced technology. New initiatives are being taken to extend field activities to the humid zone of West Africa with CGIAR and regional NARS partners.

Activities are currently focused on the improvement of small farm productivity through the introduction of multiuse water bodies on farms. Contrasting country sites are employed for action research, namely Bangladesh, in humid south Asia having abundant small water bodies; Malaŵi, a semi-arid country in southern Africa dependent upon seasonal rainfall; and Cameroon, where the project seeks to assess the viability of IAA within the continuum from peri-urban to remote rural farming systems and to demonstrate the efficiency of the research-extension team approach to IAA introduction and improvement of production. Research at each site is linked through data collection and common analytical software. At

each site, the integration and uptake of aquaculture is supported by biological research and the adaptation of aquaculture systems to local conditions. The intention is to extend the best practices learned from these studies to the introduction of aquaculture into the high potential farming systems of humid West Africa together with national and IARC partners.

Additional project activities focus on increasing and sustaining the productivity of rice and fish in the floodplain ecosystems of South and South East Asia are carried out in Bangladesh and Vietnam. The objectives are to analyze alternative resource management strategies in floodplain ecosystems; study participatory development and viable income generating options and their field validation; identify viable community-based mechanisms to secure group access to waterbodies and adequate provision of inputs and access to markets. Climatic, biological and sociological parameters will be amassed and correlated to provide recommendation domains for the optimal use of water bodies for aquaculture.

Results in 2000

Malaŵi

- Two training courses in Participatory Aquaculture Research and Extension were conducted between June and September 2000. Malaŵian research and extension staff from government and NGO's attended the courses. The course objectives were to train research and extension staff in participatory aquaculture research and extension methodologies, fundamentals of aquaculture and to acquaint participants with new IAA technologies so that they could efficiently implement the new participatory approach to aquaculture extension in Malaŵi.
- A report on the Lake Chilwa Wetland and Catchment Management Project's State of the Environment Study No.5 was completed and published: *Jamu, D.M. and R.E. Brummett. 1999. Fish Reproduction in Lake Chilwa with Special Emphasis on Barbus paludinosus and the status of the Watershed. State of the Environment Study No.5, Malaŵi Ministry of Natural Resources and Environmental Affairs and Danida, 29pp.*
- A preliminary report on "*Land use patterns in the Domasi and Likangala River catchments and their effects on soil erosion, water quality, river flow rates, catchment sediment yield and Barbus reproduction in Lake Chilwa, Malaŵi*" was completed and submitted to DANIDA/Lake Chilwa Wetland and Catchment Project.
- Two collaborative studies between USAID PD/A CRSP, ICLARM-Malaŵi and Bunda College of Agriculture were completed at the Malaŵi National Aquaculture Center. A third study is expected for completion in February 2001 at the Bunda College of Agriculture. Both studies are aimed at verifying the results of CRSP research at its prime site and of expanding the regional effort of the CRSP by assisting with the conduct of needed research at other sites in the region.
- A 2-year research project entitled "Identification of factors regulating nitrogen use efficiency and retention in integrated aquaculture/agriculture (IAA) systems" was implemented in December 2000 with financial support from the Rockefeller Foundation. The study aims at identifying major processes regulating nitrogen use

efficiency in IAA systems and developing sediment nitrogen management strategies that improve the overall productivity and sustainability of IAA systems.

Cameroon

- Implementation phase of the new project began in September. Office within IITA Humid Forest Station established. Technical staff from local collaborating institutions have been assigned to the project. Small research station rehabilitation underway to support participatory research. Identification of project sites and cooperating farmers underway. Links are now being established with potential local and regional partners and beneficiaries. Sponsored research projects on development of IAA farming systems and indigenous species for aquaculture under review.

Bangladesh

- More than 6,000 aquaculture production demonstrations were made through NGOs following training of their staff by ICLARM. Thirteen small aquaculture research projects conducted by NARES partners have received support in the past year.
- The new Development of Sustainable Aquaculture Project has been approved through a cooperative agreement with USAID for 5 years and a budget of \$5.5 million. The new project with activities starting 1 October essentially continues the same activities and scale of operation of the old project in recent years. An annual target of 7,000 new small-aquaculture demonstrations with associated farm-day rallies and follow up training with lead farmers is programmed.
- In areas subjected to annual deepwater flooding, rice-fish experiments have been successfully conducted in eight sites in three areas in Bangladesh representing the Meghna, Brahmaputra and Ganges floodplains and in three sites in two areas in Vietnam representing the Red river and Mekong river floodplain. Institutional arrangements (group formation, input and output sharing arrangements) designed for community-based rice-fish culture worked well in all the sites.

Vietnam

- Start up phase of a new project: 'Management in Coastal Lands Protected From Salinity Intrusion' in the Mekong Delta, with initial visits and formulation of activities on aquatic resource use issues, alternative aquaculture opportunities, and socioeconomic and policy issues were formulated.

Penang

- A proposal for a Project on the Determination of High-Potential Aquaculture Development Areas and Impact in Africa and Asia was formulated; a feasibility study to be conducted in 2001 was approved for funding by BMZ/GTZ.

Expected outputs in 2001

- Released research tool package: (1.) Field Operations Guide, and (2.) Software Manual for RESTORE ver. 1.0, for farmer-participatory design and impact assessment of the integration of new enterprises (such as aquaculture) into farming systems.
- Training course on RESTORE conducted for 12 NARS participants (scientists, extensionists and decision makers, including NGOs) in Bangladesh and Malaŵi.
- Technical Report on IAA integration into farming systems in an upland forest buffer zone in the Philippines published.
- Definition of socio-economic variables governing successful adoption of IAA in selected sites in Africa and Asia

Project # 4. Fisheries Resources Assessment and Management

Under this project, ICLARM conducts research on tropical fish stock assessment and the management of multispecies fisheries and fish habitats.

The Project has previously focused on the development and provision of support in the use of fisheries assessment software (e.g., Elefan, FISAT, FAO-ICLARM Stock Assessment tools, etc.) for researchers in national institutes. A test version of the ecosystem modeling software, Ecopath, was developed in 1998, which includes a dynamic simulation module, Ecosim, developed in conjunction with Canadian partners. ICLARM has now conducted several international training workshops based on the use of Ecopath with Ecosim. Ecopath version 4 was released in 2000, and it is now possible to incorporate information from stock assessments, to fit this information over time, and to evaluate human and environmental impact. Other new features of the software also allow prediction of optimal harvesting patterns based on economic, social and ecological criteria, evaluation of the impact of uncertainty in the management process, optimization of the effect of protected areas, and development of circulation models.

The Sustainable Exploitation of Tropical Coastal Fish Stocks in Asia (TrawlBase) project seeks to deliver scientific advances in stock assessment, develop fisheries resource databases, and improve management and sustainable use of regional coastal fisheries resources. A computer package developed in conjunction with TrawlBase, known as Fisheries Resource Information System and Tools (FiRST), has been finalized and is being used to analyze the dynamics of coastal fisheries in eight participating Asian countries. Collectively, the database now contains 20,620 trawl survey hauls/stations. Initial analyses indicate substantive declines in catch rates and biomass compared to earlier ("baseline") biomass levels in selected fishing areas.

Research on resource assessment, social issues and management of fish habitats of Honda Bay and Puerto Princesa Bay, Palawan, Philippines, was initiated in February 2000. The outcomes of the assessments are aimed at the identification of the status and utilization of fisheries and related coastal resources/ habitats, the stresses or impacts on the resources, and preliminary management implications.

Stakeholders, institutional relationships, available resource, and the relative importance of problems are also being identified. The work includes fish stock assessments, an inventory of fishing gear, experimental fishing, assessments of coral reef, seagrass/seaweed, mangrove and soft-bottom habitats and assemblages, and development of a database.

With the realization that fisheries are difficult to manage through the regulation of catch and effort, there is increasing interest in using protected areas (with fishing restricted or banned) as part of management schemes. ICLARM is undertaking projects (in two states in the Caribbean and in Solomon Islands in the Pacific) aimed at a better understanding of how marine protected areas function and how they can be used to improve the management of tropical fisheries. The work in the Caribbean is supported by the recent development of spatial modeling as part of the Ecopath/ Ecosim system.

ICLARM has completed Phase I of its Caribbean Marine Protected Areas Project and has shown that in relatively degraded reef situations where overfishing occurs recruitment is low because: a) the local spawning biomass is much reduced, and b) arrival of juveniles with long-lived larval stages from remote stocks (other islands) is meager. This finding, and data on the migration of adult reef fish, contribute important scientific information to Phase II of the project which commenced in 1999 and which addresses the best use of marine protected areas in the rehabilitation of coastal coral reef fisheries within the appropriate social context.

Research on the large protected area in the Solomon Islands has focused on valuable invertebrates (giant clams, trochus, sea cucumbers). It has shown that, with the exception of trochus, the time required for restoration of stocks within fishing reserves may be decades. ICLARM is seeking further long-term funding for this project to confirm this conclusion.

Results in 2000

- Release of Ecopath with Ecosim version 4 and User manual.
- Release of the 2000 version of the Fisheries Resource Information System and Tools (FiRST) and preparation of draft technical reports for the various research components of TrawlBase (particularly resource analysis and socioeconomic components). Ecosystem models for each of the eight fisheries being evaluated are being developed.
- Analyses of trawl survey data show assemblage boundaries at depths of about 50m and 100m, and species composition changes in some countries, particularly declines in mean trophic level, due to the current high levels of fishing effort
- Eight national consultative workshops held to formulate national strategies and action plans for improved management of coastal fishery resources.
- The project on resource assessment, social issues and management of Honda Bay and Puerto Princessa Bay, Palawan, Philippines, was initiated in February 2000, including development of the database.

- The achievements of the project on protected areas in the Caribbean included: (1) incorporation of quarterly inventories of fish and invertebrate biomass at Discovery Bay, Jamaica, and Hans Creek, British Virgin Islands (BVI) into Ecopath/Ecosim models; (2) continuation of monthly sampling of postlarval fish with low-cost light traps; (3) initiation of sampling postlarval fish with crest nets; (4) regular monitoring of recruitment using mini-traps to provide a continuous record since August 1996 in Jamaica and April 1997 in BVI; and (5) collection of a comprehensive set of morphometric data to evaluate the possibility of using rectangular escape gaps in traps to increase the average size of deep-bodied fish. Another significant development in the project was the decision of the fishing community at Discovery Bay to recommend the extension of the fishery reserve to cover the entire shallows of the bay.
- A study on the effects of the 3-year fishing closure at the Marine Conservation Area (MCA) at the Arnavon Islands, Solomon Islands, showed increases in abundances of trochus and some species of sea cucumbers. The reserve had no effect on the abundances of other sea cucumbers or giant clams. Thus, closure to fishing over long time frames is likely to be needed to restore populations of many tropical marine invertebrates to pre-exploitation levels. Another lesson from the project is that complete protection of the MCA is difficult, even with the commitment and participation of local communities. Mechanisms that allow communities to benefit from species that have recovered, while continuing to protect the other species, may be needed to maintain commitment to management plans.

Expected outputs in 2000

- Continuing technical support to users of Ecopath with Ecosim and FIRST in developing country applications.
- Review of the FIRST database 2000 version and printing of the FIRST User manual.
- Organization and conduct of the TrawlBase regional consultative planning and final workshop, and finalization of eight national strategies and action plans for improved management of coastal fishery resources.
- Publication of the TrawlBase technical reports and regional workshop proceedings.
- Technical reports on the results of fish stock assessment, aquatic ecology and coastal habitat, physical oceanography, and water quality activities, and document, bibliography, and resource and spatial assessment (RSA) databases, for Honda Bay and Puerto Princessa Bay, Philippines.
- Technical Workshops to present the results of RSA project activities and to formulate preliminary measures for resource management.
- Ecopath/Ecosim models of the protected ecosystems in the Caribbean, including estimates of biomass of system components at quarterly intervals, estimates of growth and mortality rates of the principal species, catch data and trophic

interrelationships. Other outputs from the Caribbean will also include: (1) data on the efficacy of escape gaps in fish traps and morphometric data from a wide variety of sources; (2) information on the rates of settlement of reef fish during the 2001 spawning season using standard light traps; (3) assessment of the potential for using crest net to provide post-settlement reef fish for cage culture and subsequent release into protected areas; (4) long-term data on abundance of reef fish in the Discovery Bay Fishery Reserve, Jamaica, modified appropriately if the Government takes action to expand the Reserve to incorporate all of the shallow waters of Discovery Bay.

- Development of a proposal to continue monitoring the protected area in Solomon Islands for another three years. This proposal will include protocols for transferring trochus (a marine mollusc) of commercial value that have accumulated in the protected area to other reefs under the customary marine tenure of local communities in a way that provides sustainable yields.

Project # 5. Assessing and Limiting Coral Reef Degradation

In partnership with key institutions around the world, ICLARM is continuing to develop ReefBase, a global database of coral reef systems, their resources and use by humans. ReefBase is designed to provide access to both data and summary results from key assessment programs operating at the global and regional level. The most recent version of ReefBase on CD (ReefBase 2000) was launched at the 9th International Coral Reef Symposium in Bali, and a further revision of the user interface has been developed to allow immediate access to ReefBase information via an interactive Web site. The development of ReefBase as the premier source of key information on all aspects of coral reef status, trends and management will continue throughout the term of this Plan. A major initiative for 2001 will be to add comprehensive GIS capability to ReefBase, so that all results can be queried and displayed through interactive maps.

ICLARM will continue to be a major partner in the International Coral Reef Action Network (ICRAN) for which major United Nations Foundation (UNF) funding is anticipated over the next four years. Under ICRAN, ICLARM will add further information on Reefs at Risk in four different regions to ReefBase, will add a meta-database feature to ReefBase and will continue to investigate the genetic linkages and resulting ecological interdependencies between key reef areas in the south-east Asian region.

A key component in limiting degradation of coral reef resources is effective and efficient coastal management at the local level. ICLARM, with the support of the MacArthur and Packard foundations will, over the next three years, develop Coastal Management Training programs for local managers in Vietnam and Indonesia based on the comprehensive needs assessment and curriculum development protocols of the UNDP Train Sea Coast program.

Results in 2000

- ReefBase 2000 was released at the 9th International Coral Reef Symposium. ReefBase now has information on over 10,000 reefs, and contains major assessment data sets from the ASEAN Australia LCR program, ReefCheck and CARICOMP initiatives.

- The ReefBase website has been revised with a new interface and simple access to published status reports as well as basic data on the 10,000 reefs held on the CD version. Images and maps can be accessed using a simple on screen query, and new material can be uploaded via the web for rapid incorporation into the database
- The PISCES project on genetic linkages of coral reef associated populations in the South China Sea has demonstrated clear genetic structuring of all three fish species studied, leading to specific recommendations for the implementation of conservation and management strategies for six groups of reefs.
- ICLARM, through its staff and consultants, has convened and chaired the initial meetings of the ICRAN steering committee and developed, with ICRAN partners a Strategic Plan which included a fund raising strategy.
- A Reefs at Risk analysis for the southeast Asian region has been conducted, which builds on the successful global Reefs and Risk project and included a more detailed spatial analysis and a more sophisticated risk modelling procedure.
- Coastal Management Training programs have been commenced in Indonesia and Vietnam, building on the work carried out under the National Course for Integrated Coastal Management in the Philippines. ICLARM has received training in course development from, and has been designated as a Course Development Unit by, the UN Train Sea Coast network.

Expected outputs in 2001

- Project a fully functional GIS capability within ReefBase, with interactive maps for querying and display of data available on the Web
- Addition of the Reefs at Risk analysis for southeast Asia to ReefBase
- Inclusion of monitoring data from ReefCheck and GCRMN on ReefBase as they become available
- Addition of meta-data information and links for southeast Asian regions in ReefBase
- Commencement of the action phase of ICRAN (subject to approval of funding from UNF)
- Publication of the results of the PISCES project on genetic linkages between coral reefs in the South China Sea
- A southeast Asian network of coastal zone managers operational in three countries (Vietnam, Indonesia & Philippines)

Project # 6. Coastal Aquaculture and Stock Enhancement

This project focuses on developing methods to increase the productivity of species associated with coral reefs. Its location at the Coastal Aquaculture Centre (CAC) in Solomon Islands had allowed research to be undertaken on the conservation and management of inshore marine resources. In 1999, research was concentrated on the farming and restocking of giant clams, culture of blacklip pearl oysters, stock enhancement of sea cucumbers and development of artisanal fisheries for aquarium species based on the capture and culture of postlarvae. The latter project is an investigation of the feasibility of utilizing wild-caught postlarval fish in grow-out trials to supply the marine aquarium trade to overcome biodiversity-threatening overexploitation of adult fish. ICLARM has extended its technological knowledge to improve the captive rearing of high-value molluscs (pearl oysters, giant clams) to other countries of the region and continues the organization of regional efforts to promote coastal aquaculture industries in partnership with coastal farmers, NARS, development banks and the private sector.

ICLARM had to reduce the number of projects in Solomon Islands in 2000 due to civil unrest and the closure of the main Coastal Aquaculture Centre in late 1999. Some research has been maintained at the fieldstation in the Western Province of Solomon Islands, however, including expansion of the demonstration black pearl farm, preliminary releases of cultured sea cucumbers in coral reef and mangrove-seagrass habitats, and release of trochus reared in combined culture with giant clams.

There are plans to increase the facilities at the fieldstation in Solomon Islands, and maintain a suite of aquaculture and stock enhancement projects there. However, in response to increased demands for projects from neighbouring countries, ICLARM has made arrangements to establish a Pacific Office in Noumea within the Secretariat of the Pacific Community (SPC) complex, and to initiate projects in New Caledonia, Tonga and Papua New Guinea.

Results in 2000

- The final report on the 5-year project on development of methods for mass-rearing of sea cucumbers for the purposes of stock enhancement was completed, together with the final reports to the donor on the ecology of juvenile sandfish and several scientific publications on the reproductive cycle, larval rearing and ecology of sea cucumbers.
- A series of experiments on the combined culture of trochus and giant clams, showing that: 1) trochus could be reared more rapidly for release onto reefs when cultured with giant clams, and 2) the co-culture of these species reduced the labour required to produce giant clams for the aquarium trade and restocking programs.
- Publication of improved methods for collection and grow-out of pearl oyster spat and successful marketing, over the Internet, of the first crop of black pearls from the demonstration pearl farm in Solomon Islands.

- Identification of the relative catch rates of postlarval coral reef fish from light traps and crest nets, and successful rearing of most species of value to the aquarium trade.
- The report of the pilot study for the effects of runoff from forestry operations was completed. Unfortunately, this project was unable to proceed further due to long-term disruption to necessary arrangements in the Solomon Islands.

Expected outputs in 2001

- Increased capacity of NARS in the Western Pacific to collect and grow-out blacklip pearl oyster spat to establish pearl farms.
- Further information on the quality of cultured black pearls from the Western Pacific through marketing of the second crop from the demonstration farm in Solomon Islands.
- Production of juvenile sea cucumbers in New Caledonia and Vietnam for restocking experiments and farming trials.
- Information on the potential for establishing artisanal fisheries for the aquarium trade in Papua New Guinea, based on the capture and culture of postlarval coral reef fish.
- A major review of stock enhancement of marine invertebrates worldwide.

Category 4: Policy

ICLARM's overall programs seek innovative and new technologies to augment aquatic production and find better ways to manage the aquatic environment. ICLARM conducts three projects specifically examining the policy environment to ensure (a) wider adoption of these technologies to benefit the poorer people in developing countries, and (b) promotion of improved policies for the management of natural aquatic systems. The project seeks to: 1) examine policy environments and provide policy options for i) ensuring wider adoption of technologies and policies to enhance nutrition, income and employment; and ii) ensuring benefits to poorer people in the developing world from production, management and conservation of aquatic resources and aquatic habitat; and 2) to provide proper measures for i) setting research priorities; and ii) assessing the impact of aquatic resources research and development.

Within ICLARM, the Center's Policy Research and Impact Assessment Program Center-Commissioned External Review was held from mid-December 2000 to the first week of January 2001. Project site visits and meetings with project collaborators and research partners were held in Europe and in Bangladesh, Cambodia, Thailand, Lao PDR and the Philippines by the reviewers. The review confirmed the direction and focus of the projects noting significant achievements in research to support policy development in the aquatic resources management field. Pipeline projects were also reviewed by the Review Panel.

ICLARM has received additional donor support for the conduct of projects in this general area, so that in allocation of resource terms, the three projects contribute 29 % of ICLARM's total portfolio.

Project # 7. Economic Monitoring and Evaluation of Developing Country Fisheries

The project combines the development of information and methods to provide the economic value of goods and services from aquatic resources with research conducted on the effect of macro-level policy developments on the contribution which living aquatic resources make to food security. The intent over the Plan period will be to extend economic and ecological evaluation techniques to other aquatic resource systems, concentrating on coral reefs and wetlands areas in the first instance.

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 have expanded during the Plan period.

ICLARM has completed the first phase of its worldwide collaborative research project on case studies of coastal fisheries co-management. A further phase has been 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. Renewed support to the phase II of this project in Bangladesh has been secured. Small-scale work has also been undertaken on the evaluation of coral reef systems in the Philippines to provide baseline studies for more generally applicable resource valuation methods.

Results in 2000

- Integration of economic and other related issues to determine the value of the coral reefs for sustainable management
- Review of methodologies and application on the valuation of coastal resources (value of marketable goods and services as well as non-market values)
- Preliminary data collection and parameter estimation for key demand, supply and production factors for fisheries sub-model were completed for integration into IMPACT Model by IFPRI. Additional donor support has been provided to this project.
- Training workshop on Participatory Research Methods and Gender Analysis for Management and Monitoring of Local Aquatic Resources in the Mekong Delta
- Training and capacity building for local partners

Expected outputs in 2001

- Conduct of "An International Workshop on Policies and Priorities for Sustainable Management of Coral Reefs"

- Technical report on the application of non-market valuation techniques and benefit transfer analysis in the estimation of benefits from coral reef systems, including field studies undertaken in Bolinao and Taklong Island, Philippines.
- Final data gathering and derivation of parameters for IMPACT Model jointly with IPFRI and collaboration with FAO and INFOFISH.
- Technical report on the Socioeconomic Status of Coastal Fisheries in Asia (in conjunction with the project “Sustainable Management of Coastal Fish Stocks in Asia under CMRRP)
- Technical report on the “Assessment of the Contribution of Aquatic Resources in the Mekong River Basin to Food and Nutritional Security of the Fishing and Farming Population”.
- Conduct training needs analysis on research methodology and instrumentation with the collaborators as well as develop impact indicators and monitoring scheme of the research activities.
- Develop an electronic database system that will include production and consumption values of aquatic resource systems in Southern Vietnam.
- Initiation of a three-year project titled “Strategies and Options for Increasing and Sustaining Fisheries and Aquaculture Production to Benefit Poorer Households in Asia”, to be implemented in nine DMCs namely, Bangladesh, China, India, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam.
- Conduct regional training and workshop on the development of research framework and methodology on the supply and demand of fish in Asia.

Project # 8. Legal and Institutional Analysis for Fisheries Management This project examines 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. Institutional research extends to the governance of common property aquatic resources, especially inland water fisheries in Bangladesh and the multiple use of the wetlands in the Mekong Basin countries.

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 has been 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.

Results in 2000

- Publication and dissemination of results in fisheries co-management.
- Start-up activities were conducted during late 2000 on a new project, "Legal and Institutional Frameworks and Economic Valuation of Resources and Environment in the Mekong River Region – a Wetlands Approach".
- Identification of policy research issues and development of policy research agenda
- Conducted four national and one regional workshops and produced five revised logframes with a regional summary for the Wetlands project in the Mekong Basin submitted to Sida
- A report on "Beel Fisheries Managed by Communities" summarizing the three-year monitoring of fishing and fish consumption in beels managed by communities through conservation measures or stock enhancement was prepared.
- Problem census and consensus planning workshops were held with NGO partners in Bangladesh.
- Application of the revised research framework with emphasis on legal, institutional and policy analysis and the evaluation of specific hypothesis about co-management to NARs projects funded under the NARs research grant.
- Research outputs from Phase 1 of Fisheries Co-management were reviewed and consolidated for publication and dissemination.
- Conducted a workshop on research framework and hypothesis testing for the Fisheries Co-management project Phase 2
- Publication of the "Common Property in the Mekong: Issues of Sustainability and Subsistence" edited by M. Ahmed and P. Hirsch.
- Training and capacity building

Expected Outputs in 2001

- Conduct national workshops with partners to establish detailed activity plans
- Presentations of legal and institutional aspects related to community coastal management in international conference
- Preparation of technical report on legal and institutional analysis and economic valuation in the four riparian countries

- Improve the understanding and awareness of wetland management issues at local, provincial, national and regional levels
- Improve the capacity of riparian countries to promote sustainable wetland and aquatic resources management
- Test the system-based workshop method to facilitate consensus in resource management in Bangladesh
- Assess changes in social capital and attitudes to cooperate between stakeholder groups in the pilot areas in Bangladesh
- Publication of the proceedings for the international workshop on fisheries co-management
- Design methodologies for testing the legitimacy of fisheries co-management in the partner countries.
- Funding of the NARS research projects
- Production and circulation of a policy brief on fisheries co-management to policymakers
- Implementation of hypothesis testing on co-management in collaboration with NARs in Asia and Africa
- Continue to develop, test and assess CBFM arrangements in existing and new sites together with NGO and DOF in Bangladesh
- Identify and initiate ways to link local community management over larger linked fisheries comprising of rivers, beels and floodplains in Bangladesh
- Assess fishery policy formulation processes and roles of various stakeholders

Project # 9. Aquatic Resources Research Planning and Impact Assessment. This project evaluates the impact of technological research completed by the institute (*ex post* analysis) and, 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 convinced 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.

Results in 2000

- Research paper published on impact evaluation of adaptive extension approach to aquaculture development
- Conducted a national workshop in Bangladesh to provide recommendations on appropriate fishery extension systems for transfer of technology based on evaluation of existing alternative extension approaches.
- Conducted a local workshop with farmers on assessment and improvement of farming systems that include aquaculture in Bangladesh.

Expected outputs in 2001

- Publication of technical report on bioeconomic analysis of giant clam mariculture in Solomon Island.
- Conduct a workshop of CGIAR's integrated natural resource management (INRM) group on methods for addressing indicators and scale consideration in natural resource systems.
- Publication of a set of recommendations that will include a comprehensive framework and guidelines on principles and strategies towards assessment of impact of aquatic resources research.
- Completion of the *ex-ante* assessment of carp genetic/breeding research
- Publication of a compilation of seven papers defining the impacts of improved tilapia germplasm on Asian aquaculture and farming systems.

Category 5: Enhancing NARS

Project #10: Information and Capacity Building for Aquatic Resources Research in Developing Countries. ICLARM has consolidated its activities for the enhancement of NARS capacity in aquatic resources research and management under this one project for the new plan period. The project brings together the aspects of managing relationships with research and development partners, networks, training and the sharing of ICLARM's own outputs and other aquatic resources research data. Other individual projects within ICLARM also contribute to capacity-building of NARS through project-related training programs (e.g., training in use of FishBase in ACP countries). Moreover, public awareness activities on behalf of the institute are also carried out under this program in conjunction with the office of the Director General; additional activities are undertaken in conjunction with the PARC of the CGIAR.

This ICLARM project coordinates a research network called the International Networks for Genetics in Aquaculture (INGA) and the research outputs are listed under the *Germplasm Improvement* heading. Membership of INGA has been extended to leading ARIs in aquaculture genetics worldwide and eleven such institutes are now included to provide

additional assistance to national members so that the combined INGA network now covers four continents. 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.

Results in 2000

- Specialist information was retrieved and compiled in response to numerous requests, for example two hundred bibliographic entries for the two information sections of *Naga* in 2000 including three comprehensive indexes (subject, taxonomic and geographic). The Information Services Unit has provided information and reference services to 379 users. The Selective Fisheries Information Service (SFIS) responded to 27 requests from 15 countries.
- Library linkages and cooperation were established with the University of Malaya, Universiti Putra Malaysia, Universiti Sains Malaysia and the Fisheries Research Institute Library, Penang.
- Thirty-one papers and articles were cleared and recorded in the ICLARM Contribution Series. In 2000 the Communications Unit produced 17 publications and two issues of *Naga*, the *ICLARM Quarterly*.
- Strategies were implemented to raise public awareness of ICLARM's move to Penang, updated corporate identity and research activities and results.
- Meetings were held with NARS, regional and international organizations to identify priority areas for research collaboration.
- ICLARM represented at the Global Forum on Agricultural Research and presented case studies of successful partnerships.
- Survey of partners undertaken to get feedback for strengthening partnerships and information sharing.

Expected outputs in 2001

- ICLARM expects to continue to provide services to partners and stakeholders as well as its own program staff around the world. Cooperation and resource sharing with other fisheries and aquatic libraries worldwide will continue and strategies to provide access to information through web-based technologies developed.
- Second meeting of GoFAR and Expert Consultation on Research Priority Setting for Asia Pacific NARS will be held in collaboration with ISNAR.
- Sixth Steering Committee Meeting of INGA will be held in Hanoi, Vietnam.

- Continued assistance to NARS in germplasm transfer following Material Transfer Agreements.

(b) Highlights of the 2002 Project Portfolio

Germplasm improvement: For tilapia ICLARM will have active programs of selection research being conducted on Nile tilapia in Malaysia and in Egypt. Additional countries in Africa will be using ICLARM's selection procedures to enhance related indigenous species (e.g. *O. shiranus* in Malaŵi). A new project will be initiated with the University of Wageningen to evaluate the benefits of selection of Nile tilapia in high and low input environments. For carps, work will move from the description of existing genetic resources to the exploitation of common carps and silver barb. ICLARM will assist in the development of national breeding plans with a focus on the traits of growth and disease resistance. Efforts to enhance the breeding and inclusion of other species into farming systems will be continued in Africa. Breeding and stock enhancement of invertebrate species of importance to the Pacific will be focused on commercially valuable sea cucumber species. The scientific feasibility of establishing village level grow out trials for key reef fish species will be established.

Germplasm collection: ICLARM does not undertake activities for which the collection of germplasm is a major goal or output and the institute has not established germplasm collections, except transiently, to support individual research activities. Small collections of tilapia are held for germplasm improvement projects, mostly as live fish. The establishment of hatchery procedures for conservation and stock enhancement purposes of invertebrate species (giant clams, sea cucumbers) has involved the collection of broodstock and their maintenance in land based hatcheries. Experimental procedures for the collection of juvenile reef fish for grow out procedures or of adult reef fish for genetic studies are continuing. Collectively these studies result in the relatively small percentage allocation of resources to this output. These activities do not result in permanent collections of germplasm and in instances where germplasm transfers are arranged ICLARM shares germplasm under specific Material Transfer Arrangements.

Sustainable production: ICLARM's work in five major project areas contributes to the sustainability of production of fisheries, coral reefs and coral reef organisms, and fresh water aquaculture. For freshwater systems ICLARM will complete surveys on the heterogeneity of *Sarotheradon melanotheron*, a tilapia species widely used in fisheries and aquaculture in West Africa. A project will be initiated to evaluate the genetic impacts of the introduction of improved species for aquaculture in the collaborating countries of INGA. Now working as a member of the FishBase Consortium ICLARM will complete the updating of species lists and provide training courses in the use of LarvalBase for collaborators.

ICLARM's freshwater aquaculture enhancement encompasses rice-fish systems and the introduction of aquaculture as a new enterprise into farming systems in Asia and Africa. ICLARM will publish its particularly successful studies on the management of deepwater rice-fish research including recommendations for productivity enhancement and equitable management of flood prone ecosystems in Bangladesh and Vietnam. ICLARM will continue to evaluate the best agroecologies and practices for the introduction of aquaculture, with a major project in Bangladesh and work in Cameroon, Malaŵi and Zambia in Africa.

For fisheries, ICLARM will release an upgraded version of the FiRST database which allows the accumulation and analysis of fisheries resource data particularly from trawl fisheries. The project will conduct cross site analyses in the Philippines to evaluate the management and fishing practices that have led to resource changes. With partners at the University of British Columbia, Canada, ICLARM is applying new developments in Ecopath to the ecosystem analysis of Asian and other developing country fisheries. A management program for a coral reef fishery site in Jamaica will be implemented including development of alternative fisheries and the stock enhancement of key trial species. Marine protected area monitoring of invertebrate fauna will be continued in the Pacific with an emphasis on assessing the time required for recovery of sea cucumbers.

ICLARM has revised the make up and accessibility of ReefBase, the major database on coral reefs globally and will have incorporated new data and risk assessments, particularly focused on the Caribbean. Training Needs Assessments for the management of the coastal zone will be carried out in Vietnam and Indonesia. Quantitative data will be available determining the genetic linkage amongst reefs in six Asian countries, illustrating the specific needs for transboundary management approaches pursued.

In coastal aquaculture ICLARM's programs, despite the interruption of work in the Solomon Islands will have trained regional staff in the Pacific in the hatchery production of pearl oyster spat. The third crop of pearls from an experimental pearl farm in the Solomon Islands will have been harvested and evaluated and the farm handed over to the Government. Establishing further research sites in the Pacific, ICLARM anticipates that it will complete preliminary field experiments to optimize release strategies for culture juvenile sea cucumbers in New Caledonia, Vietnam and Indonesia.

Policy: ICLARM conducts research in three project areas which contribute to the theme of providing scientific and policy advice on aquatic resource issues in developing countries. ICLARM is initiating research in the economic monitoring and evaluation of developing country fisheries. Trends in demand and supply for fish and seafood products in relation to food security, employment, income, consumption, trade, and resource production and management will be measured for indicator countries in Asia. In the Mekong region, ICLARM will have developed critical indicators of livelihood for communities with varying dependence on the aquatic resources of the river Basin as well as determining the economic values of the resources themselves.

ICLARM conducts research on the legal and institutional governance of fisheries and wetlands. ICLARM will have completed extensive descriptions of fisheries co-management practices in Asia and Africa with partners from the North Sea Center. Research is under way to evaluate the issues of legitimacy and compliance in successful examples of co-managed fisheries in Asia. In the Mekong the institutional policy analysis focus is on the region's wetlands. Involvement in action research and analysis will raise awareness of wetlands values and governance. In the Bangladesh floodplain areas ICLARM will have developed and initiated networks and community organisation (including NGOs and local users) for addressing fisheries management and policy issues for community-based fisheries. This marks the second phase of a long-standing and successful project on community organisation.

ICLARM will continue to evaluate the impacts of aquaculture, new aquaculture technologies and extension methods. By 2002, the impacts of research and technology development for giant clam mariculture in the Indo-Pacific will have been assessed. More generally a set of recommendations that includes a comprehensive framework and guidelines towards assessment of the impact of aquatic resources research will be provided.

Enhancing NARS:

In 2001 ICLARM will move to its permanent headquarters site in Batu Maung, Penang, Malaysia which will entail the re-establishment of library and information services. These will expect to be fully functional in 2002 and increased use of virtual services will be implemented both for the Center and for national program enquiries. ICLARM provides coordination and technical backstopping to INGA, the International Network for Genetics in Aquaculture and an information network for tropical aquaculture and fisheries scientists. These will continue. ICLARM will continue to seek out appropriate partnerships with NARS and ARIs to augment the efficiency and dissemination of best practices in aquatic resources research and management. ICLARM expects to raise the level of research training and of public awareness activities in the new facility.

(c) Anticipated Highlights by 2004

Germplasm improvement: The outcomes of current activities in the final year of the plan are expected to include the completed analysis of three generations of combined family and individual selection of *O. niloticus* for increased growth in different environments in Malaysia. This will include correlated trait analysis and pave the way for multi-trait selection and the inclusion of other methods to potentially augment selection procedures. Similar outputs will be expected from work currently under way with *O. niloticus* in Egypt with the focus on growth and cold tolerance. Early indications from the selection experiments in high and low input environments will govern the transfer of improved fish into integrated farming systems. Work on carp improvement through selection in common carp and silver barb will be in progress in Asia.

Germplasm collection: ICLARM does not anticipate developing germplasm collections. ICLARM expects aspects of its work to contribute to the development of legislation on fish transfers and the introduction of improved genotypes of fish and invertebrates.

Sustainable production: ICLARM will continue to focus on resource assessments and the provision of fisheries management advice. Resource databases will be shared with countries more widely and across site comparisons, for example in the Philippines, will be used to assess the implications of alternative management strategies on sustainable resource use. Stock enhancement procedures will have been assessed as a means of accelerating recovery of stocks in protected areas. ReefBase will be substantially updated for ease of use by partners and Reefs at Risk analyses will have been published with the World Resources Institute for the Pacific Ocean. Coral reef valuation and policy studies will have been completed as one of ICLARM's contributions to the international coral reef conservation project, ICRAN. ICLARM will have assessed and made recommendations about the feasibility of culturing wild postlarval coral reef fish for export through the marine aquarium trade. This aims to protect adult fish of reproductive age and to provide potential

livelihood opportunities to coastal dwellers in developing island states. Pilot scale mass-release of sea cucumbers will have been assessed using the optimal release strategy for stock enhancement in the Asia Pacific region.

Policy: Trends in supply and demand for fish as they affect households, markets and the opportunity for exploiting enterprises based on aquatic resources will be assessed for target developing countries in Asia. ICLARM expects to be able to publish policy guidelines for policy makers implementing co-management arrangements. Community-based fisheries management in Bangladesh will be improved through action research and social studies of community management. Also in Bangladesh, livelihood opportunities and future income opportunities for the next generation of fishing communities will have been assessed.

ICLARM's impact studies will assess the response of farming systems and the national aquaculture production of the introduction of improved carp species in Asia. Methodologies for integrated natural resource management will be tested in Bangladesh, Cameroon and Malaŵi.

Enhancing NARS: ICLARM views its information and network support services to be of continuing high priority throughout the plan period. The project will also contribute materials to ICLARM's overall public awareness campaign to raise the profile and knowledge about the critical role of aquatic resources in meeting the food security and livelihood aspirations of the poor in developing countries. Awareness and valuing the resource base are critical to efforts to sustain production in the future.

(d) *Measures of Achievement: Project Milestones*

Each major ICLARM project has developed a set of time bound milestones to describe and monitor progress towards the overall outputs.

B. FINANCING THE AGENDA

B1.1 2000 Results and 2001 Development

The 2000 expenditure level was US\$11.17 million of gross expenditures and US\$10.94 million net of recovery of indirect cost; 77% of 2000 resources were utilized for programmatic activities. ICLARM ended the year with a surplus of US\$2.38 million.

This is primarily due to an overall 12% decrease in spending on projects and personnel costs as a result of the relocation to a temporary office, in tandem with a 6% increase in the level of funding for the year. In addition, indirect cost recovery on restricted projects increased from US\$0.45 million to US\$0.68 million. Earned income rose from US\$0.26 million to US\$ 0.49 million for the year.

The 2000 grant income from donors amounted to US\$12.38 million in addition to US\$0.49 million of earned income. Recovery of indirect costs from restricted projects amounted to US\$ 0.68 million.

The 2001 expenditures are estimated at US\$15.85 million compared to actual spending of US\$10.49 million for 2000. Overall income from donors is estimated at US\$16.64 million compared to US\$12.38 million for 2000.

Resource allocation to programs for 2001 is projected to be around 75 % of total available:

Table D: Comparison of 2000 performance and 2001 current estimate

	2000 Actual (US\$ million)	2001 Estimate (US\$ million)
Sources of Funds		
Donor Funding	12.38*	16.64
Earned Income	0.49	0.20
Total	12.87	16.84
Application of Funds		
Programmatic	8.17	13.24
Management and General Expenses	1.90	3.01
Headquarter Site Renovation	1.06	
Depreciation	0.04	0.29
Less: Overhead Recoveries	(0.68)	(0.69)
Net Expenditures	10.49	15.85
Unexpended Balance	2.38	(0.99)

* Targeted project funding which follows the matching principle was not fully spent in 2000.
Actual grant income for the year was substantially higher

The 2000 spending and 2001 current planned resource allocation by CGIAR activity are summarized below:

Table E: Actual and planned resources allocation by CGIAR activity for 2000 and 2001

	US\$ (million)		
	2000 Actual	2001	
		Estimate	%
Increasing Productivity	2.72	3.19	20
Protecting the Environment	4.58	6.04	38
Saving Biodiversity	0.14	0.23	1
Improving Policies	1.42	4.53	29
Strengthening NARS	1.63	1.86	12
Total	10.49	15.85	100

38% of 2001 resources are allocated to protecting the environment, 29% to improving policies, 20% to increasing productivity and 12% to strengthening NARS. These allocations are consistent with ICLARM's long-term strategic direction.

Table F: Allocation of resources by outputs (logframe format) US\$ (million)

	US\$ (million)		
	2000 Actual	2001	
		Estimate	%
Germplasm Improvement	0.99	1.11	7
Germplasm Collection	0.14	0.23	1
Sustainable Production	6.82	8.12	51
Policy	1.42	4.53	29
Enhancing NARS	1.12	1.86	12
Total	10.49	15.85	100

B1.2 Funding Trends

With the continued efforts in fundraising and the harnessing of greater public awareness on the importance of aquatic resources management amongst its community of donors, ICLARM has consistently increased its share of resources within the CGIAR System since 1993. Funding has increased, in nominal terms, from US\$9.6 million in 1996 to US\$16.8 million in 2001 (expected), an increase during the five-year period of over 75%. In real terms (in 2001 US\$ at 4% price change) the increase has been from US\$11.7 million in 1996 to US\$16.8 million in 2001, an increase of approximately 44%.

Table G: Nominal and Real Funding to ICLARM, 1996 – 2001 in US\$ (million)

Funding	1996	1997	1998	1999	2000	2001	% Increase 1996 to 2001
Nominal	9.6	9.0	10.4	12.3	12.9	16.8	75
Real *	11.7	10.5	11.7	13.3	13.4	16.8	44

* 2001\$ at 4% annual inflation

In line with the revised fund raising strategy, sharper research focus, the establishment of the Regional Center for Africa and West Asia as well as the establishment of state of the art headquarters research facilities in Penang, Malaysia; ICLARM expects a reasonably steady growth in funding beyond the year 2002.

B1.3 Inflation and Exchange Rates

ICLARM commenced its first year of operations in Penang, Malaysia in 2000. Actual inflation for the year was around 2% and is forecast to be between 2.7-3.0% in 2001. ICLARM will monitor actual inflation in 2001 and assess its impact on the purchasing power of the budget. The RM (Malaysian Ringgit) is presently fixed at the exchange rate of RM 3.80 to one US\$. If the RM is liberalized its impact on the budget will also be assessed.

Inflation on the US\$ expenditures is expected to be around 2.6-3% for 2001.

B1.4 Depreciation of Fixed Assets

The actual depreciation of existing ICLARM fixed assets for 2000 was only US\$0.04 million as against US\$0.25 million in 1999. Most of the depreciated fixed assets held in the Philippines were disposed of in early 2000 when ICLARM's headquarters transferred to Penang, Malaysia. At the new headquarters in Penang, Malaysia, depreciation for 2001 is projected at US\$0.29 million. Annual depreciation charges are used to finance the Center capital purchases and replacement.

B1.5 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 2000 was US\$1.09 million, financed through the annual depreciation charges. For 2001, the fund is expected to increase by US\$0.29 million, which is equivalent to the budgeted depreciation for year.

B1.6 Capital Investments

The Malaysian Government has made available to ICLARM on a long-term (60 years) nominal lease 5.2 ha of land with buildings on the land. The renovation of these building to international standards is expected to be completed by 30 May 2001. The cost of renovation and setting up the facility is estimated at US\$3.35 million broken down as follows:

	<u>US\$ (M)</u>
Building renovation	2.39
Project Management	0.20
Equipment and furniture	0.39
Other capital needs	0.37
Total	<u>3.35</u>

As at 31 December 2000, renovation costs amounted to US\$1.06 million. Further spending of approximately US\$2.29 million will be incurred in 2001 by the scheduled date of the project completion. Through its fund raising efforts, ICLARM has generated approximately US\$ 3.07 million of the total building renovation. The fund raising drive is still ongoing.

B1.7 Operating Fund

The operating fund increased substantially from the 1999 level of US\$1.74 million, equivalent to 51 days of operation, to US\$4.12 million in 2000, equivalent to 143 days of operations. It should be noted that this is a temporary achievement as a result of the under spending in 2000 due to the relocation of ICLARM headquarters from Manila, Philippines to Penang, Malaysia.

B1.8 Liquidity

The Center's liquidity improved in 2000.

Table H: Liquidity ratio analysis

	1999	2000
Current Ratio (times)	1.21	1.47
Quick Ratio (times)	1.21	1.47
Cash Ratio (%)	72	70
Cash to Current Liabilities (%)	89	103

The Center is continuing its efforts to refine the cash flow by programming operating and capital expenditures to improve overall liquidity and spending patterns.

B2 2002 - 2004 PLANS

B2.1 Funding Requirements and Financing Plans

The 2001 Financing Plan level, approved at MTM-2000, has been used as the basis for developing the plans for 2002 to 2004. The Financing Plan level has been adjusted to reflect the current estimate of ICLARM's operations for 2001.

The expected level of donor funding for 2001 is projected at US\$16.64 million, in addition to earned income and indirect cost recoveries from restricted projects. ICLARM projected operating levels (net of indirect cost recoveries) for 2001 to 2004 are:

Table I: ICLARM Operating Levels

	US\$ (million)			
	2001*	2002	2003	2004
Projected Donor Funding	16.64	16.16	16.74	17.42

* 2001 Operating Level.

A combined growth and inflation rates of 3.25%, 3.50% and 4.00% are incorporated in the plans for the years 2002, 2003 and 2004.

Earned income. On-going initiatives to improve the billing and collection of project funds as well as to identify better investment opportunities are carried out each year. Earned income is projected at a conservative level of US\$0.20 million during the plan period.

Indirect Cost Recovery. Most donors are resistant to meeting real costs (direct and indirect) of the Centers. Indirect cost recovery is a critical component for financing ICLARM's non-research activities and operations that are essential support services to research. The CGIAR Secretariat has initiated a system wide indirect cost study to increase transparency and donor awareness. ICLARM's overhead is expected to be at a level of approximately US\$0.69 million in 2001.

B2.2 Operating Budget 2002-2004

The focus of research activities and allocation of resources were determined by a review of ICLARM projects and activities by program leaders and Center-wide review by management. Similarly to the year 2000, the five programs were allocated around 75 - 80% of total resources consistent with Center and priorities strategy. The allocation of funds to the projects, source of funding, and linkage with the CGIAR research agenda within the newly adopted log frame are reflected in the main budget tables.

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 43% of the resources are allocated to personnel costs (Budget Table 6).

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 (see Budget Table 2).

Allocation of resources by region. Approximately, 58% of resources are allocated to Asia, 30% to Sub-Saharan Africa, 4% to Latin America and the Caribbean and 8% to West Asia and North Africa (see Budget Table 5).

Personnel input: Center - hired Internationally Recruited staff (IRS) level is estimated at around 34 positions including post-doctoral fellows and visiting scientists. Additional positions are planned subject to funding availability in 2001 and beyond (see Budget Table 9).

Regionally Recruited Staff (RRS) level is approximately 17 positions. The RRS largely represents the Philippine senior national staff relocated to the new Penang headquarters in February 2000.

Nationally Recruited Staff (NRS) overall level will reach around 231(all locations) including the staff at the Regional Center for Africa and West Asia (Egypt).

B2.3 Capital Budget

The capital requirements of ICLARM will be approximately US\$3.22 million for the plan period. The requirements are for the renovation of the headquarters facility in Penang, Malaysia and the purchase of laboratory and operating equipment. The requirements are summarized as follows (in US\$ million):

Table J: ICLARM capital requirements 2001 – 2004, US\$ (million)

	2001	2002	2003	2004
Capital Needs	2.29	0.43	0.25	0.25

Capital fund. The capital fund is the only source for financing ICLARM's core capital purchases. The balance in the capital fund as at 31 December 2000 was US\$1.09 million.

B2.4 Financial Ratios

Liquidity. ICLARM's operating fund experienced a temporary increase to US\$4.12 million or 143 days of operations as at 31 December 2000 from the 1999 level of US\$1.74 million, equivalent to 51 days of operation.

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

Table K: Financial ratio analysis 2000 – 2004

	2000	2001	2002	2003	2004
Current ratio-times	1.47	1.73	1.78	1.63	1.82
Quick ratio-times	1.47	1.72	1.78	1.62	1.81
Working capital-%	91	85	85	78	80
Cash/current assets-%	70	66	65	70	70
Operating fund-days	143	90	90	90	90
Working capital-days	170	124	133	109	134

B2.5 Inflation and Exchange Rates

Combined annual weighted inflation in developed countries is projected to be around 2.6-3.0% while local inflation is estimated to fluctuate between 2.7 – 3.0% during the plan period. The Malaysian Ringgit (RM) is fixed at the rate of RM3.80 for one US\$. If the RM is liberalized during the plan period, the impact of the change on the purchasing power of the budget will be assessed.

The US dollar is expected to decline slightly against major currencies, which will have positive impact on non-US dollar denominated contributions.

B2.6 Summary of Financing Plan

The resource requirements over the plan period are based on the 2001 Financing Plan level approved at the MTM-2000 adjusted to reflect the expected operational level for 2001. The adjusted level is increased by an annual inflationary factor of 2.25%, 2.50% and 3.00% for years 2002, 2003 and 2004 respectively. We have also projected that ICLARM will grow in real terms by 1.0% for the years 2002-2004.

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 Program
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
WANA	West Asia and North Africa

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Table 1. ICLARM – 2002 Research Agenda Requirements by CGIAR Output
(Expenditure in US \$ million)

Center Projects	Germplasm Improvement	Germplasm Collection	Sustainable Production	Policy	Enhancing NARS	PROJECT TOTALS
001. Conservation of Aquatic Biodiversity			1.61	0.22	0.32	2.15
002. Genetic Enhancement and Breeding	0.89	0.06			0.17	1.12
003. Improvement of Freshwater Aquaculture			2.79			2.79
004. Fisheries Resources Assessment and Management			1.04			1.04
005. Assessing and Limiting Coral Reef Degradation		0.11	1.92		0.23	2.26
006. Coastal Aquaculture and Stock Enhancement	0.12	0.06	1.03			1.21
007. Economic Monitoring and Evaluation of Developing Country Fisheries				0.61		0.61
008. Legal and Institutional Analysis for Fisheries Management				3.72		3.72
009. Aquatic Resources Research, Planning and Impact Assessment				0.12		0.12
010. Information and Capacity Building for Aquatic Resources Research In Developing Countries	0.13				1.21	1.34
OUTPUT TOTALS	1.14	0.23	8.39	4.67	1.93	16.36

Table 2. ICLARM Research Agenda – Allocation of Resources, 2000-2004
(Expenditure in US \$ million)

Allocation of Resources by Outputs
Logical Framework Format

Outputs:

Germplasm Improvement

(Activity: Germplasm Enhancement & Breeding,
plus Networks as appropriate)

Germplasm Collection

(Activity: Saving Biodiversity,
plus Networks as appropriate)

Sustainable Production

(Activity: Production Systems Dev & Mgmt,
Protecting the Environment, plus Networks as appropriate)

Policy

(Activity: Improving Policies, plus Networks as appropriate)

Enhancing NARS

(Activity: Strengthening NARS - the three sub-activities,
plus Networks as appropriate)

TOTAL

	2000 (actual)	2001 (estimate)	2002 (proposal)	2003 (plan)	2004 (plan)
Germplasm Improvement	0.99	1.11	1.14	1.20	1.23
Germplasm Collection	0.14	0.23	0.23	0.24	0.25
Sustainable Production	6.31	8.12	8.39	8.69	9.04
Policy	1.42	4.53	4.67	4.82	5.03
Enhancing NARS	1.63	1.86	1.93	1.99	2.07
TOTAL	10.49	15.85	16.36	16.94	17.62

Allocation of Resources by CGIAR
Activity

Increasing Productivity

of which:

Germplasm Enhancement & Breeding

Production Systems Development & Management

Protecting the Environment

Saving Biodiversity

Improving Policies

Strengthening NARS

of which:

Training and Professional Development

Documentation, Publications, Info. Dissemination

Organization & Management Counselling

Networks

TOTAL

	2000 (actual)	2001 (estimate)	2002 (proposal)	2003 (plan)	2004 (plan)
Increasing Productivity	2.72	3.19	3.29	3.43	3.54
Germplasm Enhancement & Breeding	0.99	1.11	1.14	1.20	1.23
Production Systems Development & Management	1.73	2.08	2.15	2.23	2.31
Protecting the Environment	4.58	6.04	6.24	6.46	6.73
Saving Biodiversity	0.14	0.23	0.23	0.24	0.25
Improving Policies	1.42	4.53	4.67	4.82	5.03
Strengthening NARS	1.63	1.86	1.93	1.99	2.07
Training and Professional Development	0.64	0.67	0.70	0.72	0.75
Documentation, Publications, Info. Dissemination	0.48	0.59	0.60	0.63	0.65
Organization & Management Counselling					
Networks	0.51	0.60	0.63	0.65	0.67
TOTAL	10.49	15.85	16.36	16.94	17.62

**Table 3. ICLARM Research Agenda Project and Output Cost Summary,
2000-2004
(in US \$ million)**

	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
001. Conservation of Aquatic Biodiversity	1.75	2.08	2.15	2.22	2.31
002. Genetic Enhancement and Breeding	1.00	1.08	1.12	1.16	1.20
003. Improvement of Freshwater Aquaculture	2.56	2.70	2.79	2.89	3.01
004. Fisheries Resources Assessment and Management	1.13	1.01	1.04	1.08	1.12
005. Assessing and Limiting Coral Reef Degradation	0.93	2.19	2.26	2.34	2.43
006. Coastal Aquaculture and Stock Enhancement	0.81	1.17	1.21	1.26	1.31
007. Economic Monitoring and Evaluation of Developing Country Fisheries	0.10	0.59	0.61	0.63	0.66
008. Legal and Institutional Analysis for Fisheries Management	1.14	3.61	3.72	3.85	4.01
009. Aquatic Resources Research Planning and Impact Assessment	0.01	0.12	0.12	0.12	0.13
010. Information and Capacity Building for Aquatic Resources Research In Developing Countries	1.06	1.30	1.34	1.39	1.44
Total	10.49	15.85	16.36	16.94	17.62

Summary by CGIAR Output:

	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
Germplasm Improvement	0.99	1.11	1.14	1.20	1.23
Germplasm Collection	0.14	0.23	0.23	0.24	0.25
Sustainable Production	6.31	8.12	8.39	8.69	9.04
Policy	1.42	4.53	4.67	4.82	5.03
Enhancing NARS	1.63	1.86	1.93	1.99	2.07
Total	10.49	15.85	16.36	16.94	17.62

Institutional Cost Components:

	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
Direct Project Costs	11.17	16.54	17.07	17.67	18.38
Indirect Project Costs (Overhead)	(0.68)	(0.69)	(0.71)	(0.73)	(0.76)
Total Project Costs	10.49	15.85	16.36	16.94	17.62

Table 4. ICLARM Allocation of Project Costs to CGIAR Activities, 2000-2004
(in US \$ million)

Project	Activity	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
001. Conservation of Aquatic Biodiversity	Production Systems	0.35	0.42	0.43	0.44	0.46
	Protecting the Environment	0.79	1.14	1.18	1.22	1.27
	Improving Policies	0.17	0.21	0.22	0.22	0.23
	Strengthening NARS-Training	0.44	0.31	0.32	0.34	0.35
		1.75	2.08	2.15	2.22	2.31
002. Genetic Enhancement and Breeding	Enhancement & Breeding	0.80	0.86	0.89	0.93	0.96
	Saving Biodiversity	0.05	0.06	0.06	0.06	0.06
	Strengthening NARS-Networks	0.15	0.16	0.17	0.17	0.18
	1.00	1.08	1.12	1.16	1.20	
003. Improvement of Freshwater Aquaculture	Production Systems	0.77	0.81	0.84	0.87	0.90
	Protecting the Environment	1.79	1.89	1.95	2.02	2.11
	2.56	2.70	2.79	2.89	3.01	
004. Fisheries Resources Assessment and Management	Production Systems	0.11	0.10	0.10	0.11	0.11
	Protecting the Environment	1.02	0.91	0.94	0.97	1.01
	1.13	1.01	1.04	1.08	1.12	
005. Assessing and Limiting Coral Reef Degradation	Production Systems	0.05	0.11	0.11	0.12	0.12
	Protecting the Environment	0.74	1.75	1.81	1.87	1.95
	Saving Biodiversity	0.05	0.11	0.11	0.12	0.12
	Strengthening NARS-Training	0.09	0.22	0.23	0.23	0.24
	0.93	2.19	2.26	2.34	2.43	
006. Coastal Aquaculture and Stock Enhancement	Enhancement & Breeding	0.08	0.12	0.12	0.13	0.13
	Production Systems	0.45	0.64	0.67	0.69	0.72
	Protecting the Environment	0.24	0.35	0.36	0.38	0.39
	Saving Biodiversity	0.04	0.06	0.06	0.06	0.07
	0.81	1.17	1.21	1.26	1.31	
007. Economic Monitoring and Evaluation of Developing Country Fisheries	Improving Policies	0.10	0.59	0.61	0.63	0.66
008. Legal and Institutional Analysis for Fisheries Management	Improving Policies	1.14	3.61	3.72	3.85	4.01
009. Aquatic Resources Research, Planning and Impact Assessment	Improving Policies	0.01	0.12	0.12	0.12	0.13
010. Information and Capacity Building for Aquatic Resources Research in Developing Countries	Enhancement and Breeding	0.11	0.13	0.13	0.14	0.14
	Strengthening NARS-Information	0.48	0.59	0.60	0.63	0.65
	Strengthening NARS-Training	0.11	0.14	0.15	0.15	0.16
	Strengthening NARS- Networks	0.36	0.44	0.46	0.47	0.49
	1.06	1.30	1.34	1.39	1.44	
Total		10.49	15.85	16.36	16.94	17.62

Summary by Undertaking:	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
Increasing Productivity	2.72	3.19	3.29	3.43	3.54
Protecting the Environment	4.58	6.04	6.24	6.46	6.73
Saving Biodiversity	0.14	0.23	0.23	0.24	0.25
Improving Policies	1.42	4.53	4.67	4.82	5.03
Strengthening NARS	1.63	1.86	1.93	1.99	2.07
Total	10.49	15.85	16.36	16.94	17.62

Summary by Output:	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
Germplasm Improvement	0.99	1.11	1.14	1.20	1.23
Germplasm Collection	0.14	0.23	0.23	0.24	0.25
Sustainable Production	6.31	8.12	8.39	8.69	9.04
Policy	1.42	4.53	4.67	4.82	5.03
Enhancing NARS	1.63	1.86	1.93	1.99	2.07
Total	10.49	15.85	16.36	16.94	17.62

Table 5. ICLARM Research Agenda, 2000-2004
Investment by Sector, Commodity and Region
(in US \$ million)

PRODUCTION SECTORS & COMMODITIES	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
1/ <u>Germplasm Improvement</u>					
Crops					
Commodity A					
Commodity B					
Commodity C					
Commodity D					
Livestock					
Trees					
Fish	0.99	1.11	1.14	1.20	1.23
TOTAL	0.99	1.11	1.14	1.20	1.23
2/ <u>Sustainable Production</u>					
Crops					
Commodity A					
Commodity B					
Commodity C					
Commodity D					
Livestock					
Trees					
Fish	6.31	8.12	8.39	8.69	9.04
TOTAL	6.31	8.12	8.39	8.69	9.04
3/ <u>Total Research Agenda</u>					
Crops					
Commodity A					
Commodity B					
Commodity C					
Commodity D					
Livestock					
Trees					
Fish	10.49	15.85	16.36	16.94	17.62
TOTAL	10.49	15.85	16.36	16.94	17.62
REGION	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
Sub-Saharan Africa (SSA)	3.15	4.76	4.91	5.08	5.29
Asia	6.08	9.19	9.49	9.83	10.22
Latin American and the Caribbean (LAC)	0.42	0.63	0.65	0.68	0.70
West Asia and North Africa (WANA)	0.84	1.28	1.31	1.35	1.41
TOTAL	10.49	15.85	16.36	16.93	17.62

Table 6. ICLARM Research Agenda, 2000-2004
Expenditure by Object of Expenditures, Capital Investments and Capital Fund
(in US\$ million)

OBJECT OF EXPENDITURE	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
Personnel	4.55	6.43	6.82	7.16	7.52
Supplies and Services	5.04	8.03	8.11	8.26	8.53
Operational Travel	0.86	1.10	1.12	1.14	1.17
Depreciation	0.04	0.29	0.31	0.38	0.40
TOTAL	10.49	15.85	16.36	16.94	17.62
CAPITAL INVESTMENTS	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
<i>Physical Facilities</i>					
Research					
Training					
Administration					
Housing					
Auxiliary Units					
sub-total	1.06	1.90			
<i>Infrastructure & Leasehold</i>					
<i>Furnishing & Equipment</i>					
Farming					
Laboratory & Scientific					
Office					
Housing					
Auxiliary Units					
Computers					
Vehicles					
Aircraft					
sub-total		0.39	0.43	0.25	0.25
TOTAL	1.06	2.29			
CAPITAL FUND CASH RECONCILIATION*	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
<i>Balance, January 1</i>	3.65	2.92	0.92	0.80	0.93
plus: annual depreciation charge	0.04	0.29	0.31	0.38	0.40
plus / minus: disposal gains/(losses)**					
plus / minus: other	0.29				
minus: asset acquisition costs	(1.06)	(2.29)	(0.43)	(0.25)	(0.25)
equals: Balance, December 31	2.92	0.92	0.80	0.93	1.08

* Capital investment due to relocation to Malaysia have not been included in this presentation

** Net of depreciation

Table 7. ICLARM Research Agenda Financing Summary, 2000-2004
(in US \$ million)

Member	2000 (actual)		2001 (est)	
	(US\$)	(national currency)	(US\$)	(national currency)
Unrestricted Contributions				
Arab Republic of Egypt	0.35	US\$0.35	0.35	US\$0.35
Australia	0.23	A\$0.40	0.22	A\$0.40
Belgium	0.07	BEF3.00	0.07	BEF3.00
Canada	0.23	C\$ 0.34	0.22	C\$0.34
Center for Tropical Agriculture (CTA)	0.06	US\$0.06		
China	0.01	US\$0.01	0.01	US\$0.01
Denmark	0.60	DKR 5.00	0.62	DKR5.00
European Union			0.79	EURO0.85
BMZ, Germany	0.29	DM 0.60	0.19	DM0.40
India	0.04	US\$ 0.04	0.04	US\$0.04
Japan	0.87	YEN100.00	0.86	YEN100.0
Netherlands	0.86	NGL 2.00	0.84	NGL2.00
Norway	0.23	NOK 2.00	0.23	NKR2.00
Philippines	0.03	PHP1.63	0.03	PHP1.63
Sweden	0.22	SKr 2.00	0.23	SKR2.20
Thailand	0.01	US\$ 0.01	0.01	US\$0.01
United States Agency for International Development	0.65	US\$ 0.65	0.65	US\$0.65
World Bank	2.26	US\$ 2.26	1.78	US\$1.78
subtotal	7.01		7.14	
Targeted Contributions				
	(US\$)	(national currency)	(US\$)	(national currency)
Asian Development Bank	0.53		0.75	
Australia	0.01		0.70	
Belgium			0.26	
California Academy of Sciences	0.01		0.13	
Canada	0.02		0.03	
CGIAR				
DANIDA	0.03			
DfID	0.50		2.53	
European Union	0.79		0.19	
FAO	0.03			
Ford Foundation	0.06			
Germany BMZ/GTZ	0.32		0.61	
IDRC	0.02		0.05	
IFAD	0.08		0.24	
IFPRI				
Japan	0.28			
McArthur Foundation	0.09		0.34	
New Zealand ODA	0.13			
Netherlands			0.23	
Norway	0.11		0.15	
Oxfam	0.02		0.08	
Rockefeller Brothers			0.03	
Sweden	0.41		0.93	
SW-PRGA			0.02	
TAC Special Fund	0.10		0.08	
UNEP			0.38	
UNFIP	0.46		0.25	
UNDP/TCDC	0.03		0.26	
USAID	1.23		1.11	
Others	0.11		0.15	
World Bank				
subtotal	5.37		9.50	
TOTAL CONTRIBUTIONS		12.38	16.64	
Summary Statement of Activity				
Investor Grants	12.38		16.64	
+ Center Income (other revenues)	0.49		0.20	
= Total Revenues	12.87		16.84	
Less:				
Total Expenses	10.49		15.85	
Surplus (Deficit) of total revenues over total expenses	2.38		0.99	

**Table 8a. ICLARM Allocation of Member Financing to Projects
by Output for the Year 2000
(in US \$ million)**

	Project	Member	Total
001.	Conservation of Aquatic Biodiversity	EU	0.79
		TAC	0.10
		GTZ	0.27
		CAS	0.01
		Unrestricted+center inc.	0.58
	Total Project	1.75	
002.	Genetic Enhancement and Breeding	ADB	0.22
		DFID	0.01
		FAO	0.02
		Japan	0.12
		UNDP	0.03
		Unrestricted+center inc.	0.60
	Total Project	1.00	
003.	Improvement of Freshwater Aquaculture	USAID	1.23
		FAO	0.01
		IFAD	0.08
		DANIDA	0.01
		DFID	0.04
		Japan	0.09
		GTZ	0.05
		Unrestricted+center inc.	1.05
	Total Project	2.56	
004.	Fisheries Resources Assessment and Management	ADB	0.31
		DFID	0.38
		Japan	0.01
		Others	0.03
		Unrestricted+center inc.	0.40
	Total Project	1.13	
005.	Assessing and Limiting Coral Reef Degradation	UNFIP	0.46
		SIDA	0.09
		McArthur Foundation	0.09
		Others	0.01
		Unrestricted+center inc.	0.28
	Total Project	0.93	
006.	Coastal Aquaculture and Stock Enhancement	ACIAR	0.01
		CIDA	0.02
		NZODA	0.13
		Unrestricted+center inc.	0.65
	Total Project	0.81	
007.	Economic Monitoring and Evaluation of Developing Country Fisheries	OXFAM	0.02
		Ford Foundation	0.03
		Others	0.01
		Unrestricted+center inc.	0.04
	Total Project	0.10	
008.	Legal and Institutional Analysis for Fisheries Management	SIDA	0.32
		DFID	0.07
		DANIDA	0.02
		Others	0.06
		Unrestricted+center inc.	0.67
	Total Project	1.14	
009.	Aquatic Resources Research Planning and Impact Assessment	Unrestricted+center inc.	0.01
		Total Project	0.01
010.	Information and Capacity Building for Aquatic Resources Research In Developing Countries	Norway	0.11
		IDRC	0.02
		Japan	0.06
		Ford Foundation	0.03
		Unrestricted+center inc.	0.84
	Total Project	1.06	

Center Totals

	Total
Total Targeted Funding	5.37
Total Unrestricted Funding	5.12
Total Center Income	
Total Allocations	10.49

**Table 8b. ICLARM Allocation of Member Financing to Projects
by Output for the Year 2001
(in US \$ million)**

Project	Member	Total
001. Conservation of Aquatic Biodiversity	EU	0.19
	GTZ/BMZ	0.51
	TAC	0.08
	CAS	0.13
	Netherlands	0.23
	Belgium	0.26
	Others	0.01
	Unrestricted+center inc.	0.67
	Total Project	2.08
002. Genetic Enhancement and Breeding	ADB	0.11
	DFID	0.03
	UNDP/TCDC	0.26
	Malaysia	0.04
	Unrestricted+center inc.	0.64
	Total Project	1.08
003. Improvement of Freshwater Aquaculture	USAID	1.11
	GTZ/BMZ	0.10
	IFAD	0.10
	DFID	0.30
	Unrestricted+center inc.	1.09
	Total Project	2.70
004. Fisheries Resources Assessment and Management	DFID	0.39
	ADB	0.30
	Others	0.03
	Unrestricted+center inc.	0.29
	Total Project	1.01
005. Assessing and Limiting Coral Reef Degradation	Peckard	0.10
	McArthur Foundation	0.34
	SIDA	0.29
	UNFIP	0.25
	UNEP	0.38
	Rockefeller Brothers	0.03
	Unrestricted+center inc.	0.80
	Total Project	2.19
006. Coastal Aquaculture and Stock Enhancement	ACIAR	0.16
	AUSAID	0.45
	Unrestricted+center inc.	0.56
	Total Project	1.17
007. Economic Monitoring and Evaluation of Developing Country Fisheries	ADB	0.31
	OXFAM	0.08
	CCLF	0.03
	IDRC	0.05
	Unrestricted+center inc.	0.12
	Total Project	0.59
008. Legal and Institutional Analysis for Fisheries Management	SIDA	0.64
	DFID	1.81
	IFAD	0.14
	Unrestricted+center inc.	1.02
	Total Project	3.61
009. Aquatic Resources Research Planning and Impact Assessment	ACIAR	0.07
	Others	0.02
	Unrestricted+center inc.	0.03
	Total Project	0.12
010. Information and Capacity Building for Aquatic Resources Research In Developing Countries	AUSAID	0.02
	NORAD	0.15
	Unrestricted+center inc.	1.13
	Total Project	1.30

Center Totals

	Total
Total Targeted Funding	9.50
Total Unrestricted Funding	6.35
Total Center Income	
Total Allocations	15.85

Table 9. ICLARM Research Agenda Staff Composition, 2000-2004
(in US \$ million)

	2000 (actual)		2001 (est)		2002 (proposal)		2003 (plan)		2004 (plan)	
	Hired by:		Hired by:		Hired by:		Hired by:		Hired by:	
	center	other	center	other	center	other	center	other	center	other
<u>Internationally-Recruited Staff (IRS)</u>										
Research and Research Support	26	1	28		29		29		30	
<i>of which:</i>										
<i>Post-doctoral Fellows</i>										
<i>Associate Professionals</i>										
Training / Communications	1		1		1		1		1	
<i>of which:</i>										
<i>Post-doctoral Fellows</i>										
<i>Associate Professionals</i>										
Research Management	5		5		6		6		6	
<i>of which:</i>										
<i>Post-doctoral Fellows</i>										
<i>Associate Professionals</i>										
Total IRS	32		34		36		36		37	
<u>Regionally-Recruited Staff (RRS)</u>										
Research and Research Support	12		13		14		14		14	
<i>of which:</i>										
<i>Post-doctoral Fellows</i>										
<i>Associate Professionals</i>										
Training / Communications	1		1		1		1		1	
<i>of which:</i>										
<i>Post-doctoral Fellows</i>										
<i>Associate Professionals</i>										
Research Management	3		3		3		3		3	
<i>of which:</i>										
<i>Post-doctoral Fellows</i>										
<i>Associate Professionals</i>										
Total RRS	16		17		18		18		18	
Support Staff	200		231		233		233		235	
TOTAL STAFF	248	1	282		287		287		290	

**Table 10. ICLARM – Financial Position: Statement of Case Flows,
2000 and 2001
(in US \$ million)**

2000	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Opening Cash Balance	8,213	9,768	9,524	9,288	8,478	8,060	8,165	8,383	7,974	7,647	7,417	7,825
Receipts												
Grants:												
Unrestricted	1,858	431	216	115	206	395	1,097	246		102	393	1,255
Restricted		30	304	30	157	301	63		633	725	1,157	87
Earned Income	60	55	54	55	40	35	38	35	25	26	32	40
Disbursements												
Operations	338	730	770	965	781	581	940	640	940	753	799	747
Capital Acquisition										300	350	406
Other	25	30	40	45	40	45	40	50	45	30	25	40
Ending Cash Balance	9,768	9,524	9,288	8,478	8,060	8,165	8,383	7,974	7,647	7,417	7,825	8,014

2001	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Opening Cash Balance	8,014	8,934	8,083	7,450	5,816	4,887	5,297	5,361	4,857	5,370	6,395	7,690
Receipts												
Grants:												
Unrestricted	1,826	487	244	210	233	447	1,241	310	276	176	471	1,219
Restricted	175	79	630	80	416	797	167	112	1,576	1,908	1,937	850
Earned Income	20	15	15	15	10	15	10	15	15	20	25	25
Disbursements												
Operations	471	1,017	1,072	1,344	1,088	809	1,309	891	1,309	1,049	1,113	1,200
Capital Acquisition	600	380	410	550	460							
Other	30	35	40	45	40	40	45	50	45	30	25	40
Ending Cash Balance	8,934	8,083	7,450	5,816	4,887	5,297	5,361	4,857	5,370	6,395	7,690	8,544

CURRENCY STRUCTURE OF EXPENDITURES

Currency	2000 (actual)			2001 (estimate)			2002 (proposal)		
	Amount	\$ value	% share	Amount	\$ value	% share	Amount	\$ value	% share
US Dollar		7.29	70%		9.50	60%		9.10	55%
Malaysian Ringgit		2.10	20%		4.75	30%		5.66	35%
Others		1.10	10%		1.60	10%		1.60	10%
TOTAL		10.49	100%		15.85	100%		16.36	100%

Table 11. ICLARM Statement Financial Position, 2000-2004
(in US \$ '000)

	2000 (actual)	2001 (est)	2002 (proposal)	2003 (plan)	2004 (plan)
<u>Assets</u>					
<u>Current Assets</u>					
Cash & Cash Equivalents	8,014	8,544	8,825	9,230	10,130
Accounts Receivable					
Donors	3,075	2,725	2,875	2,800	3,175
Employees	261	110	115	120	130
Other	1,171	875	850	875	830
Inventories	4	35	50	50	50
Prepaid Expenses	15	80	90	100	110
Other Current Assets*	2,775	500	800		
Total Current Assets	15,315	12,869	13,605	13,175	14,425
<u>Fixed Assets</u>					
Property, Plant, & Equipment					
Less: Accumulated Depreciation					
Total Fixed Assets - Net	510	930	1,050	1,410	1,600
Total Assets	15,825	13,799	14,655	14,585	16,025
<u>Liabilities and Net Assets</u>					
<u>Current Liabilities</u>					
Bank Indebtedness					
Accounts Payable					
Donors	5,789	2,800	2,730	2,470	2,100
Employees	89	80	85	90	100
Others	968	150	160	150	170
Advances from Donors	0	0	0	0	0
In-Trust Accounts	1,350	1,300	1,400	1,600	1,700
Accruals and Provisions	2,221	3,112	3,250	3,780	3,860
Total Current Liabilities	10,417	7,442	7,625	8,090	7,930
<u>Long-Term Liabilities</u>					
Total Liabilities	10,417	7,442	7,625	8,090	7,930
<u>Net Assets</u>					
Capital Invested in Fixed Assets					
Center Owned					
In Custody					
Capital Fund					
Operating Fund					
Other Funds					
Total Net Assets	5,408	6,357	7,030	6,495	8,095
Total Liabilities & Net Assets	15,825	13,799	14,655	14,585	16,025

* Based on the revised CGIAR Accounting Manual 1999

ANNEX 1. ICLARM's PROJECT PORTFOLIO

ICLARM Project No. 1

Title: Conservation of Aquatic Biodiversity

Objectives [≡ logframe purpose]:

There are two objectives for this project:

1. NARS, management agencies and NGOs use tools and methods (in part, developed by ICLARM) to understand, conserve and sustainably use aquatic biological diversity.

Conservation and sustainable use of aquatic biota require robust methods and accurate, up to date, globally accessible information at the molecular genetic, population, species and ecosystem levels. Along with partners in IARCs, NARS and ARIs, staff will develop laboratory and field methods to characterize and evaluate genetic diversity within and among aquatic species. Relational databases for all finfish species will be established through partnerships for use by researchers, teachers and planners and will be linked to ecosystem modeling functions. The Project will focus on the development of countermeasures to threats of aquatic diversity and to adverse genetic influences from human activity.

2. National fishery agencies implement policies and regulations to conserve and restore aquatic genetic and species diversity.

The conceptual framework and training materials needed by NARS scientists and national resource managers to manage aquatic genetic and species diversity sustainably are not widely available. Regional training courses on the application of information from FishBase will be provided in workshops organized for NARS through five regional centers in Africa, the Caribbean and the Pacific (ACP).

Outputs (Results) [≡ logframe indicator at output level]:

1. Extended use of FishBase on web and greater availability of FishBase on CD ROM
2. Use of LarvalBase in species identification and aquaculture
3. Linkages of FishBase with other databases and further development of functional link to Ecopath
4. Scientists and managers in at least ten ACP countries trained in the use of FishBase by 2004
5. Use of FishBase in species diversity and fisheries assessments in ten ACP countries by 2004
6. Use of interactive modules in FishBase to analyse status of aquatic biodiversity and fisheries by 2002
7. Definition of genetic population structure of important aquaculture species completed:
completed for silver barb; 2001;
completed for black-chinned tilapia; 2002;
completed for white sea bass; 2004;
common carp complex in China; 2005;
8. Study of genetic population structure of a key species of fish associated with mangroves; 2005.

9. Use of ICLARM research results and recommendations in formulation of national conservation plans in developing Asian and ACP countries.
10. Use of ICLARM recommendations on designs and operations of aquatic protected areas
11. Use of ICLARM research results and recommendations in formulating plans for sustainable use of aquatic species in Asian and ACP countries
12. Use of ICLARM recommendations on translocations of non-native species.
13. Decision-making tool is available for national and local fishery agencies to show consequences of various actions on fish species and production within the Mekong River Basin; (2001) and probability model relating interaction between fish populations and fish harvest refined; (2003)
14. Decision-making tools for two additional river basins in SE Asia; (2005)

Gains (Impacts) [≡ logframe outputs]:

1. Global biological database (FishBase) is further expanded, refined, maintained and disseminated on the world-wide web and through CD ROM
2. NARS and fisheries management agencies in ACP countries are supported in use of databases and strategies to develop and implement national management plans for conservation and sustainable use
3. Assessments of genetic diversity are conducted for key species in selected regions
4. Management recommendations for restoration and conservation of aquatic biodiversity
5. Management recommendations are developed on how to integrate restoration, and conservation of biodiversity and sustainable use of aquatic species

Duration and Milestones:

Duration: The milestones cover 5 years of a continuing program

YEAR	MILESTONES
2000	<ul style="list-style-type: none"> ❖ Consolidated five fully functional regional nodes serving the ACP developing countries and substantial progress towards national fish biodiversity databases, established by project trainees and available on the Internet, for most of the 55 ACP countries participating in the project. ❖ FishBase strengthened by addition of specific tables and aquaculture species profiles. ❖ Species coverage of FishBase increased to 25,000 species. ❖ All of FishBase available on the Internet. ❖ Definition of the dynamics of flood plains habitats demonstrated for the lower Mekong River Basin to provide a baseline for fish production and biodiversity management in the region.
2001	<ul style="list-style-type: none"> ❖ Develop a 'web wizard' to facilitate identification of fishes for FishBase. ❖ Develop a 'web wizard' to facilitate analysis of length-frequency data for FishBase. ❖ Implement routines to estimate trophic levels for FishBase. ❖ Collaboration programs established with NARs and fisheries agencies on fishery management and biodiversity conservation. ❖ ACP collaborators provided with enhanced communication systems, information access, and management training workshops conducted. ❖ Coverage of LarvalBase increased to 1,000 species; LarvalBase becomes an

	<p>integral part of FishBase for use in fisheries and aquacultural research.</p> <ul style="list-style-type: none"> ❖ Provide information to LarvalBase on cultivation of fish larvae on 25 species. ❖ Semi-quantitative model of Mekong River discharge and fish production in the Great Lake of Cambodia. ❖ Convene a workshop to identify key research issues on relationship between mangrove ecology and coastal fishery production for developing management strategies. ❖ Convene international workshop on biodiversity, conservation and sustainable use of black-chinned tilapia in Ghana. ❖ Complete laboratory analysis of remaining samples of silver barb. ❖ Submission of manuscripts on assessment of genetic population structure of silver barb for publication. ❖ Complete review of available information of genetic population structures of coastal marine species in S.E. Asia.
2002	<ul style="list-style-type: none"> ❖ Expand links of FishBase with Ecopath, and ecosystem-oriented analytical routines. ❖ Update species listings in FishBase with Eschmeyer fish species database in particular. ❖ Compilation of final report integrating the results of biochemical genetic studies, aquaculture trials and secondary data on the status of the genetic resources of <i>S. melanotheron</i>. Conservation and management recommendations and related training materials published. ❖ Initiation of project to evaluate the genetic impacts of the introduction of improved species for aquaculture in the collaborating countries of INGA. ❖ Provide training courses on use of LarvalBase for collaborators in developing countries. ❖ Analysis of historical and current fish abundance datasets to identify shifts and declines in species diversity in 2 selected developing country regions. ❖ Complete examination of samples of tilapias from West Africa. ❖ Complete gathering of information on biology, ecology and exploitation of black-chinned tilapia. ❖ Develop and test antisera as tool for identifying species. ❖ Complete review of available information and write white paper on effects of non-native species.
2003	<ul style="list-style-type: none"> ❖ Consolidation of the structures and linkages necessary to sustain FishBase and its further evolution and services to developing countries. ❖ Techniques and results of fish and larval mapping in the Mekong Basin area published and contributed to wetlands management plans.
2004	<ul style="list-style-type: none"> ❖ Continue monthly web updates and distribute FishBase 2000 CD-ROMS widely, especially in developing countries.

Costs:

2001 2.08 million
2002 2.15 million
2003 2.22 million
2004 2.31 million

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.

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.

Collaborators:

World Conservation Union (IUCN); FAO; museums and centers of taxonomic expertise worldwide [for example; the British Museum (Natural History), London; the Musée National d'Histoire Naturel, Paris; the Musée Royale de l'Afrique Centrale, Tervuren, the University of Kiel, Germany]; all IARCs participating in the SGRP, 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.

Regional organizations, networks and NARS in the ACP countries, the Mekong River Commission and riparian NARS in the Mekong River region, IUCN, FAO, IWMI and other IARCs participating in the SGRP, especially IPGRI and museums and other centers of taxonomic expertise which contribute to the FishBase Consortium.

System Linkages:

System-wide Genetic Resources Program and its information project, SINGER. IWMI, through inter-center collaborative project in the Mekong River region.

Financing Plan:

EU through strengthening Biodiversity and Fisheries Management in ACP countries, Phase I & II and EU through earmarked core fund. Government of Belgium. Government of Malaysia IRPA funds. GTZ/BMZ, regional donors to the Mekong basin, CGIAR through SGRP, USAID. ICLARM core.

ICLARM Project No. 2

Title: Genetic Enhancement and Breeding

Objectives [≡ logframe purpose]:

1. National breeding programs maintain and continuously improve strains for distribution to farmers.
2. National breeding programs take measures to ensure genetic diversity of aquaculture species.

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.

Outputs (Results) [≡ logframe indicator at output level]:

1. Carp genetics improvement book published in 2001.
2. Identification of key carp species and strains for genetic improvement in Asia; (2000).
3. Carp genetics resources book published in 2001.
4. At least 15 scientists from African countries are trained in fundamental and practical concepts of selective breeding of tilapias (by end of 2001).
5. Five National breeding plans for tilapias are developed for Asian and African countries (by end of 2001).
6. Six National breeding plans for carps are developed for Asian countries; (by end of 2002).
7. Innovative approaches for selective breeding and recording economically important traits (esp. disease resistance) tested within National breeding programs; (2003).
8. Scientists from six Asian countries are trained in fundamental and practical concepts of selective breeding of carps; (2003).
9. Three genetically improved strains of tilapias (*O. niloticus* and *O. shiranus*) with faster growth, delayed sexual maturation, better feed utilization, improved disease resistance and cold tolerance are available to National breeding programs; (2004).
10. Selective breeding technology is developed for three additional species and available to National breeding programs; (by 2004).
11. Crossbreeding and YY-male technology are evaluated as additional methodologies for genetic enhancement and the results published; (by end 2004).

Gains (Impacts) [≡ logframe outputs]:

1. Improved strains of fish available for National breeding programs
2. Methods for genetic improvements are further developed, adopted and disseminated
3. Capacity of National breeding programs is increased

The provision of better breeding materials to world's major carp and tilapia farming countries and methods for their safe and productive deployment (including appropriate hatchery management), is expected to provide a more stable increase in fish productivity and consequently improved income of small-scale enterprises. The gains will be measured with socioeconomic and environmental surveys in collaboration with developing countries.

Duration and Milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none"> ❖ Prioritization and selection of carp species, choice of farming system and selection of traits for research carried out. ❖ A comprehensive special report on SocioEconomics of Tilapia Cultures in Asia published.
2001	<ul style="list-style-type: none"> ❖ Documentation of carps genetic resources in Asia published. ❖ Documentation of genetic improvement of carps in Asia published. ❖ 80 families of the 6th generation GIFT tilapia to FRI, Malaysia imported. ❖ A base population of 70 families of <i>O. niloticus</i> with breeders from 4 localities in Egypt established. ❖ A base population of <i>O. shiranus</i> created with breeders from 4 localities in Malaŵi. ❖ National breeding plans completed for tilapias for Egypt, Côte d'Ivoire, Ghana, Malaŵi and Malaysia. ❖ Practical training course in selection methodologies and quantitative genetics conducted for African scientists in the Philippines. ❖ Workshop on statistical analysis of data from breeding programs at ICLARM Egypt for African scientists. ❖ Complete review of methods available for genetic improvement of aquatic organisms for publication.
2002	<ul style="list-style-type: none"> ❖ Initiate breeding studies at Abbassa to develop improved strains of tilapias with low- and high-input diets ❖ Two generations of combined family and individual selection of <i>O. shiranus</i> conducted for increased growth and reduced frequency of early maturing females. ❖ Review literature on existing methods to record fertility traits, disease resistance, cold tolerance and feed utilization in <i>O. niloticus</i> for publication. ❖ The genetic diversity for growth and disease resistance in existing populations of <i>C. carpio</i> and <i>B. gonionotus</i> evaluated in six Asian countries. ❖ F₁ crossbred clones of <i>O. niloticus</i> tested as genetic controls to measure genetic gain. ❖ Combined family and individual selection of <i>O. shiranus</i>, <i>C. carpio</i> and <i>B. gonionotus</i> for several traits initiated. ❖ National breeding plans developed for carps in Bangladesh, China, India, Indonesia, Thailand and Vietnam.

	<ul style="list-style-type: none"> ❖ Two training courses on transfer of GIFT selective breeding technology to carps conducted.
2003	<ul style="list-style-type: none"> ❖ Quantitative methods applied to the improvement of indigenous fish species in at least two African countries. ❖ Diallele cross of four genetically enhanced strains of <i>O. niloticus</i> completed to measure hybrid vigor. ❖ YY-males of GIFT strain developed to produce all-male population. ❖ Outline effective strategies developed to record responses of <i>O. niloticus</i> to disease and cold challenges. ❖ Methods for recording feed intake of <i>O. niloticus</i> in hapas developed and published.
2004	<ul style="list-style-type: none"> ❖ Third generation of combined family and individual selection of <i>O. niloticus</i> completed to increase growth in different environments in Malaysia. ❖ Record correlated responses in fertility, frequency of early sexual maturation, feed utilization and disease resistance of <i>O. niloticus</i> at FRI, Malaysia. ❖ Conduct 3 generations of combined family and individual selection to increase growth and cold tolerance of <i>O. niloticus</i> in Egypt.

Costs:

2001 1.08 million
 2002 1.12 million
 2003 1.16 million
 2004 1.20 million

Users:

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

Collaborators:

NARS: specifically Bangladesh, China, India, Indonesia, Philippines, Thailand, Vietnam, Egypt, Ghana, Côte d'Ivoire, Malaŵi and other INGA centres.

ARI: Norwegian Institute of Aquaculture Research (AKVAFORSK), the Universities of Swansea, Stirling and Wageningen, and other European and US institutes concerned with germplasm enhancement and genetic marker development for fish species.

New partnerships to be developed initially in Africa and West Asia through the INGA network (See project 10).

System Linkages:

None specifically, but ICLARM's work in genetic enhancement is also reported to the SGRP and intellectual property issues in aquaculture discussed with the Central Advisory Service.

Financing Plan:

DFID, UNDP TCDC, Asian Development Bank collaborative project funds from the University of Wageningen, USAID through Auburn University. Potentially Government of Norway, IDRC through INGA network. ICLARM core funds.

ICLARM Project No. 3

Title: Improvement of Freshwater Aquaculture

Objectives [≡ logframe purpose]:

1. Small scale farmers in Africa and Asia practice IAA on a sustained basis
2. NARS and national extension institutions promote IAA as an element of their general dissemination strategy

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. Work in Bangladesh seeks to raise the efficiency of aquaculture and contribute to human nutrition and small enterprise development.

The potential number of smallholder farmers who could benefit is considered to be very large, but remains underexploited. The target group in Africa is the large number of smallholder farmers who presently are not performing any form of IAA but would benefit from additional contributions to food security and resource preservation.

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

Outputs (Results) [≡ logframe indicator at output level]:

- 1.1 Annually 100 – 150 NGO extension staff in Bangladesh are qualified in the field of IAA through initial and refresher training courses
- 1.2 Annually 30 DoF extension staff in Malawi (including staff from Zambia) and 5 in Cameroon are qualified through intensive formal training (2 week courses) and joint field work of extensionists and researchers (at least twice per year)
- 2.1 Annually at least 6000 farmers in Bangladesh receive initial training (one day), financial and logistical support as well as regular advice to improve their IAA systems and establish at least 6000 on-farm demonstrations
- 2.2 Annually at least 150 farmers in Malawi and 100 in Cameroon receive on-farm advice and logistical support to start IAA
- 3.1 A comprehensive manual for introduction and gradual expansion of locally adapted IAA systems in Africa and Asia (targeted for non-specialist audience and covering preconditions, principles as well as approaches) is available for distribution by end 2004
- 3.2 Comprehensive analysis of potential and actual impacts (especially on nutrition, income, social structure) of IAA systems within different farming systems is available by end 2005
- 4.1 A web-based ex ante assessment tool for identification of high potential areas for aquaculture development on a national level (maps and impact estimates) is available by 2004

5.1 By 2005 management models are identified for at least 2 rural locations in one SSA country which provide significant benefits to the community (income, fish consumption), are environmentally sustainable, socially acceptable and within the management capacities of the community.

Gains (Impacts) [≡ logframe outputs]:

1. Capacity of NARS / NARES to plan for and promote IAA increased
2. Extension message regarding IAA communicated to farmers in program pilot areas
3. Principles and recommendations for management of IAA developed and tested under station and farm conditions (i.e. technology bottlenecks identified, productivity enhancements through appropriate technology improvements achieved and demonstrated through on-station and on-farm research)
4. Decision making procedures for targeting areas and types of IAA are operational
5. Models for community based management of small water bodies to exploit their fisheries potential are developed and tested

Duration and Milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none"> ❖ Started a new project on developing a tool for estimating potential impact scenarios and necessary support for inland aquatic resources management in Bangladesh. ❖ Started a project in Malawi to train research and extension staff, including partners from Zambia, in new approaches for dissemination and appropriate and successful IAA technologies, with a focus towards improvement of the nutritional conditions of targeted households. ❖ Started a new research project in collaboration with IITA-HFS in Cameroon, into the opportunities for IAA introduction into the continuum of different farming systems ranging from peri-urban to forest-margin situations.
2001	<ul style="list-style-type: none"> ❖ Released research tool package: (1.) Field Operations Guide, and (2.) Software Manual for RESTORE ver. 1.0, for farmer-participatory design and impact assessment of the integration of new enterprises (such as aquaculture) into farming systems. ❖ Training course on RESTORE conducted for 12 NARS participants (scientists, extensionists and decision makers, including NGOs) in Bangladesh and Malawi. ❖ Technical Report on IAA integration into farming systems in an upland forest buffer zone in the Philippines published. ❖ Definition of socio-economic variables governing successful adoption of IAA in selected sites in Africa and Asia
2002	<ul style="list-style-type: none"> ❖ Publication of Technical Report on deepwater rice-fish research project, including recommendations for productivity enhancement and equitable management of flood prone ecosystems in Bangladesh and Vietnam. ❖ Publication of recommendations for improved IAA systems designed for different farming systems in Bangladesh. ❖ Start of research project on improvement of recommendation domains for introduction of IAA practices. ❖ Reviews on two inland aquatic resource systems conducted, outlining

	<p>potential for development and defining scope of required research, with particular focus on African inland waters.</p> <ul style="list-style-type: none"> ❖ Database designed, required data identified, analysis routines defined for tool for estimating potential impact scenarios and necessary support for inland aquatic resources management in Bangladesh. ❖ Recommendations formulated for inland aquaculture in areas of lowered salinity and acid-sulphate soils (Vietnam)
2003	<ul style="list-style-type: none"> ❖ Workshop held and recommendations for implementation formulated, on productivity enhancement and equitable management of flood prone ecosystems in Asia, Africa and Latin America, based on conclusions from the project conducted in Bangladesh and Vietnam. ❖ Historic data analysed of development of aquaculture sector and its subsectors in selected countries with "success stories" in Asia, and characterisation of potential threshold countries in Asia and Africa. Results will lead into work on formulation of recommendation domains for IAA introduction in Asia and Africa. ❖ Start of project in African country on productivity enhancement and equitable management of flood prone ecosystems.
2004	<ul style="list-style-type: none"> ❖ A comprehensive manual for introduction and gradual expansion of locally adapted IAA systems in Africa and Asia (targeted for non-specialist audience and covering preconditions, principles as well as approaches) available for distribution. ❖ A web-based <i>ex-ante</i> assessment tool for identification of high potential areas for aquaculture development on a national level (maps and impact estimates) available.

Costs:

2001	2.70 million
2002	2.79 million
2003	2.89 million
2004	3.01 million

Users:

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

Collaborators:

IARCS: IRRI (for Bangladesh/Vietnam projects), IITA (for Cameroon) and IFPRI, IRRI, WARDA, AVRDC, (largely through utilization and extension of RESTORE)
NARS: Including institutes in Bangladesh, Philippines, Vietnam, Malawi, Cameroon and Zambia and others to be selected in 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 2001 design plan for Africa

System Linkages:

Links to regional activities of IITA and WARDA in West Africa contributed to participatory research of the CGIAR. Work with IRRI in Vietnam augments rice and livelihood research in areas protected from saline intrusions.

Financing Plan:

USAID bilateral funds for Bangladesh; DFID of the UK; DANIDA, Rockefeller Foundation, USAID, GTZ/BMZ, ICLARM core.

ICLARM Project No. 4

Title: Fisheries Resources Assessment and Management

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 found in catches from 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.

The objectives of this project are to address the problem of managing multispecies tropical fisheries through: 1) development of ecosystem modeling software and resource information systems for collecting and analysing data, and 2) assessment of the potential for using marine protected areas (MPAs) to replenish fisheries in surrounding areas. The software and information systems are being applied mainly to trawl fisheries, whereas the use of MPAs is being assessed initially for fisheries associated with coral reefs. However, these various tools and interventions may be appropriate for both types of fisheries.

Outputs (Results):

Analytical tools, models, cost-effective data acquisition systems and databases for fisheries ecosystems, and assessments of marine protected areas (fishery reserves), for management of tropical multispecies fisheries for the benefit of fishing communities and fish consumers in developing countries.

Gains (Impacts):

Effective fisheries management systems in developing countries leading to sustained or increased fish production and stable food supplies, employment, export earnings and the conservation of aquatic biodiversity. The benefits of the project will be proportional to the importance of fish and fish production in regional economies and diets.

Duration and Milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none">❖ Release of Ecopath (ecosystem modeling tool) version 4.0 incorporating the dynamic simulation module, EcoSim.❖ National workshop to analyze demersal fisheries and socioeconomic data in the partner countries of the TrawlBase project.❖ Dissemination of improved software, including a biomass estimation analysis module for collecting and analyzing demersal trawl survey data.❖ Ecotrophic data, in the form of fish and invertebrate counts and length

	<p>frequencies, from Caribbean protected areas for construction of an Ecopath model of a coral reef ecosystem.</p> <ul style="list-style-type: none"> ❖ Extension of the reserve at Discovery Bay, Jamaica, based on robust estimates of variation in fish biomass. ❖ Development of a model for post-settlement mortality of yellowtail snapper in the Caribbean as a guide to the optimum time for release of cultured juveniles in protected areas. ❖ Completion of three years monitoring of the Marine Conservation Area (MCA) at the Arnavon Islands, Solomon Islands.
2001	<ul style="list-style-type: none"> ❖ The initial version of Fisheries Resource Information System and Tools (FiRST) software completed and released. ❖ Strategic planning workshop for fisheries resource management for Asia held in Penang, Malaysia. ❖ National/regional development strategies and action plans developed for improved management of coastal fisheries resources in selected Asian countries. ❖ TrawlBase project technical reports and workshop proceedings published. ❖ Database on resources in support of coastal fisheries management and across-site comparison of selected sites in the Philippines completed and made available to partners. ❖ Local capacity in resource assessment methods and database use developed in at least one southeast Asian country (Philippines). ❖ Documentation of management implications of assessment work in Palawan, Philippines. ❖ Feasibility of using rectangular escape gaps as a management tool in Caribbean trap fisheries assessed and reported. ❖ Rates of recruitment of fish into heavily fished and well-protected areas in the Caribbean compared and published. ❖ The effects of the MCA protected area in Solomon Islands on abundances of tropical invertebrates determined and published.
2002	<ul style="list-style-type: none"> ❖ Project on simple measures for fisheries management in data-poor fisheries initiated. ❖ Upgraded FiRST database (version 2002) released. ❖ Project initiated on across-site analyses of resource assessments (Philippines). ❖ Management program for Discovery Bay, Jamaica implemented including development of alternative fisheries offshore and stock enhancement of depleted snappers. ❖ Monitoring of invertebrate populations completed 5 and 6 years after declaration of the MCA in Solomon Islands, with emphasis on assessing the time needed for recovery of sea cucumbers.
2003	<ul style="list-style-type: none"> ❖ Minimum parameter methods for fisheries estimation and management tested for feasibility in two Asian countries. ❖ Establishment of long-term assessment/monitoring site for coastal fisheries in Malaysia. ❖ Documentation on the results of across-site analyses of fishery resources data in Philippines. ❖ Alternative livelihood opportunities identified in the marine sector for

	communities dependent on MPAs in the Caribbean.
2004	<ul style="list-style-type: none"> ❖ Completion of Phase II development of FiRST with expanded data coverage and analytic modules. ❖ Joint analysis of data in FiRST (version 2004) completed with partners. ❖ Regional/national workshops to assess management implications of analyses results using FiRST (version 2004). ❖ Management implications of across-site work (Philippines) completed with partners. ❖ Stock enhancement assessed as an option to accelerate recovery of stocks in MPAs.

Costs:

2001	1.01 million
2002	1.04 million
2003	1.08 million
2004	1.12 million

Users:

Fisheries managers will benefit from training in the use of analytical methods, improved understanding of the status of stocks and the potential use of protected areas to sustain multispecies fisheries. They will also have improved ability to communicate the problems facing management, and the range of potential solutions, to fishing communities and politicians. Ultimately, the principal users will be the fishers who should benefit from more stable and improved incomes, and consumers who will have better assurance of adequate fish supplies.

Collaborators:

1. North Sea Centre, Denmark
2. Fisheries Centre, University of British Columbia
3. FAO
4. New partners to be identified in Africa & West Asia Program having similar resource assessment requirements.
5. Centre for Marine Sciences, University of the West Indies
6. Conservation and Fisheries Department of the Ministry of Natural Resources and Labour, British Virgin Islands
7. CARICOM Fishery Resources Assessment and Management Project, Belize
8. Department of Forests, Environment and Conservation, Solomon Islands
9. Department of Agriculture and Fisheries, Solomon Islands
10. The Nature Conservancy

System Linkages:

None

Financing Plan:

Asian Development Bank, DFID, FRMP Philippines, DANIDA, ICLARM core funds.

Objectives

Coral reefs are vital to the well being of many of the more than 500 million people that live within 100km of a reef. In order to ensure that these diverse and productive ecosystems are able to sustainably support the people that depend on them, it is vital that coral reefs are used in an ecologically sustainable manner and that reliable data are available on how use and extraction affects a reef's condition and productivity.

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.

The specific objectives of this project are to: 1) develop and maintain a global information system on coral reef resources, use and management (ReefBase) from which recommendations on policies for conservation, sustainable use and restoration of coral reefs can be made; 2) examine the interdependencies between reefs systems in order to highlight the trans-boundary aspects of effective coral reef conservation and management; 3) strengthen the capacity of local coastal zone managers to implement effective and efficient policies and management practices; 4) work with other regional and international agencies to develop a coordinated global program to reverse the decline of the world's coral reefs; and 5) examine the relationships between ecological sustainability and population pressures, and the role of marine protected areas in achieving sustainability.

Outputs (Results)

1. ReefBase – a web-based database designed to provide managers of coral reefs with information on the status and threats that they need to achieve sustainable use and conservation of these ecosystems. ReefBase includes GCRMN and Reef Check data, as well as summary and analysis, images and interactive mapping facilities and is updated continuously.
2. Regional analysis of genetic relatedness for fish and invertebrates, and likely larval transport, amongst 18 reefs of 6 SEA countries.
3. Regular contributions from ReefBase to GCRMN, Reef Check and Reefs at Risk, including summary data and interpretation of spatial/temporal patterns of coral reef health and fisheries production from coral reefs.
4. Policies on sustainable use and conservation of coral reefs for consideration by national and international management committees.
5. Cost-effective methods for bio-physical and socio-economic assessment of coral reefs, accompanied by measures of the value and sustainability of these ecosystems.
6. Standardized methods for assessing and reporting coral bleaching and subsequent mortality of coral over large spatial scales.
7. Analysis of the effectiveness of marine protected areas in ensuring sustainable use of a regions coral reef resources.

Gains (Impacts)

1. Increased productivity from restored coral reefs, leading to improved livelihoods for coastal communities.
2. Maintenance of biodiversity
3. Resource managers (from local government units) trained in sustainable coastal management and equipped with the ability to make recommendations for reversing degradation of coral reefs and managing these habitats for sustainable use.

Duration and Milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none"> ❖ Results on genetic linkages among reefs published and a new project addressing transboundary management mechanisms formulated. ❖ ReefBase 4.0 released. ❖ A set of coral reef valuation tables, produced in collaboration with ICLARM's policy program designed, verified by experts and operational within ReefBase. ❖ Publication of a paper on indicators for natural resource management of coral reefs. ❖ Formation and funding of an International Coral Reef Action Network (ICRAN) with key international partners to assist coastal communities to restore coral reefs.
2001	<ul style="list-style-type: none"> ❖ The global ICRAN network operational with projects among seven international agencies. ❖ ReefBase released on the Web with GIS capabilities. ❖ South East Asian Regional network of coastal zone managers operational and involved in coastal zone training activities in three countries of Asia (Indonesia, Philippines, Vietnam). ❖ A reef linkage network established among active research institutions to enhance the investigation of "source" vs "sink" reefs globally. ❖ The Southeast Asian Reefs at Risk Analysis in collaboration with the World Resources Institute (WRI) published and available on ReefBase. ❖ A review of sustainable development and migration issues as they apply to the coastal zone completed.
2002	<ul style="list-style-type: none"> ❖ ReefBase updated with new GCRMN & ReefCheck data and linked to all major sources of information on coral reefs. ❖ Reefs at Risk analyses published for the Caribbean region in collaboration with WRI and available on ReefBase. ❖ Training Needs Assessment completed for coastal managers in Indonesia and Vietnam. ❖ Development of indicators for the effectiveness of coral reef marine protected areas in Malaysia or in Philippines. ❖ Quantitative data available on genetic linkages among coral reef available for 18 reefs in six countries in SE Asia.
2003	<ul style="list-style-type: none"> ❖ ReefBase updated with GCRMN and ReefCheck data. ❖ Reefs at Risk analyses published for Indian Ocean with WRI and available on ReefBase.

	❖ Training Manuals developed for coastal managers in Indonesia and Vietnam.
2004	<ul style="list-style-type: none"> ❖ ReefBase updated with GCRMN and ReefCheck data. ❖ Reefs at Risk analyses published for Pacific Ocean with WRI and available on ReefBase. ❖ META database of coral reef information for Pacific Ocean included in ReefBase as part of ICRAN program. ❖ Coral Reef Valuation and Policy analysis completed for Regional Seas areas participating in ICRAN.

Costs:

2001	2.19 million
2002	2.26 million
2003	2.34 million
2004	2.43 million

Users:

1. People dependent on coral reefs for food and livelihood now and in the future.
2. Coral reef coastal zone, and other complex ecosystem, managers and researchers.
3. Global policy makers and the general public in need of information on coral reefs.
4. Coastal dwellers and local community leaders.
5. Coastal zone managers, policy makers and development workers.
6. Researchers and academic institutions.

Collaborators:

NARS in Indonesia, Malaysia, Philippines, Republic of China, Solomon Islands, and Vietnam
 Coastal development, policy makers and management agencies in Indonesia and Vietnam
 Philippine Department of Agriculture, national academic and administrative institutions, local government units and management councils in the Philippines (e.g. UP Marine Science Institute; Silliman University); Subic Bay Management Authority
 World Conservation Monitoring Centre
 World Resources Institute
 Australian Institute of Marine Science
 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
 Local Government Units and management councils

System Linkages:

None

Financing Plan:

ICLARM core funds, MacArthur Foundation, Packard Foundation, ICRAN (UNF plus other contributing fund donors over time), the Netherlands, Sweden.

ICLARM Project No. 6

Title: Coastal Aquaculture and Stock Enhancement

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 many 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. 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 objective 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.

Outputs (Results):

1. Methods to reduce the cost of "seed" giant clams produced in hatcheries.
2. Techniques for restocking giant clams.
3. Identified sources of wild spat (seed) of blacklip pearl oysters.
4. Improved methods for collecting pearl oyster spat.
5. Robust estimates of growth and survival of giant clams and pearl oysters at village farms.
6. Market information (prices, demand) for farmed giant clams and black pearls from the Western Pacific.
7. Establishment of demonstration farms for pearl oysters.
8. Methods for spawning sea cucumbers, rearing their larvae and releasing the juveniles with high rates of survival.
9. Data on the abundances of wild caught juvenile reef fish, and methods for grow-out, relevant to the development of artisanal and enhanced fisheries.
10. Methods for rearing and releasing trochus for restocking reefs.

Gains (Impacts):

1. 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, sea cucumbers and trochus will benefit growers in remote areas, however, sale of giant clams and coral reef fish to the aquarium trade will only be possible for villagers close to adequate transport links.
2. Improved knowledge of the value of coral reef habitats leading to greater care of the ecosystem and increased productivity from wild stocks.

Duration and Milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none"> ❖ Improved methods for collection and grow-out of pearl oyster spat published. ❖ Transfer of technology for catching and growing pearl oyster spat transferred to Fiji and Tonga. ❖ Hatchery methods for mass propagation of sea cucumbers. ❖ Hatchery methods for sea cucumbers extended to Vietnam. ❖ Assessment of survival of cultured juvenile sea cucumbers during preliminary releases into coral reef and mangrove-seagrass habitats carried out. ❖ The most appropriate methods for catching postlarval coral reef fish for subsequent grow-out identified.
2001	<ul style="list-style-type: none"> ❖ Village farming methods for giant clams transferred to Tonga. ❖ Methods for the combined culture of trochus and giant clams, and release of culture trochus published. ❖ Fisheries staff from the Western Pacific (PNG) trained in collection and grow-out of pearl oyster spat. ❖ The second crop of pearls from the demonstration farm in Solomon Islands marketed. ❖ Juvenile sea cucumbers produced in New Caledonia and Vietnam for large-scale restocking experiments. ❖ 12 months data on the capture and culture of postlarval reef fish published. ❖ Restocking protocols developed for trochus that have accumulated in marine protected areas to reefs under customary marine tenure. ❖ Methods for the capture and culture of coral reef fish transferred to PNG. ❖ Review of the stock enhancement of invertebrate fisheries worldwide completed.
2002	<ul style="list-style-type: none"> ❖ Regional staff trained in the Pacific in the hatchery production of pearl oyster spat. ❖ The third crop of pearls from Solomon Islands evaluated and the demonstration farm handed over to the Government. ❖ Completion of preliminary field experiments to optimise release strategies for cultured juvenile sea cucumbers in New Caledonia, Vietnam and Indonesia. ❖ Data on availability of postlarval reef fish and their suitabilities for rearing for the aquarium trade published. ❖ Methods necessary to manage restocked and enhanced fisheries assessed and published.
2003	<ul style="list-style-type: none"> ❖ Information on growth and survival of pearl oysters derived from wild and hatchery-

	<p>reared spat collected and published.</p> <ul style="list-style-type: none"> ❖ Completion of large-scale experiments to identify optimal strategies for releasing cultured sea cucumbers in New Caledonia and initiation of such experiments in Indonesia. ❖ Identification of the coral reef fish species suitable for the creation of artisanal aquaculture ventures to supply the marine aquarium trade. ❖ Implementation of a strategy for the development of coastal aquaculture in the Pacific.
2004	<ul style="list-style-type: none"> ❖ Trials of cultured wild postlarval coral reef fish for export to the marine aquarium trade assessed. ❖ Pilot-scale mass-release of cultured sea cucumbers assessed using the optimal release strategy for stock enhancement. ❖ Workshop held for the Asia-Pacific region in methods for rearing and releasing sea cucumbers for restocking programs.

Costs:

2001	1.17 million
2002	1.21 million
2003	1.26 million
2004	1.31 million

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 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 restored and enhanced fisheries. 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. Local companies (e.g., exporters) and 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.

Collaborators:

Ministry of Agriculture and Fisheries, Solomon Islands
Ministry of Fisheries, Tonga
National Fisheries Authority, Papua New Guinea
Overseas Fishery Cooperation Foundation (Japan)
Secretariat of the Pacific Community
James Cook University, Australia
AIMS, Australia
The Nature Conservancy

System Linkages:

None

Financing Plan:

There are some uncertainties in the attribution of funding during the time of transition and the need to establish work in other sites in the Pacific. ACIAR, NZODA, AusAID, ICLARM core funds, in kind contributions from the Governments of the Solomon Islands and territories of New Caledonia.

ICLARM Project No. 7

Title: Economic and Social Analysis and Valuation of Aquatic Resources in Developing Countries

Objectives [≡ logframe purpose]:

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.

Outputs (Results) [≡ logframe indicator at output level]:

Methods and models will be developed to (a) provide an economic value of goods and services from coastal resources; and (b) address the relationships between natural ecosystems and economic systems as an integral part of the policy and management process

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

Gains (Impacts) [≡ logframe outputs]:

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

Duration and Milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none">❖ Economic assessment of coral reefs in selected areas.❖ Integration of economic values of coral reefs in ReefBase.❖ A database that includes biophysical and socioeconomic information on world fisheries with special reference to developing countries established.❖ Identify variables needed to assess and monitor trends in demand for and supply of fish and seafood products in relation to food security, employment, income, consumption, trade, resource management and sustainable production in the developing countries of Asia.❖ The IFPRI-ICLARM-FAO joint proposal on the integration of fish in the World Food Model finalized.❖ Plans for conducting an Asian regional study on assessment and monitoring of demand, supply, consumption and trade finalized.❖ Methodology established and parameters identified to integrate fish into the World Food Model.❖ Training and workshop to determine values and relevance of aquatic resources in the Mekong River and to create community and institutional capacities for improving the management through community inputs and

	interventions undertaken.
2001	<ul style="list-style-type: none"> ❖ Policy analysis and economic assessment of selected coral reef resources in the Philippines and other Southeast Asian countries completed. ❖ Socioeconomic information that will aid in developing strategies and action plans for sustainable utilization of coastal fish stocks in Asia provided. ❖ Demand and supply study with national, regional and international partners in Asia implemented. ❖ Variables needed to assess and monitor trends in demand for and supply of fish and seafood products in relation to food security, employment, income, consumption, trade, resource management and sustainable production in the developing countries of Africa identified. (This will look at fish only in Africa while IFPRI-ICLARM Model considers all fish supply globally.) ❖ The values and relevance of aquatic resources to households in selected areas of the Mekong River Basin determined, and community and institutional capacities for improving the management through community inputs and interventions created. ❖ Technical assistance to Can Tho University and Pakse Southern Agricultural College in the design and establishment of community assessment, management and monitoring of local aquatic resources provided, including application of participatory research and gender analysis tools ❖ Socioeconomic indicators for monitoring the impacts of fish conservation and management of aquatic resources developed. ❖ In collaboration with IFPRI and FAO, the integration of fish in the World Food Model undertaken, and Fish to 2020 report published ❖ Tools/variables for the integration of the fisheries sector more fully into policy discussions about food demand, production, and trade at the global, regional and sub-regional levels identified.
2002	<ul style="list-style-type: none"> ❖ Trends in demand for and supply of fish and seafood products in relation to food security, employment, income, consumption, trade, resource management and sustainable production in the developing countries of Asia assessed and monitored. ❖ Critical indicators of livelihood for communities with varying degrees of dependence on aquatic resources in the Mekong river basin identified. ❖ Economic values of wetland in the Mekong river basin resources identified. ❖ Monitoring program for assessing impacts of conservation and management of aquatic resources established, and data collected and analyzed. ❖ Spatial and temporal benefits accruing to different stakeholders and resource users in the fishing and farming communities of the Mekong Delta assessed. ❖ The constraints and opportunities to the growth of milkfish industry in the Philippines, Indonesia and Taiwan identified with emphasis on the adoption and technological development.
2003	<ul style="list-style-type: none"> ❖ Economic values of wetlands and their resources in the Mekong River Region described and published. ❖ Results of the study on supply and demand for seafood and aquatic produce reported, starting with Asia. ❖ Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poorer households in Asia recommended. ❖ Trends in demand for and supply of fish and seafood products in relation to food security, employment, income, consumption, trade, resource

	<p>management and sustainable production in the developing countries of Africa assessed and monitored.</p> <ul style="list-style-type: none"> ❖ The variables needed to assess and monitor trends in demand for and supply of fish and seafood products in relation to food security, employment, income, consumption, trade, resource management and sustainable production in the developing countries of Latin America identified. ❖ Policy briefs and policy recommendations for technology adoption and optimal resource allocation in the milkfish industry in the Philippines and Indonesia published, and report prepared. <p><i>Note: The focus in assessing the supply-demand project will first be in Asia (2001-2003) then Africa (2002-2004) and finally LAC (2003-2005).</i></p>
2004	<ul style="list-style-type: none"> ❖ Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poorer households in Africa recommended. ❖ Trends in demand for and supply of fish and seafood products in relation to food security, employment, income, consumption, trade, resource management and sustainable production in the developing countries of Latin America assessed and monitored.

Costs:

2001	0.59 million
2002	0.61 million
2003	0.63 million
2004	0.66 million

Users:

Policymakers, government agency managers, NARS, NGOs, regional bodies

Collaborators:

FAO, IFPRI, INFOFISH, NARS, ASIs in Asia, Africa and Latin America

System Linkages:

Links to IFPRI's World Food Model 'IMPACT', PRGA-CIAT

Financing Plan:

This project will be funded through the following sources: ICLARM unrestricted core fund, ADB, Swedish Sida, Oxfam, IFAD, IDRC and others to be identified

ICLARM Project No. 8

Title: Legal and Institutional Analysis for Fisheries Management

Objectives [≡ logframe purpose]:

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.

Outputs (Results) [≡ logframe indicator at output level]:

Reports and recommendations on sustainable, equitable, efficient and responsible institutional arrangements for sustainable governance of coastal resources

Gains (Impacts) [≡ logframe outputs]:

1. Improved coastal resource management policies and systems;
2. More participatory coastal resources management
3. Improved quality of life for fishers
4. Strengthening of NARS

Duration and Milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none">❖ Collaboration with national agencies in Asia (Philippines, Indonesia, Thailand, Malaysia, Bangladesh, Cambodia, Vietnam and Lao PDR) and Africa (Malaŵi, South Africa, Zambia, Zimbabwe and Mozambique) to work on the legal, institutional and policy analyses and the evaluation of specific set of hypotheses about co-management established.❖ Research framework on fisheries co-management reviewed and case studies revisited to determine long-term process.❖ Methodologies for testing hypotheses on scale, legitimacy, resiliency, transaction costs and compliance in co-management of coastal resources developed.❖ Workshops in Asia and Africa for NARs partners on the research framework conducted, and methodologies developed for their implementation.❖ Legal, policy and institutional analysis of fisheries and coastal zone management expanded to at least one African country.❖ Collaboration with Newcastle University, Portsmouth University and HTS (DFID NRSP manager) for institutional capacity building on community-based fisheries management in Bangladesh established.❖ A comprehensive agenda for socioeconomic and policy research on coastal wetlands management issues in Southeast Asia formulated.❖ Priorities for socioeconomic and policy research on coastal wetlands in South and Southeast Asia determined through workshops and consultations with NARS.❖ Methodologies for analyzing the legal and institutional framework for wetlands management in the Mekong River Basin developed.

	<ul style="list-style-type: none"> ❖ Country-specific logframes with objectively verifiable indicators formulated, and means of verification for legal analysis of wetlands management developed. ❖ National plans and programs for legal and institutional analysis of wetlands governance in the Mekong Basin countries reviewed through national workshops.
2001	<ul style="list-style-type: none"> ❖ Proceedings of Asian and African Workshops on results from co-management case studies published, and pilot testing of optimal co-management arrangements in countries in South East Asia started. ❖ Workshops to disseminate research results to policymakers and other researchers for the co-management project at the national level conducted. ❖ Country specific research on issues of scale, legitimacy, resiliency, transaction costs and compliance using research framework and methodology developed in 2000 undertaken. ❖ Workshops on Interdisciplinary Multivariate Analysis for adaptive co-management in Africa and Asia conducted. ❖ Indicators and outcome functions for adaptive co-management developed. ❖ Available information on wetland resources, production levels and potentials in selected areas in the Mekong River region collected and synthesized. ❖ Available information in the Mekong River region collected, and structures related to legal and institutional aspects of wetlands and wetland resources utilization analyzed. ❖ Training on legal and institutional analysis and economic valuation of wetland resources conducted in the Mekong River region. ❖ Information materials to foster debate and promote policy changes on CBFM disseminated. ❖ Workshop on consensus building methods for common property management in Bangladesh held ❖ Develop partnerships with NGOs and government agencies for CBFM in Bangladesh ❖ Policy process analysis for fisheries in Bangladesh ❖ Develop training program for partners on CBFM for Bangladesh. ❖ Workshop on CBFM (inception and review) in Bangladesh. ❖ Develop indicators for CBFM livelihood and sustainability indicators for Bangladesh with links to similar sets of indicators for general co-management. ❖ Initiate pilot activities for CBFM and monitoring programs in about 60 sites in Bangladesh.
2002	<ul style="list-style-type: none"> ❖ Evaluation of pilot co-management arrangements completed ❖ Policy guidelines for co-management developed. ❖ Policy actions for global and regional co-management arrangements recommended. ❖ Collaborative work in Asia and Africa continued. ❖ National workshops to disseminate research information to policymakers and other researchers conducted. ❖ Research on legal and institutional analysis and economic valuation of wetland resources undertaken in the Mekong River region.

	<ul style="list-style-type: none"> ❖ Local and national awareness on wetlands, wetland resources and wetland uses strengthened in the Mekong River region. ❖ Develop/initiate networks for NGOs, community organisations, etc for fisheries management, policy issues and gender issues in Bangladesh. ❖ Focused research on fishery management and policy issues in Bangladesh through partners
2003	<ul style="list-style-type: none"> ❖ International workshop to disseminate research results from co-management projects in Asia and Africa conducted. ❖ Guidelines for policymakers on implementing co-management arrangements developed and published. ❖ Awareness generated and understanding of wetland management issues at the local, provincial, national and regional levels enhanced as shown by the active participation in workshops in each of the riparian countries in the Mekong River region. ❖ Capacity of riparian countries in the Mekong River region to promote sustainable wetland and aquatic resources management improved. ❖ Linkages and networks on wetland management between institutions at national and regional levels in the Mekong River region improved. ❖ Economic values of wetlands and wetland resources in the Mekong River region identified and described. ❖ Capacity of relevant agencies to involve communities in sustainable use of wetland resources in the Mekong River region strengthened. ❖ Capacity to integrate local management systems into institutional regulatory and planning processes improved and strengthened in the Mekong River region. ❖ Institutional and legal frameworks for wetlands and aquatic resources management in the Mekong River region improved. ❖ Research on legal and institutional analysis and economic valuation of wetland resources in the Mekong River Region together with NARS in the riparian countries completed. ❖ With active participation of experts from the countries in the Lower Mekong Basin, a national wetland plan or program which incorporates local management systems that is integrated across all sectors developed for each of the these countries. ❖ National workshop on CBFM and wetlands in Bangladesh ❖ Mid-term review of CBFM in Bangladesh ❖ Assessment of livelihood options and future income opportunities for next generation of fishing communities in Bangladesh.
2004	<ul style="list-style-type: none"> ❖ Research results from the co-management project discussed during the international workshop disseminated in Asia and Africa. ❖ Publication of the guidelines for policymakers on implementing co-management arrangements. ❖ Project review of CBFM in Bangladesh conducted. ❖ Livelihood options and future income opportunities for next generation of fishing communities in Bangladesh assessed and implemented.

Costs:

2001	3.61 million
2002	3.72 million
2003	3.85 million
2004	4.01 million

Users:

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

Collaborators:

NARS and NGOs in Bangladesh, Benin, Cambodia, Côte d'Ivoire, Indonesia, Lao PDR, Malaysia, Malaŵi, Mozambique, Philippines, South Africa, Thailand, Vietnam, Zambia, Zimbabwe

ARIs in Canada, Caribbean, Denmark and US

System Linkages:

System-wide project on common property and collective action research (CAPRI), IFPRI

Financing Plan:

This project will be funded through the following sources: ICLARM unrestricted core fund, DFID, DANIDA, Sida, IFAD and others to be identified.

ICLARM Project No. 9

Title: **Aquatic Resources Research, Planning and Impact Assessment**

Objectives [≡ logframe purpose]:

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.

Outputs (Results) [≡ logframe indicator at output level]:

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.

Gains (Impacts) [≡ logframe outputs]:

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.

Duration and Milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none">❖ The impact of research and technology development for giant clam mariculture in the Indo-Pacific region assessed.❖ Workshop of CGIAR's INRM group on methods for addressing indicators and scale consideration in NR systems hosted.❖ A national workshop in Bangladesh to provide recommendations on appropriate fishery extension systems for transfer of technology based on evaluation of existing alternative extension approaches conducted (held May 2000).❖ A set of recommendations that will include a comprehensive framework and guidelines on principles and strategies towards assessment of impact of aquatic resources research published.❖ Parameters to assess the beneficiaries from LARM research in developing countries completed.❖ Local workshop with farmers on assessment and improvement of farming systems that include aquaculture in Bangladesh conducted (held March 2000).
2001	<ul style="list-style-type: none">❖ <i>Ex-ante</i> assessment of carp genetic/breeding research completed.
2002	<ul style="list-style-type: none">❖ The impact of research and technology development for giant clam mariculture in the Indo-Pacific region assessed.❖ A set of recommendations that includes a comprehensive framework and guidelines on principles and strategies towards assessment of impact of aquatic resources research provided.
2003	<ul style="list-style-type: none">❖ Methods for impact assessment of improved carp species designed and implemented.❖ Methodologies for integrated natural resource management tested in Bangladesh, Cameroon and Malawi.

2004	<ul style="list-style-type: none"> ❖ Impact of improved carp species assessed in Asia. ❖ Methodologies for integrated natural resource management tested in Bangladesh, Cameroon and Malawi.
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Costs:

2001	0.12 million
2002	0.12 million
2003	0.12 million
2004	0.13 million

Users:

ICLARM scientific staff, Board and management, donors and NARS

Collaborators:

ISNAR, ASIs and ICLARM research programs
 SEAFDEC Aquaculture Department, Philippines
 NARS in South and Southeast Asia and the Pacific

System Linkages:

INRM group

Financing Plan:

This project will be funded through the following sources: ICLARM unrestricted core fund, IFAD and others to be identified.

ICLARM Project No. 10

Title: Information and Capacity Building for Aquatic Resources Research in Developing Countries
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Objectives:

1. To provide continually improving access to scientific information, through publications in various media, translations and sharing of resources and training.
2. This will increase public awareness of global living aquatic resources issues and of ICLARM's role in resolving them. 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 latest available materials and methods and to provide guidance to senior NARS managers in priority setting; and

3. 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); continuation of information network: the Network of Tropical Aquaculture and Fisheries Professionals (NTAFP); provide assistance to NARS in research planning and prioritization for aquatic resource management.

Outputs (Results):

1. NARS scientists include ICLARM and relevant aquatic research results into their own research agenda/development activities.
2. Policy makers translate ICLARM recommendations into national policies.
3. Donors continue to support and fund aquatic research of ICLARM.
4. Enhanced knowledge and research capabilities of NARS scientists from international cooperation developed through research and 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.

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.

Gains (Impacts):

1. ICLARM and NARS scientists and stakeholders have improved access to research results on aquatic resources.
2. ICLARM research results published and dissemination facilitated.

3. Raised awareness of fisheries and aquatic resources issues to inform policy and public debate.
4. Human resources development in networking and collaborating countries.
5. Increased production of aquatic organisms through improved breeds and farming systems developed.
6. Conservation and improved management of aquatic resources.
7. Food security for small farmers/fishers through increased incomes and nutrition.
8. Better informed NARS scientists and managers and thus improved aquatic resources management.

Duration and milestones:

YEAR	MILESTONES
2000	<ul style="list-style-type: none"> ❖ Library, publication and information services serving ICLARM staff and stakeholders established in temporary office in Malaysia. ❖ Electronic publishing of ICLARM's work commenced. ❖ External review of ICLARM's Information and Communication Services completed. ❖ New mailing list database constructed and made available on intranet. ❖ Strengthening/developing research partnerships with national/regional and international institutions /organizations continued. ❖ Data from survey of partners analyzed and action plans for improving partnerships initiated. ❖ Proceedings of first meeting of GoFAR published. ❖ Assistance provided in capacity building of NARS scientists. ❖ INGA member countries assisted with implementation of national breeding programs. ❖ INGA member countries assisted in transfer of germplasm complying with material transfer agreements.
2001	<ul style="list-style-type: none"> ❖ ICLARM's home page redesigned by 1/2001 and updated quarterly. ❖ Input to ASFA completed quarterly and available on the Internet ❖ Mailing and distribution outsourced by 7/2001. Mailing list updated every 7 days. ❖ On-line, up-to-date catalogues for library holdings and publications, and on-line full text new ICLARM publications by 12/2001 ❖ Develop ICLARM web search engine by 12/2001 ❖ Gateways to annotated hyperlinks to aquatic research information resources initiated by 12/2001 ❖ Review agreements with fisheries and aquatic libraries and institutions by 12/2001 ❖ Data on use of Information Services collected, analyzed and reported monthly and actions to continually improve services taken ❖ ICLARM generic publications and an average of 20 research publications published in print and electronic formats and disseminated within schedule ❖ By 12/2001 no contributor to <i>Naga</i> will have waited more than six months to be advised of the acceptance or rejection of their manuscripts ❖ Four strategies for media coverage tested by 12/2001. Two backgrounder stories for Future Harvest developed in 2001.

	<ul style="list-style-type: none"> ❖ INGA Steering Committee Meeting held and strategies for genetic enhancement and dissemination of genetically improved strains discussed; ❖ GoFAR meeting held and expert consultation on research prioritization organized for Asia-Pacific NARS in collaboration with ISNAR. ❖ Meeting held with Indian NARS and areas for research collaboration identified. ❖ INGA webpage made available on the internet. ❖ Germplasm exchange among member countries of INGA facilitated/coordinated using standardized MTAs. ❖ ICLARMs partner database updated and made available on intranet.
2002	<ul style="list-style-type: none"> ❖ Automated library system operational by 12/2002 ❖ Participate in ICLARM Virtual Library starting 2002 ❖ By 12/2002 all contributors to <i>Naga</i> will be advised of the acceptance or rejection of their manuscripts within six months ❖ Regular coverage of ICLARM in Malaysian media developing. Two backgrounder stories for Future Harvest developed in 2002. ❖ Technical backstopping provided in implementation of national breeding programs in member countries of INGA. ❖ Partnerships with NARS, ASIs, IARCs further strengthened and new partnerships identified. ❖ Germplasm exchange among member countries facilitated /coordinated by use of standardized MTAs. ❖ Training unit established by 12/2002.
2003	<ul style="list-style-type: none"> ❖ By 12/2003 all contributors to <i>Naga</i> will be advised of the acceptance or rejection of their manuscripts within five months ❖ Regular coverage of ICLARM in Malaysian media developed. Two backgrounder stories for Future Harvest developed in 2003. ❖ Technical backstopping provided in implementation of national breeding programs in member countries of INGA. ❖ INGA Steering Committee Meeting organized. ❖ Partnerships with NARS, ASIs, IARCs further strengthened and new partnerships identified. ❖ Exchange of improved strains of carps among member countries facilitated /coordinated by use of standardized MTAs. ❖ GoFAR meeting held and regional priorities in research and related activities identified and new collaborations established.
2004	<ul style="list-style-type: none"> ❖ By 12/2004 all contributors to <i>Naga</i> will be advised of the acceptance or rejection of their manuscripts within four months ❖ Regular coverage of ICLARM in Malaysian media developed. Two backgrounder stories for Future Harvest developed in 2004. ❖ Technical backstopping provided in implementation of national breeding programs in member countries of INGA. ❖ Partnerships with NARS, ASIs, IARCs further strengthened and new partnerships identified. ❖ Germplasm exchange among member countries facilitated /coordinated by use of standardized MTAs.

Costs:

2001	1.30 million
2002	1.34 million
2003	1.39 million
2004	1.44 million

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.

Collaborators:

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

ASIs may also provide trainers, materials, methods and participants.

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.

System Linkages:

PARC and other information exchanges within the CGIAR. INGA outputs reported through projects 1 and 2 and the SGRP.

Financing Plan:

ICLARM core funds are the major source of support for ICLARM's information, publication and partner services. Norway and IDRC have supported the INGA network. Workshop and training funds have been supported by a series of small grants, including ACIAR support for the GoFAR subgroup under APAARI.

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