Medium-Term Plan
2003 - 2005

formerly known as "ICLARM - The World Fish Center"

Our Commitment:
to contribute to food security and poverty eradication in developing countries.

A Way to Achieve This:
through research, partnership, capacity building and policy support, we promote sustainable development and use of living aquatic resources based on environmentally sound management.

We believe this work will be most successful when undertaken in partnership with governments and nongovernment institutions and with the participation of the users of the research results.

WorldFish Center
Medium-Term Plan 2003-2005

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CGIAR
FUTURE HARVEST

WorldFish 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.

CONTENTS

EXECUTIVE SUMMARY

This rolling Medium Term Plan (MTP) for 2003-2005 presents WorldFish Center's (WorldFish) programs and partnerships and describes how they are designed to provide the scientific basis for the multiple positive contributions of sustainable aquatic resources management to poverty eradication, food security and environmental rehabilitation. Building upon WorldFish Center's recent achievements in aquatic resources research and development, the MTP has been developed against the backdrop of world events in 2001-2002; particularly the food emergencies in Africa, the plight of world capture fisheries, global impacts of economic stagnation and anxiety about national and regional security.

Poverty, food security, the environment and peace are inter-connected. The low incomes of an estimated 777 million poor people in developing countries, 70 per cent of whom are women, largely determine that they will be food-insecure. Perhaps as many as half the people on earth are chronically malnourished through lack of essential micronutrients. Poverty of this magnitude, juxtaposed to the benefits of inequitable access to natural resources enjoyed by the wealthy, drives people to desperate acts of environmental abuse and political insurrection.

Unfortunately, these problems are not new and this MTP is therefore largely an update of the earlier plan. There is an increased emphasis on the adverse impact of alien species and on freshwater fisheries. Some other projects were redefined to better present the issues and needs. For the revision, each of WorldFish Center's programs revisited its research agenda, identifying new constraints and the research thrusts and outputs needed to overcome them. An MTP taskforce was created with members from each program, including support staff and outreach, to merge these revised program plans into a coherent planning document.

SUMMARY OF RESULTS: 2001 - 2002

WorldFish Center is only engaging in research that we believe will foster changes in terms of new policies, institutional reform, public and private investments, and human behaviour vis-à-vis the management of natural resources. These changes should result in substantial and measurable impacts on the livelihoods of people, either directly or indirectly. To do this, we work in close partnership with a wide range of local, regional and international collaborators and focus mostly on the applied side of research, endeavoring to make international research advances applicable to developing country needs and resources. The following are key achievements for the years 2001 and 2002:

- Documentation by the trawl fisheries project of the alarming declines in capture fisheries among eight countries in South and Southeast Asia. Stocks are down to 10-30 per cent of original unfished levels in most countries. Our assessments have also shown that the relative abundance of the more valuable fishes (such as groupers, snappers, sharks and rays) has decreased sharply and that there has been a proportionate increase in smaller, less valuable species (such as cardinal and trigger fishes). These results provide a clear picture of the extent of stock rehabilitation required to restore maximum economic value to the fisheries of the region. The project has also improved capabilities in coastal fisheries assessment, planning and management within national institutions, and a total of 71 counterpart staff have received training.

- Expansion of the project on straddling stocks in the South China Sea. Genetics facilities at WorldFish headquarters have been upgraded to permit the analysis of hypervariable microsatellite DNA within and among the large numbers of commercially important fish and invertebrate populations that overlap national boundaries and therefore must be managed co-operatively.

- Testing of environmentally friendly methods for catching juvenile coral reef fish and invertebrates for the marine aquarium trade, using crest nets and light traps in the Solomon Islands and the Caribbean. The juvenile fish, which can be grown to market size in 6-8 weeks with village-based methods, have been well received by the market.

- Closing of the lifecycle of *Holothuria scabra* by the sea cucumber farming and restocking project in Vietnam. The generation time of this sea cucumber can be as short as 12 months when reared in earthen ponds, which, among many other favorable attributes, makes this species a prime choice for culture and restocking programs.

- Internet access to ReefBase, the global database on coral reefs (www.reefbase.org) provides easy access to key datasets, coral reef status information, literature, photographs and user definable maps. It includes the full text of 138 coral reef status reports covering 40 countries and comprehensive information on coral bleaching. In the first month of operation, the site received over 11 000 visitors.

- The Coastal Management Training project in Indonesia and Vietnam is developing training curricula relevant to the needs of local communities and is working toward the establishment of a Regional Training Center in the Philippines.

- FishBase (www.fishbase.org) has established itself as the premier global fish biodiversity database. By 2001, there were 18.1 million hits on the website and it has covered 96 per cent of the estimated world fish species.

- The transfer to Africa of the genetically improved farmed tilapia (GIFT) breeding protocols developed in the Philippines has been initiated through selection programs undertaken with local partners in Côte d'Ivoire, Egypt and Ghana (*Oreochromis niloticus*), and in Malawi (*O. shiranus*).

- Smallholder aquaculture research and extension in Bangladesh reached more than 6000 beneficiaries in 2001, increased aquaculture production on those farms by more than 100 per cent and household income by 60 per cent. In Malawi, training of more than 60 extension agents and researchers in integrated agriculture aquaculture (IAA) and farmer participatory approaches increased production by 200 per cent and cash income by 50 per cent on a study group of 300 small scale fish farming households.

- Trials of community-based management in seasonal floodplains in Bangladesh and Vietnam which focused on aquaculture of stocked species and the simultaneously sustained fishery on small indigenous species within temporarily fenced-off areas in Bangladesh and Vietnam resulted in up to 200 per cent increases in fish harvest and 10 per cent per caput increases in income. Innovative arrangements for benefit-sharing among landless and landowners were negotiated at the community level to ensure social equitability and sustainability of results. In Lake Chilwa, Malawi, trends and threats to watershed integrity and sustainable fisheries were characterized, laying the groundwork for new projects on integrated watershed management in a basin that produces 30 per cent of this small and impoverished country's fish supply.

- WorldFish and the International Food Policy Research Institute (IFPRI), in collaboration with the Food and Agriculture Organization of the United Nations (FAO) have incorporated fish into IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT). Preliminary projections of production up to 2020 indicate a decline in average growth of capture fisheries from 1.1 (1985-1997) to 0.7 per cent (1997-2020. Aquaculture's share in global fish production is expected to increase from 31 per cent (1997) to 42 per cent by 2020. Net trade will continue to be from developing to developed countries. China is anticipated to become a large exporter of low value fish and an importer of high-quality crustaceans. India and Latin America are expected to increase their export capacity, while sub-Saharan Africa is expected to import more fish.

- A detailed assessment of fish supply and demand in Bangladesh, China, India, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam found that per capita fish expenditure is higher among urban than rural populations. Income elasticity of demand for fish falls with

an increase in income, suggesting that fish is a luxury commodity for the poor and a 'staple' for the rich. In general, income elasticities of different fish types consistently fall with an increase in income level of the household. In Bangladesh, the Philippines, Indonesia and Thailand there are significant non-linearites in the responses of fish consumers to changes in income.

- In 2001, WorldFish undertook an innovative, interdisciplinary statistical analysis of the key conditions for successful co-management and impact monitoring programs. Ten attributes were found to have an important influence on production , sustainability and average annual household income per year. The results from these studies are being incorporated into a policy brief for wide circulation to policy makers, donors and partners.

Highlights of the Project Portfolio: 2003-2005

The program outlined in the 2003-2005 MTP is designed to make contributions to poverty eradication, food security and environmental conservation through research targeted at the multiple roles of fish in development. Particular emphasis will be on equitable distribution of benefits from improved fisheries catches and aquaculture, enhanced livelihoods of fishing and farming households, increased access to fish by consumers, reduced fisheries impact on overstressed resources, and increased numbers of fish farmers where feasible. All this is underpinned by work to protect the aquatic environment and biodiversity. Highlights and milestones are given below:

- In 2003, WorldFish will begin the process of reconciling two important goals for restoration of global fish stocks by the year 2015: rebuilding the spawning biomass of wild stocks to increase yields, and ensuring equitable distribution of the costs and benefits of sustainable fisheries management.

- Marine protected areas (MPAs) could represent a low-cost fisheries management alternative for developing countries. However, there is an urgent need for better knowledge on how MPAs function to enhance fish reproduction and recruitment. WoldFish plans to develop reliable indicators of the effectiveness of MPAs in a variety of contexts to better target their use in fisheries enhancement.

- In addition, WorldFish will review the potential for culture-based stock enhancement to determine which general types of fisheries are likely to benefit from such interventions. Recommendations will be accompanied by management guidelines that can help optimize the cost/benefit ratio of investments in restocking.

- The eighth generation of GIFT fish will be produced in collaboration with Malaysian partners. In addition, commercial YY male technology and the use of F_1 clones as controls in breeding programs will be compared and evaluated.

- In collaboration with the International Institute of Tropical Agriculture (IITA), Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), FAO and a range of local partners, participatory research will be used to introduce appropriate aquaculture technology to a test group of 100 farm households in the humid forest benchmark of Southern Cameroon. Detailed comparisons of rural vs periurban and integrated vs non-integrated systems are planned. In addition to increasing fish production and rural incomes, findings are expected to contribute significantly to the aquaculture planning and development process in sub-Saharan Africa.

- In collaboration with International Rice Research Institute (IRRI) and national partners in the Mekong Delta in Vietnam, trials with improved breeds of tilapia (GIFT) in small homestead ponds and in large brackishwater ricefield-ponds (i.e. fish and shrimp polyculture alternating with rice), are expected to lead to resilient production and income increases for the targeted poor farm households.

- Country-specific fish-sector models for nine Asian countries will be developed. Projections of the demand-supply for different types of fish and seafood in these nine Asian countries under alternative policy scenarios will contribute to the prioritization of fisheries and aquaculture in national natural resources management (NRM) policy.

- On-going work to improve the institutional and legal frameworks for wetlands and aquatic resources management in the Mekong basin will be completed and reinforced by an economic valuation of wetland resources. In collaboration with local authorities and NARS, guidelines for institutional and legal analysis in the Mekong basin will be developed and published.

- Participatory action research on aquatic resources management in Bangladesh and the Mekong basin will continue with the increased involvement of local communities, NGOs and NARS. Key criteria for successful co-management of larger fisheries in Bangladesh will be established and documented.

- Regular consultations will continue with developing country NARS to better understand the constraints to sustainable aquatic resource management and to undertake collaborative research to address these constraints.

- Capacity within developing country institutions will be strengthened through training programs in areas of WorldFish's expertise. Expert consultations will be organized to address some of the main policy issues.

Financial Highlights

The 2002 funding level approved at the 2001 annual general meeting (AGM) of the Consultative Group on International Agricultural Research (CGIAR) has been used as the basis for developing the plans for 2003 - 2005. The Financing Plan has been adjusted to reflect the current estimate of WorldFish's operations for 2002.

The expected level of donor funding for 2002 is projected at US$15.04 million, in addition to earned income of US$ 0.15 million and indirect cost recoveries from restricted projects. WorldFish's projected operating levels (net of indirect cost recoveries) for 2003, 2004 and 2005 are US$ 15.40, 15.95 and 16.51 million, respectively. A combined growth and inflation rate of 3.50 per cent has been incorporated into the plans for the years 2003, 2004 and 2005.

The resource allocation to CGIAR activities and outputs for the planned period will not deviate substantially from the 2001 and 2002 spending levels. For the 2002 resources, 38 per cent were allocated to protecting the environment and saving biodiversity, 36 per cent to improving policies, 16 per cent to increasing productivity, and 10 per cent to strengthening NARS. These allocations are consistent with the center's long-term strategic direction.'

A.1 LIVING AQUATIC RESOURCES RESEARCH FOR EQUITABLE AND SUSTAINABLE DEVELOPMENT

This Medium Term Plan 2003-2005 presents the WorldFish Center's programs and partnerships and describes how they are designed to provide the scientific basis for multiple positive contributions that living aquatic resources (fish for short) can make to poverty eradication, food and regional security, and sound management of the environment.

The Plan has been developed against the background of world events in 2001–2, particularly renewed concerns for poverty, food security, human health and the environment, food emergencies in Africa, growing conservation attention to the plight of world capture fisheries, along with global impacts of the declines in the economies of many developed countries, and anxiety about national and regional security.

Poverty, food security, the environment and peace are interconnected. The low incomes and purchasing power of hundreds of millions of poor people in developing countries largely determine that they will be food-insecure. The majority of these are women and rural dwellers. Of the 777 million food-insecure people, who mostly live in rural, including coastal, areas, in the developing world, 70 per cent are women. Many more than this number, perhaps as many as half the people on Earth, are chronically undernourished in some way, e.g. they lack sufficient iron, calcium or vitamin A in their diets and hence do not reach their full human potential. Poverty and the environment intersect – the poor, almost by definition, are those who lack access to environmental goods and services, such as clean fresh water, good fishing grounds and good farming land. Meanwhile, the wealthy consume an increasing share of all natural resources.

Throughout the 1990s, apparently good progress was made against poverty and food insecurity, though the same cannot be said for the environment, including fisheries resources, which continued to suffer the effects of overuse. In 2001, however, the Food and Agriculture Organization announced that even the promising rate of decline in the number of hungry throughout the 1990s had slowed, and in most developing countries the number of hungry had even increased[1]. Thus the target to reduce the number of hungry to 400 million by 2015 is receding.

In 2002, the poverty, food security, environment nexus was comprehensively addressed by the World Summit on Sustainable Development. The Summit preparation recognized that the objectives of sustainable development are to eradicate poverty, change unsustainable patterns of production and consumption and protect and manage the natural resource base of economic and social development[2].

Wise use of fish and other living aquatic resources can assist equitable, sustainable and peaceful human development in numerous ways but these contributions can be easily jeopardized by actions inside and outside the fish sectors.

How can positive contributions of fish to sustainable development be better achieved? The complex nature of the associations between fish and development do not lend themselves to simple answers. At the WorldFish Center, we have carefully assessed the situation and outlook and we propose that sustainable development plans affecting fish must be served by well targeted research, implemented in strategic partnerships. Such plans should include sound policy and technical solutions, information and methods to help resolve conflicts and identify emerging problems and basic knowledge on which to build solutions. Moreover, the requisite research must be multi-disciplinary, participatory and relevant to particular regions, countries and locations where the results will be applied.

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[1] FAO 2001. The State of Food Insecurity in the World 2001. Food and Agricultural Organization, Rome, 58pp.

[2] From point 3 of 'Proposed elements for the political declaration of WSSD', presented by the Chairman of the Preparatory Committee, Dr Emil Salim, 2 July 2002.
http://www.johannesburgsummit.org/html/documents/summit_docs.html

The following sections describe the complex and multiple associations of fish and development, the key challenges that need to be addressed and how the challenges differ across regions and countries. An overview of the research needed is then given.

The Multiple Associations of Fish to Equitable and Sustainable Development

Fish is more important in the daily food of people and in the economies of many developing countries than in developed ones. Nevertheless, as a minority sector in most economies, it is generally overlooked totally in country-specific development assistance, especially if viewed only on a superficial sectoral basis or if policy makers are simply unaware of its importance. For example, fish is commonly overlooked in national poverty eradication strategies now being developed as a pre-condition for much donor assistance.

Fish are associated with many dimensions of sustainable development. The multiple and complex associations of fish and development, however, often create diffuse and difficult challenges which countries and development assistance agencies find difficult to address. The following list of four main associations highlights the complexity.

First, fish provide ***direct goods*** for developing countries such as food, livelihood and income for millions of the world's poorest people. Fish also contributes to the overall economic well-being of many developing countries through tourism, recreation and export commodity trade. Trade in fish increased rapidly for the developing countries in the 1990s[3]. Excessive extraction of these direct goods, however, is a serious global problem now and in the future[4].

Most of the world's fish is now produced in developing countries (Fig. 1), where it provides nearly 20 percent of the animal protein, compared to 12 per cent in developed countries[5]. Indeed, the overall animal protein divide between the developed and developing world is starkly illustrated by fish consumption. In 2000, in absolute consumption per person, people in developing countries only consumed 3.7 grams of fish protein each per day compared to 6.6 grams for the people in developed countries – indicating both an animal protein divide and a divide in the relative importance of fish in the more meager diets of those in developing countries. The divide is important not only because fish is an important source of animal protein but also because the vitamins and micro-nutrients it supplies are vital for nutrition.

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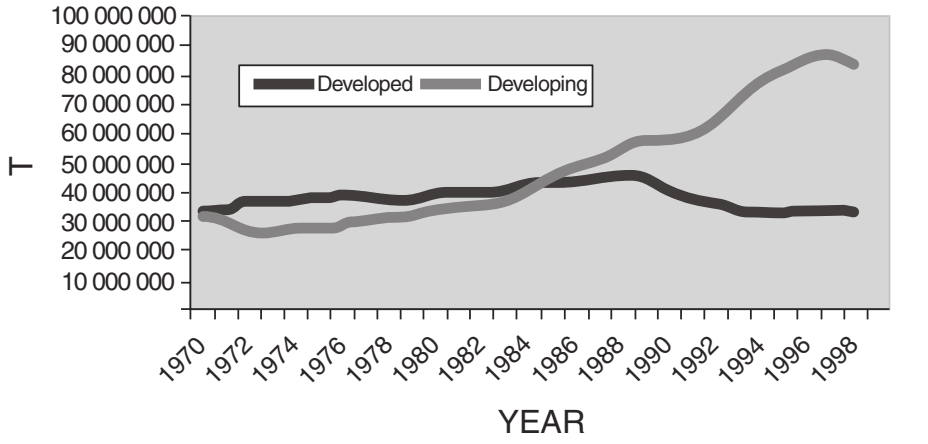
[3] Delgado, C., M. W. Rosegrant, S. Meijer, N. Wada and M. Ahmed 2002. Fish as Food: Projections to 2020. Paper presented at the Biennial Meeting of the International Institute for Fisheries Economics and Trade (IIFET), Wellington, New Zealand, 19-23 August 2002.

[4] Pauly, D., V. Christensen, S. Guenette, T.J. Pitcher, U. Rashid Sumaila, C. J. Walters, R. Watson and D. Zeller 2002. Towards sustainability of world fisheries.
Nature 418:689-695.

[5] Source: From FAOSTAT nutrition database, http://www.fao.org

Fig. 1. World Fish Production, Developed and Developing Countries



Source: FAO, FISHSTAT

World production of fish, crustaceans and molluscs reached 129.3 million t in 2000[6] of which capture fisheries in marine and inland waters were 94.8 million t and fish from aquaculture 35.5 million t. The value of world total fishery production is estimated at US$ 125 billion.[7] FAO has projected two outlooks for fish production to 2010 (Table I), the optimistic being for an increase to 144 million t and the pessimistic being 107 million t, or 23 million t less than the 2000 production. If the latter scenario were to come true, then the world, especially the developing world, will be in great difficulty.

More than 75 percent of global fish production is used for direct human consumption. In 1999 the average global consumption was 16.3 kg per person. Of this average capture fisheries supplied 2/3 and aquaculture, 1/3.

In absolute terms supplies from marine capture fisheries have remained fairly stable since the mid-eighties whereas supplies from inland capture fisheries have increased slightly. In relative per caput terms there has been a decline of more than 20 percent in the supplies from capture fisheries.

[6] FAO 2001. FISHSTAT+, http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp..

[7] Unfortunately, fisheries statistical data are not very accurate as many countries grossly under-report the production, particularly from small-scale, family fishing. Over-reporting by some countries also is a problem. Discards of fish are not accounted for in the statistics but may amount to some 25-30 percent of the total marine catches.

Table I. Projection of World Fishery Production (million t) in 2010

	Production 2000	Pessimistic scenario 2010	Optimistic scenario 2010
Capture fisheries	95	80	105
Aquaculture	35	27	39
Total production	130	107	144
Fish for non-food use	30	33	30
Fish for human consumption	100	74	114

Source: FAO Fisheries homepage,
May 2002: Projection of World Fishery Production in 2010

Second, fish is an important ***political commodity and natural resource issue***. Through trade, industry subsidies, quarantine, fisheries and territory negotiations, fish can form the basis for international cooperation, or it can lead to conflicts, bitter disputes and regional instability. Recent OECD country trade bans of Asian export shrimp and fish have caused at least short term disruptions to lucrative export trade but have potentially helped improve the long term quality of the products. Tariff trade barriers on tuna and non-tariff trade barriers caused by disputes over use of fish names, e.g. 'catfish' and 'sardines', have surfaced recently.

Third, fish broadened to mean living aquatic resources are key ***components of the natural capital*** of developing countries because they provide large, unaccounted ecosystem services such as cultural value, coastal protection, waste assimilation, carbon sequestration and medical drugs. The parlous state of capture fisheries resources has been highlighted in recent years as one of the greatest environmental crises. Many aquatic products are also becoming less and less safe because of hazardous environments in which some are produced. Red tides along the coasts, and heavy metal, industrial and pharmaceutical pollution of all waters are creating serious erosion of natural capital.

Fourth, fish is often closely associated with ***poverty*** in developing countries. Fish play a particularly important role among disadvantaged sections of the population as the main or a supplementary source of employment and therefore income. Perhaps because of this association with those at the margins of society, the fate of fish and fish dependent people are too often disregarded when coastal pollution increases, large scale mechanized fishing is introduced, dams are built, forests logged and health burdens such as HIV/AIDS and occupational dangers at sea take their toll. Many of the usual social safety nets are not accessible to the fishers and fishing communities. Economic development and international development assistance is directly responsible for some of these poverty deepening changes in the sector, e.g. water management schemes, new fishing technologies.

The four associations outlined above pose challenges for designing useful development assistance packages that are 'fish friendly'. The next section outlines how the Medium Term Plan 2003–2005 of the Center has been designed to provide solutions and further guidance.

Key Challenges and Research Needs

As a research Center devoted to research for development, we address the equitable and sustainable contribution of fish to development through the following overall goals: improved livelihoods through sustainable and equitable management of capture fisheries in marine and inland waters and sustainable and equitable increases in aquaculture production, improved access to fish by the poor, environmental sustainability and improved knowledge and awareness of fish, poverty and environment links.

A. Improved livelihoods of the poor through sustainable and equitable management of capture fisheries

The WorldFish Center's work contributes to improving the livelihoods of poor who use natural fish stocks through fostering the sustainability of the resource base for all, and through more equitable management measures so that the poor benefit. At the heart of sustainability efforts is the need to improve governance of natural fisheries resources and thus, in this Plan, we place strong emphasis on the study and pilot testing of new fisheries ecosystem and wetlands governance arrangements, using multi-disciplinary approaches and working with community, government and non-government partners.

This goal presents the greatest challenge since many fish stocks are in serious decline due to inadequate fisheries management and because of habitat degradation. For example, in a recent study of coastal fisheries in eight Asian countries[8], the standing stocks of fishes are only between 10 and 30 per cent of their original biomass, and dangerously below their more productive sustainable levels. Moreover, the fished stocks are now composed of smaller fish of generally less valuable and desirable species. Some species have disappeared altogether, suggesting that the complex biodiversity thought to be important for making such tropical ecosystems so productive is being eroded. These patterns are widespread across most of the world's coastal and inland fisheries, including the phenomenon of 'fishing down the food web'[9]. Indeed, 75 per cent of the world's marine fisheries are fully or over-exploited[10] and a similar or worse pattern exists for inland fisheries.

With our partners, we are addressing the fisheries governance challenges through the following types of research: a nation wide community-based management pilot project is being conducted in Bangladesh, involving over 100 sites and building on smaller efforts that showed the potential power of such approaches over the last decade. In related work, our fisheries co-management project carried out with national developing country partners and the Danish Institute of Fisheries Management, is focusing in greater depth on coastal fisheries in Asia and coastal and lake fisheries in Africa. This project, based on eleven case studies, is drawing together the governance lessons of all studies carried out through the Center over the last decade. The governance of floodplains and wetlands, such as in the Mekong river basin, is of particular complexity because where overlapping sectoral uses, jurisdictions and international cooperation must be reconciled to achieve sustainable use of wetlands resources.

A question central to fisheries management is to what extent equity is achieved in schemes to manage effort, entry to or exit from fisheries. To help address this question, the role of fishing rights is being examined in detail in all these studies. As more and more governments are realizing the need to reduce fishing effort and the dependence of more and more people on declining fisheries, we seek to understand how the rights of the poor and small-scale operators can be recognized and protected.

Equity issues in fisheries and aquaculture will also be addressed through the gender lens by the Center and its partners who will further examine and recognize the role of women and men in fisheries[11,12] by launching an electronic discussion group in mid 2002. Fisheries and aquaculture lag agriculture in addressing gender issues and the Center aims to make gender considerations central to its work.

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[8] This study is coordinated by the WorldFish Center and the collaborating countries are: India, Sri Lanka, Bangladesh, Malaysia, Thailand, Indonesia, Vietnam, Philippines (www.trawlbase.org)

[9] Pauly, D., Christensen, V., Dalsgaard, J., Froese, R. and Torres Jr. F. (1998): Fishing down marine food webs. Science 279:860-863.

[10] FAO reference

[11] Williams, M.J., M.C. Nandeesha, V.P. Corral, E. Tech and P.S. Choo (Eds) 2001. International Symposium on Women in Asian Fisheries: fifth Asian Fisheries Forum, Asian Fisheries Society, 13 November 1998, Chiang Mai, Thailand. 156pp.

[12] Williams, M.J., N.-H. Chao-Liao, P.S. Choo, K. Matics, M.C. Nandeesha, M. Shariff, I. Siason, E. Tech, and J.M.C. Wong (eds.) 2002. Global Symposium on Women in Fisheries. Sixth Asian Fisheries Forum, 29 November 2001, Kaohsiung, Taiwan. 191 pp.

The Center's most comprehensive multi-disciplinary efforts have been in the above-mentioned eight-country study of coastal fisheries exploited by multiple gears. To further the adoption of policy insights gained from the first phase of this study, a new phase is proposed, working closely with the national governments concerned and expanding it to other countries that have requested to join, such as Oman.

As a tool to help reduce the impact of fishing, the Center is exploring the efficacy of marine protected areas in restoring some fish stocks. The creation of alternative livelihoods through coastal aquaculture, especially associated with the reef fisheries of small islands in the Caribbean and the Pacific, is also being pursued to help ease the social dislocation involved in removing excess fishing capacities. In some cases, replenishment of stocks of certain valuable species could be speeded up through restocking and stock enhancement programs. In early 2003, the Center and partners will complete a global review of the results of stock enhancement for invertebrates and will use this review to guide its future directions in stock enhancement. Stock enhancement work is presently focused on high value candidate species in the Pacific, especially invertebrates such as giant clams and sea cucumbers..

B. Improved livelihoods of the poor through sustainable and equitable increases in aquaculture production

In both absolute and relative per caput terms, aquaculture production has increased markedly, but unevenly, across countries and regions over the last twenty years. The trend is for an increase in production, but at a reduced rate due to environmental, technological and institutional constraints. The optimistic FAO scenario is a 20 percent increase in total aquaculture production by the year 2010[13].

As with capture fisheries, equity and livelihood considerations govern our choices of species, production and technology transfer systems and aquaculture governance mechanisms. Several of the thrusts of this Plan are designed to address the challenges of helping the poor through sustainably and safely increasing aquaculture production of the type in which they can engage or afford to buy the products. The Center takes the approach of working with species that are within the reach of the poor to grow or to purchase to eat, and environmentally friendly to produce[14]. We have mapped out projects to genetically improve, for better growth and disease resistance, low priced key species such as carps and tilapias, to study the recommendation domains for integrated aquaculture-agriculture systems and the adoption pathways for these in Africa and Asia, and to further develop low-input production of high value invertebrates for Pacific island and Southeast Asian conditions.

C. Improved access to food, including fish, by the poor

For fish to be available to poor consumers, fish price and supply are paramount since the purchasing power of income is critical. About 1 billion consumers depend on fish as an important source of animal protein. The incomes of fish producers (fishers and fish farmers) and their dependent households will depend on adequate fish catches from natural stocks, or profitable fish farming, or their ability to supplement household fish related income with that from other sectors such as agriculture, manufacturing or services.

As fish has shifted from being the 'poor man's protein' to more of a luxury food, urgent economic, sociological and biological research is needed to better understand the fish and food supply and demand outlook for the poor. The Center has recently (2001) embarked on a nine-country Asian study to examine this outlook in partnership with 28 national agencies in the region. In 2003, we intend to embark on similar studies in Africa and West Asia, where the outlook for fish is also changing rapidly. In addition, in 2003, the Center will complete the first phase of work with the International Food Policy Research Institute and FAO that has been examining how fish can be integrated into world food models, so that fish is not treated in isolation from the other food sectors. These studies incorporate broad policy and technical analyses to encompass political, commodity,

[13] FAO Fisheries Home Page, May 2002: Projection of World Fishery Production in 2010

[14] WorldFish Center 2000. Farming fish the right way. Focus for Research April 2000, Vol. 3 No. 2, 4pp.

trade, quarantine, environmental and food safety perspectives.

The Center also considers that its work on improving the production and efficiency of aquaculture through genetically improved strains and more efficient seed production and dissemination addresses one of the best-established methods for reducing the price of fish – increasing the market availability. The next steps are to continue the work on sustaining and increasing the growth performance of various species of tilapia in several Asian and African countries, to launch a new phase of carp genetic improvement in Asia and to examine the feasibility of breeding for disease resistance. The Center will also be embarking upon expert consultations to determine how to harness modern biotechnology, including genetic engineering, without creating negative impacts on natural aquatic resources and biodiversity, or consumer resistance.

D. Environmental sustainability

In addition to 'mainstreaming' environmental considerations in all its programs, the Center has four main fields of work specifically targeted at wider ecosystem and environmental concerns that vitally underpin fish productivity in developing countries: coral reef protection, aquatic biodiversity conservation and biosafety: integrated fisheries and watershed management; and coastal area management. The Center recognizes that, in addition to overfishing and destructive fishing, many of the factors impacting the sustainability of coastal and inland aquatic resources are driven by actions outside the fisheries and aquaculture sectors such as competing uses of the environment, climate and pollution. Many fisheries problems therefore cannot be resolved within the fisheries sector alone.

In management and conservation of coral reefs, we are an active partner in the International Coral Reef Action Network, the premier global strategic alliance on coral reefs. ReefBase is the offical database of this initiative and will be further enhanced, developed and used as a one-stop-shop for information on coral reefs at all scales.

Biodiversity conservation work at the Center has to date focused on genetic characterization of a few important native aquaculture species in Asia and Africa. In the period of the next Plan, we intend to go beyond this to examine the contribution scientific knowledge, such as genetic studies, and knowledge bases, such as FishBase and ReefBase, can make to conservation and management efforts in developing countries. Since the Center is also a leader in the use of fish biodiversity in the genetic enhancement of species for aquaculture, we will continue to play a lead role in developing the best possible biosafety advice for release and dissemination of improved breeds, introductions of exotic species and, in the future, introductions of genetically modified organisms.

The Center is actively leading the development of a proposal for a CGIAR Challenge Program that will examine agriculture, forestry and fishery interactions and management options to reverse habitat degradation and create additional livelihoods for coastal people based on inshore resources in coastal areas. If approved, this Program will commence in 2003. In addition, the Center is a very active participant in the CGIAR Water and Food Challenge Program (up for consideration in late 2002) and has a small role in the proposed Climate Change Challenge Program (for approval in 2003), focusing our efforts on the effects of global warming on coral bleaching.

E. Improving knowledge and awareness of fish, poverty and environment links

The Center has a commitment to use the knowledge its programs develop to inform national governments, non-government agencies, development assistance partners, other aquatic research agencies and the wider public of the complex place of fish in development. We do this through publishing our research results widely, convening and participating in workshops and conferences, providing information services at no or nominal cost to our developing country partners and creating global knowledge bases for critical aquatic resources, e.g. ReefBase for coral reefs and FishBase for fishes[15].

In addition, in late 2002, the Center launched a new 10-year initiative, *Fish for All,* designed to achieve a coherent and informed public dialogue on such issues as fish and development, fish and nutrition, health, livelihood, environment, gender, water, river basins and coasts, trade and economic growth. *Fish for All* aims to do this through the following means:

- by establishing the highest profile steering committee possible to direct and connect with the highest level policy makers from various parts of the world
- through events such as policy-science-stakeholder workshops and fora, conferences and dialogues
- through studies, policy analyses, opinion pieces, newsletters and a website on the issues and solutions.

Regional Differences

The global challenges for fish production and consumption mask important regional differences. Asia currently produces 2/3 of the world total of food fish. Fish consumption rate in the region is high: in many local areas it is above 70 kg per person. Asia is estimated to have nearly 600 million people living below the poverty line, the majority in South Asia. The Center therefore has given priority to research in Bangladesh and, to some extent India, where, fish are becoming more important. Although poverty stricken populations are smaller in number in the lower Mekong Basin countries, the dependence on fish is very high and the relative poverty level is high. The Center has therefore increased its activities in the Mekong region, and intends to establish an on-the-ground presence in the region.

The most dramatic anticipated rise in the number of people living in poverty in the near future will be in Africa, where the total population will reach 1 billion by 2010. In sub-Saharan Africa, those living in poverty are expected to number over 300 million and this figure rises to almost 400 million if North Africa and the Middle East is included. While the average figure of 7.1 kg (1997 figure) per caput fish consumption is low (7.1 kg in 1997), the regional, national and local differences are large and some countries are highly dependent on fish, almost entirely from marine, riverine, lake and wetlands capture fisheries. The Center began expanding its efforts in the region when it took over the aquaculture research facility in Abbassa, Egypt in 1997. We are now undergoing an intense period of program and project development in Africa and intend to continue these efforts to expand work in Africa and West Asia.

The small-island developing states in the Caribbean and Indo-Pacific are highly reliant on aquatic resources for food security, livelihood and income generation. Population growth is high and future needs for food fish increasing in a context of grossly overfished coastal fish resources and habitat (coral reef) destruction. The Center has taken a forward-looking approach to these regions, focusing on stock assessment and aquaculture of invertebrates as the main opportunities to restore and increase fisheries production.

Conclusion

In summary, the WorldFish Center Program outlined in this Medium Term Plan 2003-2005 is designed to make contributions to poverty eradication, food security and environmental conservation through research targeted to several of the multiple roles of fish in development. Activities will focus on improving equity benefits from fisheries catches and aquaculture, enhancing the livelihoods of fishing and farming households, improving access to fish at affordable prices for consumers, reducing the impact of fishers on overstressed resources, increasing the number of fish farmers where resources permit, and protecting the aquatic environment and biodiversity.

[15] www.reefbase.org, www.fishbase.org

A.2 VISION, MISSION AND STRATEGY

Our **vision** at the WorldFish Center is to contribute to food security and poverty eradication in developing countries

Our **mission** is to promote sustainable development and use of living aquatic resources based on environmentally sound management.

Our **strategy** for the period 2003–2005 is to implement five output-oriented inter-related research and research related **programs**, each of them focused by a few carefully selected **thrusts** (= to MTP Projects).

Biodiversity and Genetics Resources Research Program (Biodiversity and Genetics Program)

1. Conservation of aquatic biodiversity
2. Mitigation of adverse impact of alien species on aquatic biodiversity
3. Genetic improvement and breeding

Freshwater Resources Research Program (Freshwater Program)

4. Strategies and options for realizing gains from sustainable freshwater aquaculture systems
5. Freshwater fisheries in an integrated land and water management context

Coastal and Marine Resources Program (Coastal Program)

6. Increased and sustained coastal fisheries production
7. Restoration and protection of coastal habitats
8. Knowledge bases and training for improved management of coastal resources

Policy Research and Impact Assessment Program (Policy Program)

9. Economic, policy and social analysis and valuation of aquatic resources in developing countries
10. Aquatic resources planning and impact assessment
11. Legal and institutional analysis for aquatic resources management

Partnerships, Information and Training Program (Partnerships and Information Program)

12. Improved partnerships and capacity-building among developing country NARS
13. Access to information for sustainable development of fisheries and aquatic resources

Section A.6 gives the details of the recent program achievements and the plans for 2003–2005.

A.3 APPROACH

Partnerships

At the WorldFish Center we believe that our objectives can only be achieved through research in collaboration with partners and by involving end users. Since its inception in 1977, the Center has been working in partnership in research and related activities (training, workshops, conferences, and information dissemination). Partners include national aquatic research systems, non-government organizations, the private sector, universities, academic institutions, advanced scientific institutions, regional and international organizations, individual scientists, farmers and fishers. In 2002, a total of 259 partner institutions from developing and developed countries have existing collaborations with us (Fig. 2 and 3).

Fig. 2. Partners of the WorldFish Center in 2002 by category

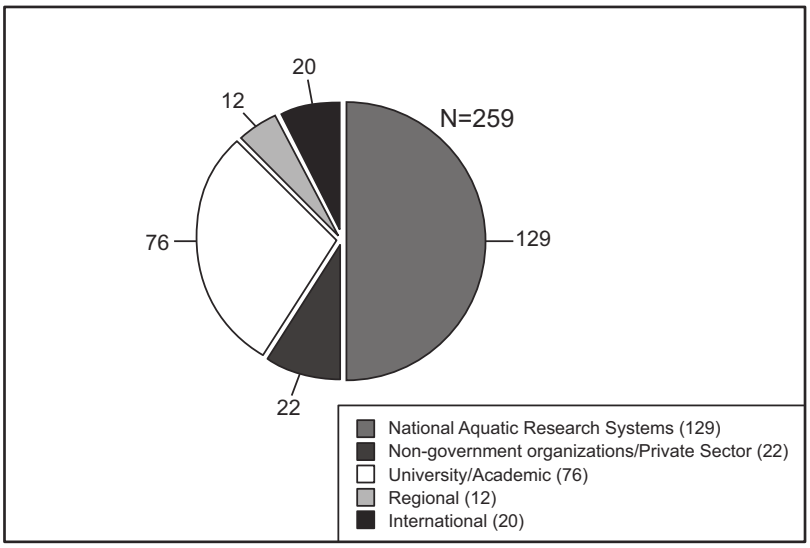
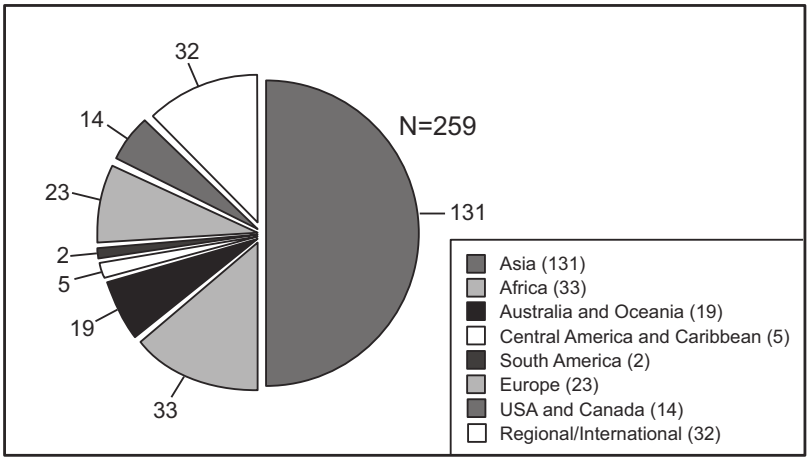


Fig. 3. Partners of the WorldFish Center in 2002 by origin



Since 1996, we have been conducting comprehensive meetings with partner institutions to identify priority areas for collaboration. As part of the planning process, we also undertook consultations with partners (developing country institutions, NGOs and advanced scientific institutions) to identify priorities for the Center's Strategic Plan 2000–2020. We translate the formal and informal results of consultation with NARS to address various development issues, keeping in mind that the problems and the precise blend of skills required vary from country to country and region to region.

Capacity-building among developing country institutions is an essential component of our programs. For nearly 25 years now we have been conducting training programs in our areas of expertise and have developed a critical mass of scientific competence among developing country institutions especially on research methodologies and tools to address issues on living aquatic resources management and low-input aquaculture technologies.

Box 1. Partnerships in Research and Related Activities

Partnerships at the WorldFish Center are formally recognized collaborative, mutually beneficial research and research related activities (training, workshops, advisory services, publications, etc.) between WorldFish Center and National Aquatic Research Systems (NARS), government and non-government organizations, advanced scientific institutions, regional and international organizations, research centers, individual scientists and the private sector. Partnerships could be with farmers/fishers, when they are experimenters in the generation and evolution of production/management technologies.

Guiding principles

Selection of partners and partnerships are guided by the principles that partnership(s) should:

- have a shared vision of the needs being addressed and how these may be addressed;
- be on a participatory basis, with joint sharing of responsibilities and accountability;
- be based on mutual respect between the parties;
- have complementarity of skills between partners;
- be pro-active, responsive and flexible;
- be undertaken in a research, teaching, learning or information-sharing mode, depending on which is appropriate to the activity;
- involve interdependence in that neither partner would be able to complete the tasks alone;
- be conducted in a contractual, collaborative or collegial mode;
- have joint responsibility for preparation of reports and publication of research results.
- be within priority areas of WorldFish Center's strategic research and those of partner(s), and meet the criteria set by them;
- result in WorldFish Center's skills and knowledge benefiting the partners' activities which are aimed at a shared goal; and
- give due cognizance to political, cultural and institutional sensitivities of the participating agencies/organizations/individuals.

Source: WorldFish Center Policy on Partnerships in Research and Related Activities

The Center has been a major provider of scientific knowledge to developing country researchers, policy makers, managers and the general public. This is done through workshops, consultations and dissemination of targeted information material and provision of world-class library services.

Box 2. The Ian R Smith Memorial Library

The Ian R Smith Memorial Library and Documentation Center houses a rich and diverse collection of materials on fisheries and aquaculture, particularly in "grey" literature from developing countries. The Center provides information services to the fisheries and aquatic research community worldwide, focusing on services to scientists in countries where access to information is limited. Increasingly, the Center provides access to its vast information resources on-line, both as electronic publications and direct access to catalogues and gateways to information, with the aim of becoming a cyber-information resource at users' desktops.

Mindful that in many developing countries, communication infrastructure is limited, the Center is streamlining parallel mail and print modes of disseminating information, and enabling access to information resources, to improve response times and user-service levels.

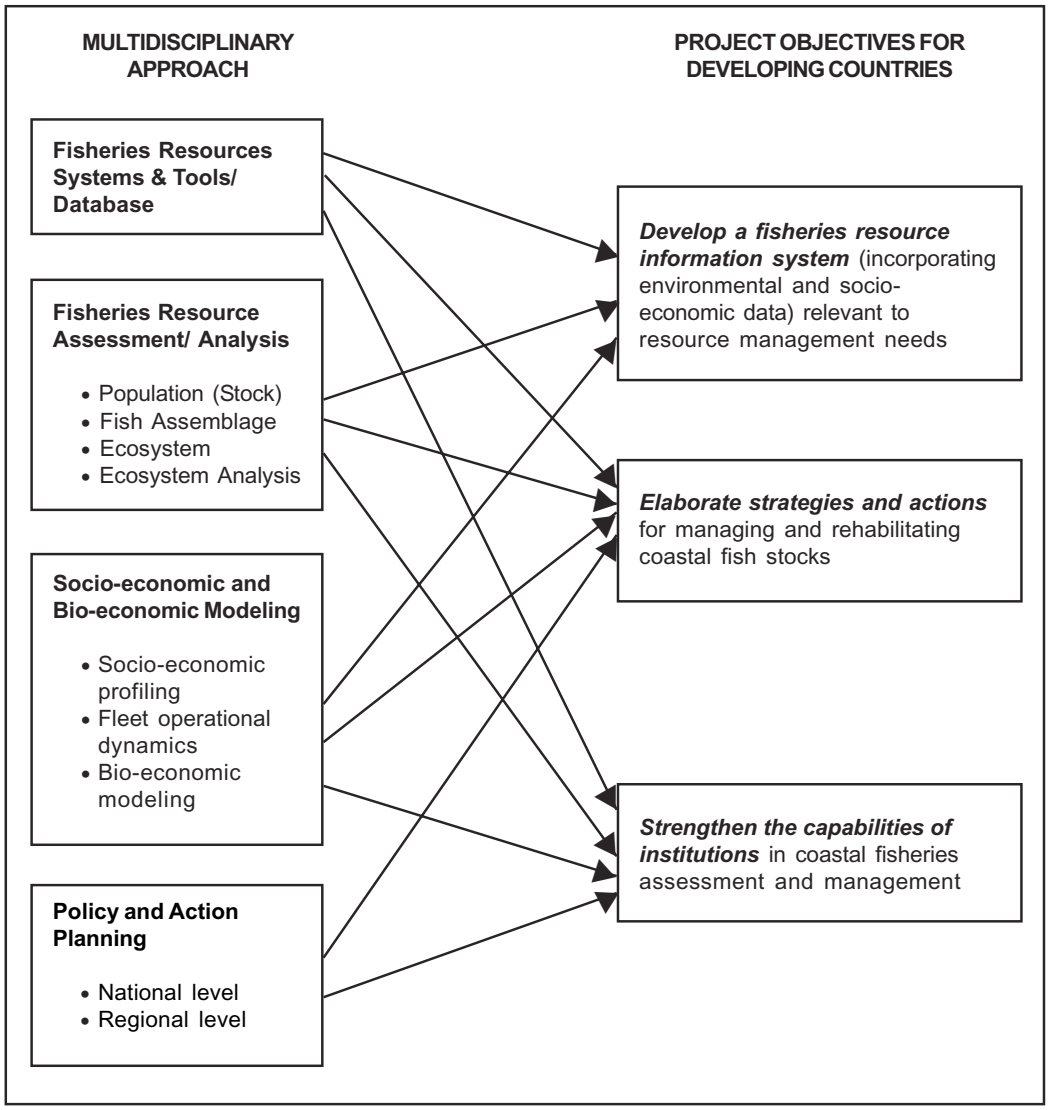
The Center's publishing program aims to serve its partners and stakeholders, both by publishing collaborative research results and by reporting on its activities, plans and impacts. Likewise the Center's public awareness activities underpin the strategic development of its research portfolio.

Multidisciplinarity

We at the WorldFish Center are fully aware that fisheries and aquaculture take place in context. Therefore appropriate solutions to problems encountered and strategies for the adoption of new potentials by our target groups will have to integrate technical, social, economic and political aspects. With our multidisciplinary approach that cuts across all our programs we ensure that our work gives equal consideration to technical feasibility, social acceptability, economic viability and environmental sustainability (see Fig. 4 for an example). This goes all the way from the conceptualization of research projects to the application of resulting solutions and strategies.

Fig. 4. TrawlBase—an example of a WorldFish Center multidisciplinary project.

Research for Impact



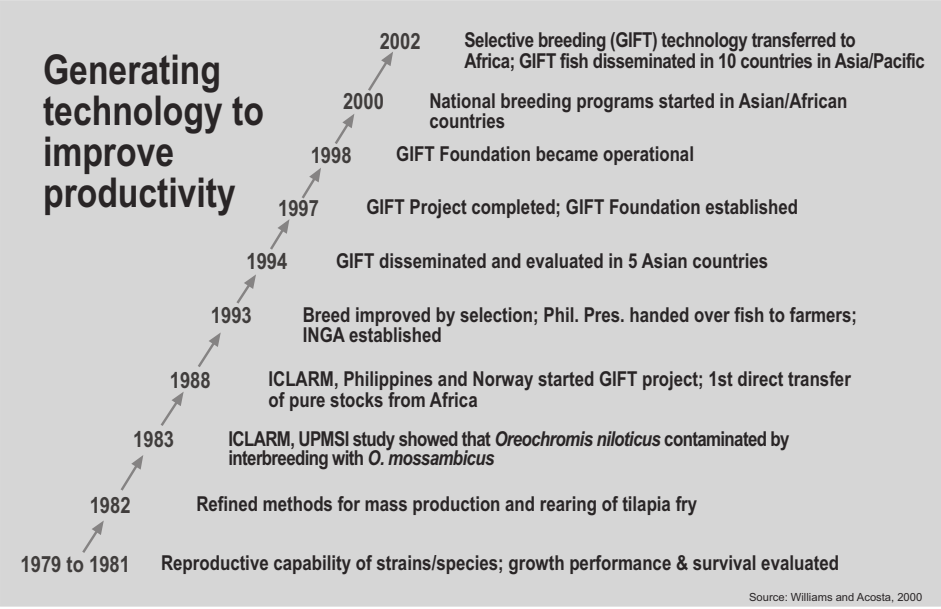
To meet our goal, we at the WorldFish Center are only engaging in research that we believe will foster changes in terms of new policies, institutional developments, group and individual behavior (as stewards of natural resources) and directions of public and private investments that will have substantial and measurable impacts on the livelihood of people, either directly or indirectly. For this reason, we mostly work on the 'applied' side of research, endeavoring to make international research advances applicable to developing country needs and resources.

This approach, however, does not exclude us from taking a lead in international 'frontier' research in areas of science which hold a high potential for bringing major benefits to our main target group, the poor fisher and farmer family, within a short time perspective.

Our research is built on a strong socio-economic framework ensuring the incorporation of user perspectives. During the course of building the information base for making decisions or developing the technology for benefiting the poor fisher or fish farmer, the socio-economic and environmental impacts are evaluated to ensure that the impact is socially equitable and environmentally sustainable.

Box 3 The evolution of GIFT project is a good example of how the WorldFish Center has developed a product, the 'GIFT strain' that will have a positive impact on the poor farmer

Extensive research on tilapias of the Center and its partners which began in the late 1970s, found that inadequate seed supply and deteriorating performance of the fish in many aquaculture systems in Asia were the bottleneck for the expansion of an aquaculture industry. In Africa, aquaculture production was poor and wild stocks of native tilapias were under threat due to habitat degradation, uncontrolled fish transfers and overexploitation. Noting the widespread problem confronting the farmed and native tilapia stocks, the Center brought together in 1987 the partners from Asia and Africa and international experts on tilapias to review the status of tilapia genetic resources. The findings from this meeting and prior research efforts by the Center and partners on tilapias formed the basis for undertaking major strategic research on genetic improvement of tropical finfish.



Source: Williams and Acosta, 2000

In 1988, the WorldFish Center and partners from the Philippines (Freshwater Aquaculture Center of the Central Luzon State University, National Freshwater Fisheries Technology Research Center of the Bureau of Fisheries and Aquatic Resources, and the Marine Science Institute of the University of the Philippines) and Norway (Institute of Aquaculture Research, Ltd.) embarked on a program for developing methods for genetic improvement of tropical finfish – the–*Genetic Improvement of Farmed Tilapia* project.

Through linkages with and assistance of African, Belgian, German and Israeli scientists, four wild tilapia populations from Africa (Egypt, Kenya, Ghana and Senegal) were transferred to Asia. These strains and the four others that are used by farmers in Asia (Israel, Singapore, Taiwan and Thailand) were used to build a base population for selective breeding. The project was completed in 1997 and demonstrated the appropriateness of traditional animal breeding technology for the breed improvement of tropical finfish. The average genetic gain in growth across five generations of selection of Nile tilapia was 12-17 per cent and the accumulated genetic gain in relation to the base population was 85 per cent.

Subsequent to the development of the improved GIFT strain, the WorldFish Center and partners developed protocols to evaluate the performance (genetic and socio-economic) and environmental impacts of the improved strain under different farming systems in Bangladesh, People's Republic of China, the Philippines, Thailand and Vietnam. Overall performance evaluation of the GIFT strain of Nile tilapia undertaken in these countries showed that the GIFT strain gave a 18-58 per cent higher yield compared to the existing strains. It was projected that the adoption of the GIFT strain in the five countries would increase both tilapia and total fish production, lower the tilapia price and increase consumption, thereby improving the overall nutritional status of the population.

The Center and its national research partners in the Philippines established in 1997 the GIFT Foundation International Inc. as an independent non-stock, non-profit organization primarily to continue the selective breeding research on Nile tilapia initiated by the GIFT project, and to undertake commercialization of the GIFT strain through partnerships with the private sector.

Using the network approach, the improved tilapia strain is being distributed through the International Network on Genetics in Aquaculture (INGA) to be used directly or to improve local stocks in the member countries from Asia and the Pacific. In Africa, where the parent stocks of the GIFT strain originated, the selective breeding method is now being applied for the genetic improvement of native tilapias. The technology is also being used for the genetic improvement of important carp species in Asia.

Source: Excerpts from various the WorldFish Center and partners' publications on genetic enhancement research.

A.4 STRENGTHS AND CORE TECHNICAL COMPETENCIES

The Center has a long established and highly recognized competence in **facilitating and conducting research** that is goal oriented. Our strength lies in applying international state-of-the-art technical expertise in the context of bio-physical, socio-economic and institutional conditions found in developing countries (see Table II for an example of the Center's role in facilitating research). The major strengths that cut across all Center's programs are:

- Technical competence for high quality research on fisheries development problems;
- Experience in mobilizing partners and managing collaborative research;
- Establishment of extensive networks with advanced science institutions, and national institutions and agencies in developed and developing countries;
- Continued presence (headquarters, branch offices, researchers) in target developing countries; and
- Ability to build capacity at a range of levels within developing countries

Table II. Facilitating Co-management Research 2001–2002

RESEARCH TOPICS	COLLABORATING INSTITUTIONS	WORLDFISH CENTER'S ROLE
Case Studies		
1) Community Participation and Attitudes towards Co-management in Cambodia: A case study in Steung Hao and Tropang Lapoeuv Communes of Sihanoukville.	Ministry of Agriculture, Forestry and Fisheries, Cambodia	• Provision of technical and financial assistance for case study development
2) The Process and Impacts Evaluation of the Policy Shift Towards Decentralization: A case study of Indonesia Coastal Waters Management	Ministry of Marine Affairs and Fisheries, Indonesia	• Provision of technical and financial assistance for process documentation
3) The Study on Co-management in Reservoir Systems in Vietnam: Thac Ba Reservoir case study.	Institute for Fisheries Economics and Planning, Vietnam	• Provision of technical and financial assistance for monitoring co-management performance
Research Focus Hypothesis Testing Testing the relationship between the presence of traditional authorities and success of Co-management Arrangements initiated on:		
• Lake Chilwa, Malombe and Chiuta, Malawi	Department of Fisheries, Malawi	• Development of methodologies for testing relationships between co-management variables
• Moma/Angoche and Inhassoro districts, Mozambique	Institute for the Development of Small Scale Fisheries, Mozambique	
• NE Swaps and Upper Zambezi River, Zambia	Division of Fisheries, Ministry of Agriculture, Food and Fisheries, Zambia	
Compliance		
1) Evaluation of the Compliance Behavior of Fishers in the Communities with Different Levels of Participation in Co-management Processes: A case study in Central JavaFisheries Indonesia.	Diponegoro University, Indonesia	• Development of methodologies for compliance analysis in fisheries
2) The Effect of Co-management Process on Enforcement and Compliance with Fisheries Regulations.	University of the Philippines in The Visayas, Philippines	
Scale Issues		
1) Scale Question in Co-management: Malalison Island and LIPASECU Bay Management Council.	Southeast Asian Fisheries Development Center, Philippines	• Development of models for addressing scales issues in co-management
2) Evaluation of the Integrated Municipal Council as an Institution for Co-management in the Coastal Zone.	University of the Philippines in The Visayas, Philippines	
Resilience and Equity		
1) Levels of Resilience and Equity of Co-management Systems in the Visayan Sea, Philippines Before and After 1998.	University of the Philippines in The Visayas, Philippines	• Development of methodologies for evaluating resilience of co-management institutions

The specific **core technical competencies** of the Center's staff are described below.

1. Socio-economic analysis of the fisheries sector

The WorldFish Center has a broad range of proven expertise in the field of socio-economic analysis of developing countries' fisheries, including fish sector modeling, analysis of supply of and demand for fish, valuation of aquatic resources, livelihood analysis, and impact assessment. The Center's scientists are also linked with the policymakers and planners in developing countries of Asian and Africa through an active fisheries social science network. The Center utilizes the synergies between the research skills of its economists and other social scientists as well as the network of policymakers to assist developing countries in designing appropriate strategies and options for improving food security and livelihood, reducing poverty and protecting aquatic environments.

The Center is at present developing a disaggregated WorldFish Model to help developing countries to design appropriate fisheries and aquaculture policies. A set of studies is being conducted in various developing countries to analyze demand for and supply of fish and other aquatic products by species group. Analyses of the economic value of aquatic environments such as coral reefs, floodplains and riverine ecosystems are being conducted to develop policy priorities and appropriate management regimes. The Center is also active in analyzing the impact of various international trade regimes (e.g., WTO, eco-labeling) on the sustainability of aquatic resources and the welfare of poor households; thereby assisting developing countries to develop their fish trade polices.

2. Institutional analysis for governance of aquatic resources

As a result of the Center's long global experience in community based fisheries management (CBFM) and co-management, it has developed core competencies in the areas of institutional analysis for the improved governance of aquatic resources. The Center's tested method to facilitate consensus building for resource management has showed improved co-management of resources. The processes involved in undertaking participatory action research are documented and disseminated to development scientists. The process is used to develop planning at local and national levels for aquatic resources management. The increased participation of stakeholders in the decision-making process has raised awareness among policymakers. Appropriate tools for evaluating impacts of community approaches for governance of aquatic resources have been developed at the Center. Skills in these areas represent a core competency for the Center.

3. Global databases for management of aquatic resources

Structured resource information on fisheries, taxonomy, ecology, socio-economics and policy is essential for effective management and sustainable utilization of aquatic resources. The Center contributes significantly to this area by providing public goods like FishBase, ReefBase and TrawlBase. FishBase, the premier global biodiversity database on fishes has had over 2.5 million hits. ReefBase has gathered the available knowledge about coral reefs into one information repository to facilitate analyses and monitoring of coral reef health and the quality of life of reef-dependent people. TrawlBase has provided fisheries managers in Southeast Asia and Asia with information on the decline of fish stocks and biodiversity, and options for restoring production.

4. Methods for developing improved fish strains

WorldFish Center has made a substantial contribution to methods for developing improved fish strains as evidenced by the development of the Genetically Improved Farm Tilapia (GIFT) project, which has resulted in 85 per cent improvement in tilapia growth over 5 generations of selection. The Center's work:
i) aimed at producing improved strains for pond aquaculture production resulting in increased income for poor fish farmers, and providing fish to consumers at a reasonable price;
ii) encompasses a wide range of activities starting from assessment of market requirements, development of high yielding strains, evaluation under different farm conditions, quantification of the impact of improved strains and development of mechanisms of disseminating improved strains to farmers; and

iii) is multi disciplinary ranging from socio-economic studies to molecular genetics. The work on Nile tilapia and carp has resulted in better performing strains and the development of new approaches and techniques for the selective breeding of fish.

5. Development and evaluation of small holder focused aquaculture technologies

Working in partnership with NARES and farmers in Bangladesh, the Philippines, Vietnam, Malawi, Ghana, Cameroon and Egypt has given the WorldFish Center a broad range of experience with a wide range of smallholder-focused fish production technologies, and has used this to identify suitable entry-level technologies that can then be progressively adapted and refined *in situ* to increase fish production and aquaculture profitability. Arising from this knowledge base is a long-term working knowledge at the field level of tools and protocols that bring researchers, farmers and extension personnel together to overcome constraints to aquaculture development, intensification and dissemination. The WorldFish Center uses a wide range of participatory monitoring and evaluation tools to measure farm productivity, efficiency and other household indicators to document and track changes resulting from aquaculture introduction or technology improvement initiatives, the results of which guide planning and implementation of new initiatives. This knowledge and the application of field and software tools are shared with partners in training courses conducted with NARES in Africa and Asia.

6. Culture and restocking of coral reef invertebrates

Our expertise in the development of sustainable methods for producing and growing low-input high-value coral reef species has provided small island developing states with additional options to create alternative livelihoods through farming and restocking of severely depleted fisheries. The ability to culture several species (e.g. giant clams, small reef fish and corals) has also provided managers of inshore resources with alternative, environmentally friendly ways of supplying coral reef animals to the marine aquarium trade.

7. Stock assessment of coastal fisheries

The Center is well placed to make appraisals of the abundance, size structure and species composition of multi-species tropical coastal fisheries, and to identify the reductions in harvests and fishing effort needed to restore coastal stocks to more productive levels. This ability rests upon: 1) length-based methods for single species stock assessment, which started with the suite of ELEFAN programs and culminated in the widely-used FAO—WorldFish Center FiSAT software; 2) the Ecopath software and modeling approach to assess the effects of fishing on entire assemblages and ecosystems; and 3) regional databases and analytical methods to evaluate the status and extent of shared stocks. This is reinforced by our skills in the identification of genetic stock structure to pinpoint the nature of trans-boundary fish stocks. The focus of this research has been Southeast Asia and South Asia.

8. Watershed approach to aquatic resources management

Fish, being at the downstream end of all activities that take place within a watershed, are particularly vulnerable to changes such as deforestation, soil erosion, use of agricultural chemicals, urban sprawl and pollution. By modelling nutrient cycles and resource flows within a watershed context using tools such as Ecopath the WorldFish Center has developed a range of tactical options for the mitigation of the frequently negative consequences of changes in watershed management. These cover the range of systems from lakes and other types of stagnant water bodies, over floodplains to river deltas. The focus will expand from enclosed systems such as lakes, reservoirs and lagoons, to include models for river management within a river basin context, in particular the Mekong basin. These will be at large scale (e.g. Bayesian models for trans-boundary management issues), medium scale (e.g. Multi-Agent System models analysing relationships among resource users), and small scale (e.g. flow volume requirement models of thresholds, seasonality, etc). Generic versions can be redesigned and applied to other basins. Innovative contributions will help bridge the gap between simple water management models, ecosystem models and socio-economic models. This unique approach responds to needs actually faced by management bodies in

developing countries. The Center is thereby positioning itself at the intersection of different methods and approaches and will contribute to coordinating them in order to provide a set of tools that will facilitate river management at different levels, thus enabling wise and equitable use and the conservation of fish and other living aquatic resources.

A.5 OUR PRIORITIES

Aquatic Resource Systems

At the WorldFish Center we focus on the aquatic resource systems that support large numbers of poor people in developing countries to varying degrees as discussed in the the WorldFish Center Strategic Plan 2000–2010. These aquatic systems are listed below.

Table III. WorldFish Center's priority resource systems and regions

AQUATIC RESOURCE SYSTEM	PRIORITY STATUS	REGIONAL FOCUS
Ponds	Very high	Asia,Sub-Saharan Africa (SSA)
Small water bodies, reservoirs and lakes	Medium	Sub-Saharan Africa
Floodplains, streams and rivers	High	Mekong Basin, South Asia, Sub-Sah. Afr.
Coastal waters (including estuaries and lagoons)	High	South Asia, Southeast Asia, Sub-Sah. Afr., SIDS
Coral reefs	Very high	SIDS (Pacific, Caribbean), Southeast Asia, East Africa
Soft bottom shelves	Low	
Upwelling shelves	Low	
Open oceans	Low	

Source: WorldFish Center Strategic Plan 2000–2020

Ponds

Ponds are small freshwater bodies, man made or natural, in rain-fed and irrigated areas where aquaculture, particularly integrated with agriculture, is possible. Flooded rice fields are considered ponds also. Ponds are normally under private individual or group ownership or leasing arrangements. They hold great potential for increase in productivity through polyculture, improved breeds and better management of pesticides.

Small water bodies, reservoirs and lakes

Small water bodies are bodies of water of less than 200 ha and seasonally or permanently filled with water. Reservoirs are natural or artificial water bodies used for irrigation, hydropower or domestic water supply. Lakes are natural water bodies. This resource system is usually freshwater and has high potential for aquaculture and enhanced capture fisheries. They are usually common property and offer free access for fishing. However, increasingly fishing rights are leased from governments or other authorities to groups or individuals.

Rivers, streams and floodplains

Rivers and streams are flowing waters while floodplains are lowland areas, adjacent to watercourses that are subject to periodic or near-permanent inundation. This resource system is highly productive and supports substantial inland fisheries in many part of the world. Normally it is common property offering open access except where access and/or ownership to surrounding lands restrict this.

Coastal waters, estuaries and lagoons

Coastal waters up to 10 m in depth encompass most fishing grounds of small-scale fishers. These areas are usually directly adjacent to soft bottom shelves, leading to conflicts with (trawl) fisheries operating there. Estuaries are semi-enclosed coastal water bodies with brackish water resulting from seawater being diluted with freshwater from land drainage. Lagoons are shallow water bodies resembling ponds or lakes, which usually have one or more restricted outlets to the sea. This resource system includes mangrove swamps and other key habitats that support coastal fisheries. This resource system interferes with terrestrial land use and is often an area of inter-sectoral conflict. It has potential for aquaculture and enhanced fisheries.

Coral reefs

Coral reefs are areas of continental or island shelves in tropical oceans in which reef-building corals are dominant features, forming various types of reefs and sheltered habitats, which have potential for aquaculture. This resource system is often exposed to intensive fishing and gleaning. Reefs are often open-access but traditional use rights exist in many places.

Soft bottom shelves, upwelling shelves and the open ocean

These resource systems, though important, are considered of lower priority in view of the lower potential impact on the poor communities targeted by the Center's research priorities, and the limited expertise currently available within the center.

Geographical Regions

Asia

Asia is the major world producer and consumer of fish and fish products, both from capture fisheries and aquaculture. All the above mentioned resource systems are vastly represented in the area which has a burgeoning population at great risk from further damaging of eco-systems and resource bases on which sustained productivity depends. The Center is well established in Asia where we have strong partnerships with national institutions and NGOs. We will maintain a strong geographical focus in this region.

Africa

Africa has intensive capture fisheries in coastal waters, estuaries, lakes, reservoirs, rivers and floodplains, which can all become more productive from improved management of the fisheries and fish habitats. There is much unrealized potential for increased aquaculture production by rural small-holders. As food security increasingly becomes a major concern in this region we at the WorldFish Center have developed a new program for Africa and West Asia including specific research objectives and outputs related to resource systems, aquaculture, fishery sector policy and capacity-building (Table IV). We will, from 2002, progressively focus on developing research and related activities in Africa to pursue these objectives and outputs. The increase in our activities will particularly draw on our hub in Abbassa, Egypt.

Table IV. WorldFish Center's Program for Africa and West Asia during 2003–2005

Focus of Program	Priority Areas
Rivers and floodplains	• Identification of appropriate governance systems • Valuation of riverine fisheries • Investigation of responses to natural and artificial changes in riverine systems (fish and fishers) • Development of appropriate management strategies
Lakes and reservoirs	• Determination of status of lake and reservoir fisheries • Evaluation and identification of: - options for increasing production in reservoirs; - appropriate governance systems; - approaches for conserving biodiversity in lakes
Coastal waters and estuaries	• Valuation of the region's coastal fisheries • Identification of governance systems for coastal fisheries • Evaluation of impacts from coastal zone pressures on fisheries
Aquaculture	• Understanding of adoption process in aquaculture • Development of: - techniques for enhancing productivity - methods to measure, monitor and maintain environmental integrity
Policy	• Establishment of: - detailed estimates of future supply and demand for fish - estimates of impact of climate change on fish production
Capacity building	• Enhancement of research capacity of national institutions

Pacific and Caribbean Island States

We continue to consider the Small Island Developing States as critical clients for our research outputs because of their complete reliance on aquatic resources for food security, income generation and livelihood. The results from our applied coral reef and coastal management research are applicable in many sites in this region as well as to sites with similar habitats in other regions.

A.6 RESEARCH AGENDA (2003–2005)

6.1 Summary of Program Achievements and Future Plans

6.1.1 Biodiversity and Genetic Resources Research Program (Biodiversity and Genetics Program)

The Biodiversity and Genetic Resources Research Program (Biodiversity and Genetics Program) plans and implements research on the conservation and sustainable use of genetic diversity. The overall program goal is to ensure that the benefits of aquatic biodiversity are available for the poor in the developing world in a sustainable manner. The intermediate goals of the Biodiversity and Genetics Program include: 1) Aquatic biodiversity (genetic diversity within species, species diversity and ecological diversity) be restored, conserved and used in a sustainable manner 2) Farmers realize increased and more efficient fish production in an environmentally sustainable manner.

The main purpose of the Biodiversity and Genetics Program is that research institutions, management agencies and NGOs use scientific tools and methods for understanding, conserving and sustainably using aquatic biological diversity. Secondly that national breeding programs supported by the Center, maintain and continuously improve strains for distribution to farmers and take measures to ensure maintained genetic diversity of aquaculture species. The Biodiversity and Genetics Program has the following thrusts i) the conservation of aquatic biological diversity, ii) mitigation of adverse impacts of alien species on aquatic biological diversity and iii) genetic improvement and breeding.

WORLDFISH CENTER THRUST 1(=MTP PROJECT 1):
Conservation of aquatic biodiversity

Output 1: FishBase as a global biodiversity database

Achievements in 2001-2002

- Work on harmonizing the fish entries in FishBase and Catalogue of Fishes (CAS) to create an accurate on-line world checklist of marine and brackish water fishes was carried out. This will further strengthen the utility of FishBase in aquatic biodiversity studies.

- FishBase was enhanced with over one million records by pursuing participation of more museums, particularly in developing countries (e.g. Academia Sinica, Taiwan,), by updating collection databases (e.g., MNHN, France), and repatriation of biodiversity data to Africa, Caribbean and Pacific (ACP) countries.

- By 2001, FishBase had covered 96 per cent of the estimated world fish species; it had been made available to over 160 countries; there were 18.1 million hits on the web site with 1.2 million users' sessions and 550 000 unique visitors.

Plans for 2003–2005

- Core activities identified for maintenance of FishBase will be carried out. This would involve web-based work as well as ensuring that the recent updates on nomenclature are incorporated. A set of collaborative activities with the FishBase Consortium related to further expansion and refinement will also be implemented.

Output 2 : Applications of FishBase for developing countries

Achievements in 2001-2002

- The work on FishBase significantly expanded and facilitated access to management-oriented information on fish resources, including the use of analytical tools like *"*Key Facts*"* for status-of-fishery analyses.

- In FishBase, ecosystem analyses have been facilitated through direct links to structured biological parameters for ecosystem models (Ecopath), comparative ecosystem characterizations (Lindeman pyramids), historical analyses of national catch data (e.g. FAO statistics), and the profiling of all the 60 global Large Marine Ecosystems (LMEs).

- Morphology and biology of larvae of over 1 400 species has been encoded into LarvalBase and is supported by more than 1 428 references. LarvalBase includes more than 1 200 drawings and photographs of various aspects of larval biology. Several keys are available as identification tools for fish larvae. By compiling information on fish larvae and making it available on the web, aquaculture-relevant information on larval identification and rearing has been made available to farmers from developing countries

Plans for 2003–2005

- Through joint meetings with Philippine national partners a customized Philippine FishBase with theme-based applications will be developed and demonstrated. Work on developing similar databases in China and India will be initiated. Training manuals on building country-specific customized databases (data-encoding, validation, database linkages, related web-site development) will be developed. Training of developing country collaborators with special emphasis on Africa will be carried out, and customized database work will be initiated in two African countries.

- Analytical tools such as "Species / Key Facts" matrices for ecological and community analyses and analytical tools on species identifications will be further refined. Analytical tools to support management of protected coral reef areas and coastal zone management will be developed in collaboration with the Coastal and Marine Resource Research Program. Spatial (GIS) functions in FishBase towards natural resources modeling, and spatial management e.g. biogeographic evaluation of species introductions, identification and analysis of conservation "hotspots" will be expanded. An international workshop on developing application-based databases for fisheries and aquaculture will be held.

Output 3: Decision-making tools utilizing data on species and habitat diversity

Achievements in 2001–2002

- The semi-quantitative model for the management of water flows to optimize aquatic resources production in the Mekong Basin has been further refined and the present computer Bayesian model has clearly brought out the need for looking beyond fishery statistics, for identification of factors driving fish production.

- The workshop on "Mangrove Systems of Asia: Diversity and Variable Contribution to Coastal Zone Fisheries" was able to identify crucial ecological and diversity factors which would enable planning future programs on mangroves.

Plans for 2003–2005

- Work will be carried out on compilation of species and habitat diversity information along with socio-economic information for selected freshwater sanctuaries. Based on these a generic management plan and decision-making tool will be developed.

- Work will be carried out to further refine and implement the Bayesian model of Mekong fish resources and their environment and to develop a multi-agent model of the Tonle Sap Great Lake fisheries (fish and users) in Cambodia. Based on this work, a generic Bayesian model for use in other river basins would be developed.

- The Center will work with a range of international partners to integrate in-stream flow assessment methodologies with fish-flow models and other decision-support tools such as Bayesian models, and develop a set of methodologies that will support water allocation and fishery management decisions in tropical rivers. This will be pursued in river basins in Asia, Africa and Latin America and will be a major initiative under the Water and Food Challenge Program.

Output 4: Utilisation of genetic diversity information for conservation and management of 'key' species

Achievements in 2001–2002

- Quantification of genetic variability in the brackish water tilapia, (*Sarotherodon melanotheron)*, and related West African tilapia species that are widely exploited in the coastal zones of West Africa, has helped resolve taxonomic ambiguities and identify distinct genetic units over their distribution range. Both findings have important implications in the conservation of the natural stocks.

Plans for 2003–2005

- Genome introgression and changes in life history traits in natural stocks of common carp (China) and Indian major carp (India) due to the interaction of escaped farmed fishes with wild fish will be quantified. This would help in evolving better broodstock management practices and corrective policy measures. Characterization of domesticated and selected stocks of carp and tilapia at genetic as well as phenotypic level will be carried out. With this information it will be possible to prioritize strains that need to be conserved and utilized more extensively for aquaculture and in selection programs. Population genetics studies of giant clam and sea cucumber will be done to determine the possible genetic changes due to stock enhancement programs, and to develop stocking programs which minimize the genetic impact.

- Work on the biodiversity of freshwater fish will be continued in West Africa. This will strengthen regional capacity to carry out further biodiversity studies while pursuing more intensive research on the constraints on the use of new species in aquaculture. This will include both technological and market studies.

WORLDFISH CENTER THRUST 2 (=MTP PROJECT 2)
Mitigation of adverse impact of alien species on aquatic biodiversity

Output 1: Development of tools to assess risks and response mechanisms to mitigate the adverse impact of alien species

Identification of factors leading to freshwater alien species introduction will help in developing strategies aimed at reducing the establishment of alien species. Development of tools to assess risks and evaluate impacts will facilitate the development of guidelines and mechanisms for introduction of improved strains. Management and policy recommendations will ensure better response mechanisms to handle the adverse impacts of alien species.

Plans for 2003–2005

- The research plan will include identification of pathways and development of tools to assess risks and any adverse impact on biodiversity. Socio-economic factors influencing alien species establishment will be determined. The other major component will include development of a national strategy and guidelines for Malaysia on aquatic alien species with Malaysian partners. Generic response mechanisms and guidelines on translocations of alien species and minimizing escape of farmed individuals will also be developed.

- In Africa, a review of high priority conservation areas for tilapia species will be conducted and recommendations developed on appropriate conservation measures required, including guidance on the future development of aquaculture in these areas. A study of the biodiversity of tilapias in Lake Nasser is planned, as well as a study of the impacts of escapes from aquaculture upon the biodiversity of tilapia populations in the Nile.

WORLDFISH CENTER THRUST 3 (=MTP PROJECT 3)
Genetic Improvement and Breeding

Output 1: Development of improved strains by national breeding programs

Achievements in 2001–2002

- By means of selection programs for Nile tilapia (*Oreochromis niloticus*) in Côte d'Ivoire, Egypt and Ghana, and for *O. shiranus* in Malawi, the process of transfer of the GIFT technology to Africa has been initiated.

- The project proposal for the second phase of the activities on 'Developing improved carp strains for aquaculture in Asia' has been submitted for funding.

Plans for 2003–2005

- Project on 'Developing improved carp strains for aquaculture in Asia' initiated with a planning workshop of collaborative partners. The work would involve multi trait selection and multi location evaluation of improved strains. The developement of dissemination strategy for improved strains of carps would be a major focus of study.

Output 2: Development and dissemination of methods for genetic improvement

Achievements in 2001–2002

- New selection programs using the GIFT tilapia stocks have been initiated with Malaysian partners for undertaking strategic research on selection to strengthen already existing programs in Africa and Asia.

- A workshop on statistical analysis of data from breeding programs was held in May 2002 in Egypt. A practical manual is in its final stages of preparation for use beyond the present project, and a software Excel package has been developed to implement the estimation of parameters and the genetic evaluation of breeding stock.

Plans for 2003–2005

- Conduct further selection on 8th generation of GIFT fish at Jitra based on breeding values. The GIFT strain will be compared with local strains in a range of environments. The merits of YY male technology in a commercial situation and the value of F1 clones as controls in a genetic improvement program will be assessed. Innovative approaches for selective breeding and recording of economically important traits (especially disease resistance) will be tested. Selective breeding of tilapia for high and low input pond environments as a component of integrated farming will be carried out at Abbassa. Molecular techniques (e.g. MAS) will be incorporated into breeding programs when appropriate. A manual on selective breeding of carp and customized software will be prepared. Training programs will also be organized for developing country scientists.

6.1.2 The Freshwater Resources Research Program (Freshwater Program)

The program seeks to improve the livelihoods of fishers, fish-farmers and consumers of freshwater living aquatic resources. The program is built from a series of activities aimed at increasing the productivity, sustainability and profitability of freshwater aquaculture and the improved management of lakes, reservoirs, small water bodies, rivers and floodplains. Based on a review of human needs and the biophysical potential for positive gains from research, Africa and Asia currently dominate the activity portfolio. The overall strategy for realizing the goal of sustainably improved management of freshwater resources is based on holistic analysis and pragmatic problem-solving.

FRRP has two main thrusts aimed at (1) increasing the productivity and sustainability of freshwater aquaculture within the context of African and Asian farming systems and, 2) improving the knowledge base and management of freshwater living aquatic resources within the context of changing watersheds. The activities in these thrusts contribute to six overall outputs, i.e. three per thrust.

WORLDFISH CENTER THRUST 4 (=MTP PROJECT 4)
Strategies and options for realizing gains from sustainable freshwater aquaculture systems.

Output 1: Thorough understanding of target group needs and constraints.

Achievements in 2001–2002:

- *On-Farm Research*: In Malawi, a baseline socio-economic survey was conducted revealing that households that were already operating fish ponds were slightly better off economically than households without an aquaculture operation. New users are those farmers who have access to land in lowland areas along natural water courses (e.g. *dambos* or *dimba* gardens) or in lowland depressions holding water seasonally, and are located in the vicinity of their homesteads. Access to information on appropriate techniques of low-risk entry-level technology (usually through IAA) is essential for the successful adoption and subsequent improvement of the new farm component. Impacts of ongoing interventions with these households will be determined in the coming years, based on these data. In southern Malawi, almost 300 farmers are being monitored to determine the contribution of IAA to their livelihood and the effect of improvements to their aquaculture operations.

- *On-Farm Research*: In Cameroon, the successful startup and implementation of a strategy to study the effects of population density and market access on aquaculture adoption and the extent to which this improves their livelihood was implemented. One hundred farmers are being monitored. A range of additional studies by local partners was initiated, which will provide further key information for our understanding.

- *On-Farm Research*: In Bangladesh, detailed whole-farm surveys of 200 households that adopted rice-fish culture or carp polyculture were conducted. These will serve as a baseline for future assessments of the impact and sustainability of the adoption.

Plans for 2003–2005:

- During this Medium Term Plan period, the Malawi site will expand the implementation of the Research Extension and Training (RET) approach to cover the major aquaculture areas in Malawi and newly initiated activities in Zambia will be further supported.

- In Mozambique, the RET approach and aquaculture development activities will be initiated in the Manica Province (unlike the Zambia activity, this activity is entirely dependent on external funding).

- In Cameroon, in the final year of the project in 2005, an impact evaluation will be conducted on the households in different market access and population density categories.

- In Egypt, a study of the socio-ecnomic constraints to aquaculture will be undertaken.

- In Bangladesh, wealth-ranking exercises will be conducted to select 360 households in four separate wealth strata, with which household-level assessments will be conducted using the Research Tools for Natural Resource Management Monitoring and Evaluation (RESTORE) approach. These will serve as the baseline for subsequent improved aquaculture technology adoption trials, depending on the needs, constraints and selection of the cooperating farmers.

- In Vietnam, farm households with homestead garden-ponds will be assessed using the RESTORE approach and additional assessments made on the theoretical suitability of improved

aquaculture technologies.

Output 2: Portfolio of new and improved aquaculture technologies.

Achievements in 2001–2002:

- *Production Research*: In Egypt/Abbassa, natural spawning of African catfish was achieved through manipulation of the environment (water level, shelter). Further research is now being conducted in Abbassa, Yaounde and Domasi on identifying the nature of the cues, in order to derive a reliable technique for reproduction of catfish under low-technology conditions.

- *IAA Technology Research*: In Malawi, a study was continued on the identification of factors regulating nitrogen retention in IAA systems. In Cameroon, 20 sponsored research projects have examined a wide range of topics related to the intensification of small-scale integrated aquaculture systems. In Bangladesh, nine sponsored studies conducted through national partners on components of IAA and cultured fish utilization and quality were completed (e.g. *Azolla* in rice-fish culture, and *Macrobrachium-carp* polyculture). In Egypt, in 2001 a number of different options were examined in the experimental production ponds at Abbassa to test pond management practices that will help farmers to reduce costs, diversify production practices, and exploit market opportunities for various sizes of fish and at various times of year.

Plans for 2003–2005:

- During the MTP period, in Malawi, the study on the identification of factors regulating nitrogen retention in IAA systems will be completed.

- In Egypt, work is planned to study the role of fishponds in the nutrient dynamics of mixed farming systems. Work beginning in 2002 will evaluate the impact of tilapia in low and high environments on the nutrient dynamics of the pond. The schedule of pond experiments at Abbassa will be implemented from 2002 to 2005. This work aims to:
    - o quantify the temporal variation in nutrient availability and requirements in east-African land-based agriculture on the basis of literature data.
    - o characterise nutrient dynamics in different tilapia culture environments (including high and low input systems and different strains of tilapia).
    - o quantitatively describe the process of sludge formation and evaluate the value of sludge as a fertilizer in land-based agriculture.

- Further work in Egypt will study fish farming economics and assess overall supply and demand of fish in Egypt. The objectives of this work are to:
    - o understand the farm economics of different aquaculture practices and levels in Egypt based on the current prices for inputs and fish.
    - o assess the impact of future projections of supply and demand for fish, and the availability and costs of inputs, for the profitability and economic sustainability of these different systems.
    - o demonstrate the economic conditions under which aquaculture can continue to play its central role in food security and livelihood support in Egypt.
    - o identify market conditions under which future investment in aquaculture in Egypt will be fully viable.
    - o assess the demand for fish and fish products from different sources (national aquaculture and capture fisheries and imports) through the course of the year, taking account of consumer preferences at different social and income levels.
    - o determine the factors responsible for the decline in fish sale prices, in particular distinguishing between changing consumer preferences and market reaction to increasing supply.

- In Bangladesh together with partner institutions, research will be conducted to solve production bottlenecks and clarify key aspects of IAA systems as identified with target beneficiaries to benefit them. Technologies appropriate to economic strata of target farmers will be tested on-

farm in comparison across different sites and monitored with the RESTORE tool over three years.

- In Vietnam, farmer-selected technologies for homestead garden ponds (e.g. polyculture of carp species with Nile tilapia (GIFT strain), freshwater prawn or marble goby will be tested in on-farm trials. Shrimp-fish polyculture options will be evaluated in low-salinity (< 12 ppt) brackish water ponds in order to achieve greater species diversity and resilience of operations, among others against disease outbreaks and economic loss.

Output 3: Sustainable systems and guidelines for the dissemination of aquaculture information and technology to fish farmers.

Achievements in 2001–2002:

- *Extension*: In Bangladesh, several thousand new farmers implemented either project-supported on-farm aquaculture demonstrations in ponds or flooded rice fields, or non-sponsored trials of improved aquaculture technologies based on training given to them by the Center-trained NGO extensionists. Additionally, approximately 100 field-days/rallies were organized for interested neighbors of demonstration farmers.

- *Training*: In Bangladesh, 109 field workers (91 field assistants and 18 project coordinators) from 18 NGOs were trained; 76 senior NGO staff received training courses in the suitable, affordable and farmer-friendly aquaculture technologies developed by the Center and partners.

- *Training*: In Malawi, two training courses on participatory research and extension were held for GO and NGO researchers and extensionists including three participants from Zambia.

- *Training*: In Bangladesh, a RESTORE training course was held in Dhaka from 3-5 September for 14 staff and partners of the WorldFish Center-DSAP project. The approach will be implemented as a key component of its on-farm research activities starting 2002. In Malawi, a RESTORE training course was held in Domasi from 3 to 6 December for 12 staff and partners, including two participants from Zambia. The process is an established tool in on-farm research and monitoring activities on IAA in Malawi conducted by the Center and its GO and NGO partners.

- *Training* : In Egypt the following courses were conducted:
    - Improving Fish Farm Management (18-22 February 2001) in collaboration with MSSP for 18 participants.
    - Production of all-male *O. niloticus* fingerlings (7-10 May 2001) for one private fish farmer from Jordan.
    - Tilapia Hatchery Management (24-28 June 2001) for 3 participants of a desert farming operation.
    - Enhancing Hatcheries Productivity (26-30 August 2001), in collaboration with MSSP for 17 participants.
    - Enhancing Sustainable Aquaculture Production (13-22 October 2001), in collaboration with FAO, Near East Office, for 13 participants from 12 countries.
    - Application of Nutritional Principles and Practices in Various Farming Systems (11-14, March 2002) in collaboration with MSSP for 19 Egyptian participants.
    - Tilapia culture in fresh and brackish water (April 21 – May 02, 2002) in collaboration with FAO, Near East Office, for 5 participants from 3 Arab countries.

Plans for 2003–2005:

- In Malawi, training on participatory aquaculture research and extension for NGO personnel will be carried out.

- In Egypt the successful program of training for farmers and cooperatives will be continued. This will place increasing emphasis on new technologies being developed by the Center that

improve the cost-effectiveness of investments in pond aquaculture. Regional training courses for NARS staff will also be continued.

- In Bangladesh, over 500 extension workers and senior NGO staff of cooperating NGOs will be trained. The training program comprises foundation training, 3-5 refresher training courses and on-the-job training in participatory extension approaches, as well as technical, financial, organisational and gender issues. Ultimately, 7000 additional farmers are to benefit every year directly from training and support from the partner NGOs, and an additional number in the same magnitude are expected to benefit through adoption of improved aquaculture technologies imparted by staff of associate NGOs whose extensionists have received training from the Center, but no financial support. This will generate a good understanding of the sustainable pathways for improved aquaculture technology diffusion and the criteria for adoption.

- In Vietnam, in cooperation with the Department of Fisheries of Bac Lieu Province in the Mekong Delta, and the University of Cantho, efficient dissemination of IAA options to target farmers will be implemented.

- During the MTP period, the BMZ-funded 'Recommendation Domains' project will be implemented, which will identify characteristics of successful aquaculture development pathways and conditions, and formulate these into a useful tool for wider application. Two recently completed publications in collaboration with FAO and IIRR will be e-published on the Internet and on CD-ROM.

- Web-based and CD-ROM-based versions of two recent publications with FAO and IIRR, summarizing existing technologies for smallholder aquaculture will be prepared.

WORLDFISH CENTER THRUST 5 (=MTP PROJECT 5)
Freshwater fisheries in an integrated land and water management context.

Output 1: Thorough understanding of target communities' needs and constraints.

Achievements in 2001–2002:

- *Fish-in-Watersheds Research*: In Malawi, the importance of integrated watershed management for fish resources in the Lake Chilwa catchment was studied. Improved erosion-reducing land management options were tested and their effects documented. Techniques for enhancement of fish production from the lake through managed brushparks were tested and show higher potential harvests.

- *Fish-in-Floodplains Research*: In Bangladesh and Vietnam, socio-economic surveys of communities revealed their economic status and use of floodplains during the dry season for rice production, and during the flood season for fishing and opportunities for fish culture.

- *Fish-in-River Deltas Research*: In the Mekong River delta, surveys of fish markets, trawl surveys of fish abundance, plankton, benthos and water chemistry revealed the seasonality of fish species composition and their abundance in human-made canals, based on river freshwater flow amounts and controlled operation of sluice gates regulating saltwater inflow. Landless poor farmers depend on fisheries in brackish water canals for a major part of their livelihood. However, fish availability depends on managing sluice gate opening to supply saline water, thus making the fish and other resourcess available to the landless part-time fishers.

Plans for 2003–2005:

- During the MTP period, a project will begin in Malawi and Mozambique which will employ GIS mapping of historical land use changes and will conduct water quality monitoring in the Mnembo Catchment, Mozambique. Furthermore, geostatistical mapping of the temporal and spatial distribution of *Barbus* species (locally known as 'matemba') around the mouth of the Mnembo

River in Lake Chilwa (Malawi and Mozambique) will be conducted.

- In Bangladesh, further studies on community-based fish culture in seasonally fenced areas will be conducted.

- In the Mekong Delta in Vietnam, studies will be completed in 2003 and recommendations formulated for policymakers for water flow management under multiple-use objectives.

- Monitoring of actual catch and effort of different fishing gears, and salinity and pH of canal water before, during and after sluice gate opening will provide data for better understanding of the role of brackish water fisheries for the landless poor. These are mainly in the saline-dependent acid-sulphate soil area in the western part of the province, which is in contrast to the freshwater-sufficient areas in the eastern part with alluvial soil. Data will feed into the existing Vietnam River Systems and Plains (VRSAP) water and salinity flow model, and will enable the estimation of fish abundance dependent on on brackish water inflow amounts.

Output 2: Technological options in relation to trade-offs necessitated by the community level at which fishers operate.

Achievements in 2001–2002:

- *Community-Based Research*: In Bangladesh and Vietnam, the seasonal operation of community-based fish culture in fenced flooded areas proved socially and economically viable. We observed increases in net return to farmers of US$220-400/y, which resulted from fish yields of 1 000 - 1 550 kg/ha/flood season in the alternating fish-after-rice system, and 490-615 kg/ha/flood season in the concurrent fish-in-deepwater rice system. The success of the technology was underlined by the fact that numerous neighboring groups were spontaneously formed around the project's trial areas; these groups copied the principle of the approach and then established their own areas and arrangements.

- *Brushparks in Lakes*: In Lake Chilwa in Malawi, community-operated brushparks were field tested for the first time. The approach will be refined to achieve higher fish yields through the brushparks which serve for periphyton-grazing substrates and catch-protection shelters.

Plans for 2003–2005:

- During the MTP period, in Bangladesh, a new research initiative into the improvement of fish production (naturally occurring and stocked) in seasonally fenced areas will be implemented. In eastern India, as a new site for FRRP and in collaboration with the national partners in West Bengal, trials will be conducted on community-based fish culture in seasonally flooded and fenced areas, following the achievements and experiences gained from recent work in Bangladesh and Vietnam.

- In the Mekong Delta in Vietnam, the management options for the sluice gate operation for brackish water inflow will be assessed with regard to optimised fish production through catch in canals, in relation to the competing needs of other stakeholders.

Output 3: Appropriate decision-support tools and institutional arrangements for management of freshwater inland fisheries.

Achievements in 2001–2002:

- In Bangladesh, community-based fish culture trials revealed stable institutional arrangements developed and agreed upon by landowners and landless who formed groups for the specific purpose of joint management of the fenced and stocked area for the duration of the floods. These areas were as follows moderate size of enclosed area of 2-10ha; moderatesize of membership of 10-30 members; and sharing arrangements of 30:30:30:10 for participating landowners, non-participating landowners, landless and fund replenishment, respectively.

- The Center convened a workshop on in-stream flow requirements for tropical river fisheries in Cape Town in 2002. On the basis of this a research agenda has been developed and first steps have been taken in establishing an international consortium of research partners who will work further on these issues over the next 3 years.

Plans for 2003–2005:

- During the MTP period, social science studies will examine the adoption patterns and agreed institutional arrangements among communities already implementing the community-based fish culture approach. The expansion of this community-based aquaculture approach in Bangladesh and Vietnam will be monitored. A similar research project is planned for eastern India.

- In the Mekong Delta of Vietnam, modelling of fish availability, as a function of flood control measures through sluice gate operation to enable brackishwater inflow vs. freshwater will produce guidelines to manage the water supply for the benefit of the poor. The aim is to enable brackish water canal fishing by the most poor, and low-intensity brackish water shrimp culture (in polyculture with fish) by the less poor and other stakeholders.

- In Africa, emphasis will be given to river and lake fisheries. Activities will focus on the governance, value, flow requirements, and management approaches to increase the benefits of fisheries in lakes and reservoirs and small water bodies.

6.1.3 Coastal and Marine Resources Research Program (Coastal Program)

The Coastal and Marine Resources Research Program strives to equip developing countries with the means to increase the productivity of inshore fisheries resources on a sustainable basis. In particular, the program endeavours to assist managers to rebuild stocks to more productive levels; to increase the productivity of fisheries resources and the opportunities for alternative livelihoods through the application of aquaculture; and to reverse the degradation of the habitats that support fisheries.

The program focuses on inshore fisheries, particularly those associated with coral reefs and shallow soft sediments in Asia, Southeast Asia and the Pacific. There have been three recent changes in emphasis within the program. The first has been the decision to expand the scope of research on inshore fisheries in Asia and Southeast Asia to determine how to reconcile the need to limit catches to rebuild stocks to more productive levels, with the need to ensure that the available catch is distributed equitably among the different sectors in a way that does not jeopardize the recovery of the species. The second has been to change the nature of the database on the world's coral reefs, ReefBase, so that it also functions as the global information system on the status and management of coral reefs. The third has been to integrate many of the project activities within the program in large grant applications with multiple partners, e.g. the International Coral Reef Action Network (ICRAN) initiative funded by the United Nations Foundation (UNF), and the CGIAR Challenge Program Pre-proposal to reverse degradation of coastal resources and enhance livelihoods entitled'"Making the Most of the Coast".

WORLDFISH CENTER THRUST 6 (=MTP PROJECT 6)
Increased and sustained coastal fisheries production

Output 1: Guidelines for sustained, equitable harvests of wild stocks

Achievements in 2001–2002:

- WorldFish Center succeeded in raising awareness of the serious plight of trawl fisheries in Asia and Southeast Asia by convening the "International Workshop on Management of Tropical Coastal Fisheries in Asia" in March 2001. The workshop highlighted the decline in coastal fishery resources throughout the region to 10-30 per cent of original unfished levels. In addition,

the relative abundance of the more valuable fishes (such as groupers, snappers, sharks and rays) has decreased sharply and there has been a proportionate increase in smaller, less valuable species. These results provide a clear picture of the extent of stock rehabilitation required to restore maximum economic value to the fisheries of the region.

- Research on smaller-scale fisheries in the Caribbean has demonstrated that the introduction of progressively larger escape gaps in fish traps in Jamaica will lead to substantial increases in the value of the catch, and help to replenish the fishery. As stocks there appear to be mainly self-recruiting, such measures are needed to establish and protect a larger spawning biomass to rebuild the fishery to more productive levels.

Plans for 2003–2005

- Recruit an additional Fisheries Resources Scientist to lead projects on sustainably increasing the yields from wild stocks.

- Implement follow-up activities for the project on "Sustainable Management of Coastal Fish Stocks in Asia". The main objectives of the second phase are to: 1) assist more countries to enhance their information, assessments, capabilities and action programs for sustainable use of coastal fishery resources, and 2) strengthen regional collaboration in coastal fisheries assessment and management.

- Transfer the methods developed under the project on "Sustainable Management of Coastal Fish Stocks in Asia" to Oman to meet their request for assistance in management of coastal fisheries.

- Initiate more comprehensive research on genetic linkages between populations of valuable coral reef and inshore fish and invertebrates in Asia and the Pacific to delineate stocks as the basis for co-operative, trans-boundary management.

- Implement the results of the research in the Caribbean through: 1) a participatory co-management project with fishers to test the potential benefits of rectangular escape gaps and increased mesh size in fish traps; 2) identifying alternative livelihoods for fishers while inshore stocks are rebuilt through changes to the design of fish traps and other management measures.

- Test the potential of marine protected areas (MPAs) as a fisheries management tool by: 1) developing a proposal for a large-scale test of the hypothesis in collaboration with the Government of Malaysia, and 2) assessing the time required for the re-establishment of adequate spawning biomass for a range of invertebrates following closure to fishing in the Arnavon Islands Marine Conservation Area in Solomon Islands.

Output 2: Aquaculture-based technology to increase the productivity of coastal fisheries

Achievements in 2001–2002

- In collaboration with the Secretariat of the Pacific Community (SPC) and the University of the South Pacific (USP) the Center organized the first consultative workshop on setting priorities for aquaculture research in the Pacific in March 2002. As the partner within this regional alliance to continue the development of aquaculture, WorldFish Center is responsible for co-ordinating the provision of technology required to underpin the establishment of viable aquaculture enterprises.

- Important progress was made in the development of technology for restocking over-exploited coral reef invertebrates as a practical way of fast-tracking the recovery of spawning biomass: methods for the hatchery production of tropical sea cucumbers were transferred successfully to Vietnam, a case study was submitted to FAO on the potential for restocking sea cucumbers in the Pacific, and research to develop optimal strategies for releasing cultured juveniles in the wild was initiated in New Caledonia. In addition, a keynote address on the management of

restocking and stock enhancement programs was delivered at the Second International Symposium on Stock Enhancement and Sea Ranching.

- The capacity of Pacific Island nations to assess the potential for using aquaculture to create additional opportunities for livelihoods was increased by transferring methods for catching blacklip pearl oyster spat to Tonga. Discussions to transfer technology for production of giant clams to Malaysia was initiated to establish village-based farms to supply the aquarium trade and restock MPAs.

- The research in Solomon Islands on capturing wild post-larval coral reef fish and invertebrates, and rearing them in captivity, continued to show much promise for the development of a viable artisanal fishery capable of meeting many of the demands of the marine aquarium industry in an environmentally friendly way: many species have now been reared to market size within 4-6 weeks of capture.

Plan for 2003–2005

- Complete a major review of restocking and stock enhancement of marine invertebrates for Advances in Marine Biology.

- Produce a book on the "Status and Potential of Aquaculture in the Pacific".

- Secure funding to implement the Center's role as the provider of technology for the development of aquaculture in the Pacific.

- Transfer the methods for propagating sea cucumbers to the Asia-Pacific through a "hands on" workshop in hatchery methods.

- Complete the research needed to develop optimal strategies for the release of juvenile cultured sea cucumbers in the wild to restore stocks.

WORLDFISH CENTER THRUST 7(=MTP PROJECT 7)
Restoration and protection of coastal habitats

Output 1: Interventions to reduce damage to the coastal zone

Achievements for 2001–2002

- The action phase of the ICRAN project to reverse the degradation of coral reefs was initiated in collaboration with six other partners and support from UNF. This project is centred around the concept of identifying and strengthening "demonstration" sites, i.e. areas where coral reefs are being managed sustainably in a variety of ways, and then spreading the good practices to "target" sites. To secure the additional funds needed to achieve all the outcomes in the ICRAN Strategic Plan, a fundraising strategy has been contracted to a company in the US.

- WorldFish Center is the executing agency for the preliminary Global Environmental Facility (GEF) proposal entitled–"Investigations of the Impacts of Localized Stress and Compounding Effects of Climate Change on the Sustainablility of Coral Reef Ecosystems and the Implications for Management". This project is based on working groups to identify and implement research on major coral reef issues, particularly bleaching, connectivity, remediation, remote sensing and disease.

- The concept note for the Challenge Program to increase productivity in the coastal zone by reversing habitat degradation and advancing livelihood options, submitted to the CGIAR, was approved for progression to the pre-proposal stage. The Center then co-ordinated submission of a pre-proposal entitled "Making the Most of the Coast" by a partnership of 26 agencies.

- The Center also organized a workshop on mangroves entitled “Mangrove systems of Asia: diversity and variable contribution to coastal zone fisheries”, which highlighted the need to classify mangroves not only on the basis of their geomorphology and botany, but also on their faunal diversity and fisheries productivity.

Plans for 2003–2005

- Expand the number of demonstration sites for the ICRAN project in Southeast Asia, the Caribbean, the Pacific and in east Africa.

- Co-ordinate the development of the full proposal for the GEF targeted research proposal on coral reefs and contribute to the working groups on coral bleaching and remediation of coral reefs.

- Assist in the preparation and implementation of the full proposal (if approved) for a Challenge Program on reversing habitat degradation and enhancing livelihoods in the coastal zone, and contribute fisheries activities to the Challenge Program on Climate Change.

WORLDFISH CENTER THRUST 8 (=MTP PROJECT 8)
Knowledge-bases and training for improved management of coastal resources

Output 1: Knowledge-bases for coastal resources, technology to improve production, and options for management

Achievements in 2001–2002

- The ReefBase website now includes substantial data on the resources, status, threats and management of coral reefs worldwide, together with an interactive mapping facility to display much of this information. This material includes the national status reports produced by the Global Coral Reef Monitoring Network for more than 50 countries. In May 2002, the website was receiving over 12,000 hits per day. The Center was also a major partner in the publication of the “Atlas of Coral Reefs”, a significant new publication on the world’s coral reefs by UNEP-WCMC, and the “Reefs at Risk” report for Southeast Asia. Both of these products are now included in ReefBase.

- The “TrawlBase” database established for the project on”“Sustainable Management of Coastal Fish Stocks in Asia” to aid the co-operatrive management of eight countries in Asia and southeast Asia now contains records from ~20,000 trawl survey “hauls”. The utility of this database was improved greatly in 2001 through the release of the Fisheries Resource Information System and Tools (FiRST) software for the analysis of the data using a variety of stock assessment software produced by FAO and WorldFish Center.

Plans for 2003–2005

- In the next 3 years, ReefBase will:
    - Expand and update its information on coral reef status, threats and management to include comprehensive and current information for all countries with reef resources.
    - Create an online data access and summary analysis facility for all reef level data derived from the Global Coral Reef Monitoring Network.
    - Work with national counterparts to create coral reef information systems for each country or region which incorporate links between detailed national data and the summary global information in ReefBase.
    - Develop specialised themes for data acquisition and summary, including coral bleaching, economic valuations and MPA management.

- The TrawlBase database will be expanded geographically – the plan is to obtain funds to include data from Australia, Cambodia and China. We will also concentrate on obtaining trawl survey data that were not available previously from participating countries to ensure that the

database is as comprehensive as possible.

Output 2: Training materials to improve capacity for assessment of fisheries and habitats and decision analysis.

Achievements in 2001–2002

- Projects to provide training in integrated management of the coastal zone were established in Indonesia and Vietnam. Activities completed in 2001 and 2002 included orientation workshops, situational analyses, training needs analyses and the development of curricula and course modules.

Plans for 2003–2005

- Establish a Regional Training Center in the Philippines to build on the experience gained from previous training projects at the Center, and strengthen the existing links with the UNDP Train Sea coast Program. This center would service a diverse range of training needs relating to coral reef and coastal zone management, and coordinate the ICRAN coral reef training activities.

6.1.4 Policy Research and Impact Assessment Program (Policy Program)

This program aims to be in the forefront in the generation of knowledge on valuation and governance of aquatic resources, and on the markets of the products from these resources. This knowledge is primarily generated through research to address issues of poverty, food security and livelihoods of key stakeholders including producers, consumers and traders.

The main objectives of the Program are: a) to examine policy environments and policy options for adoption of approaches, technologies and policies to benefit the poor; and b) to provide information and tools for fishers, researchers, extension workers and policymakers in making decisions on appropriate institutions for managing aquatic resources; and c) to assess the impact of aquatic resources research and development.

The Policy Program has three thrusts which are:

1. Economic, policy and social analysis and valuation of aquatic resources in developing countries;
2. Aquatic resources planning and impact assessment; and
3. Legal and institutional analysis for aquatic resources management.

WORLDFISH CENTER THRUST 9 (=MTP PROJECT 9)
Economic, policy and social analysis and valuation of aquatic resources in developing countries.

The goal of this thrust is to value aquatic resources so that these are effectively incorporated in development planning. This thrust focuses on policy institutions, values and markets of aquatic resources and products, and the socio-economic aspects of aquaculture and fisheries.

Output 1: Appropriate valuation methods of aquatic resources and their values for policy analysis

Achievements in 2001–2002:

- An international consultative workshop to identify future research directions in economic valuation and policy analysis for sustainable management of coral reefs was conducted and a workshop proceedings published.

- The research framework and proposal for future research activities in line with the International

Coral Reef Action Network (ICRAN) Strategic Plan were conceptualized.

- A panel session was held on "The Socioeconomic Costs and Benefits" at the Second International Tropical Marine Ecosystem Management Symposium (ITMEMS 2), Manila, Philippines.

Plans for 2003-2005:

- Work on economic valuation and policy analysis in Southeast Asia, the Caribbean and meso-America, East Africa and South Pacific for sustainable management of coral reefs will be continued.

- A manual providing guidelines for economic valuation of coral reefs will be published through ICRAN and case studies in selected sites to better understand livelihoods dependent on coral reefs will be conducted.

- Work on economic valuation of wetlands and their resources in the Mekong River Region and in a number of rivers and lakes in Africa will be continued.

- Values of aquatic resources will be incorporated in policymaking and implementation processes in the Mekong River Region.

- Economic values of different stocks of major carp species in Asia will be assessed.

- Methodologies for assessing the contribution of aquatic resources to livelihoods in selected countries in Asia and Africa will be reviewed, designed and applied.

Output 2: Models of small-scale fisheries for improved management

Achievements in 2001–2002

- Collaborated with an international expert group on managing excess capacity in fisheries.

- Data on capacity of small-scale fisheries in Malaysia, Philippines, Indonesia and Thailand were collected.

- Bioeconomic models for the analysis of fisheries capacity in South East Asia were developed.

Plans for 2003–2005

- Bioeconomic models and analysis will be adapted and extended as appropriate to the Mekong River Region, China and South Asia; strategies and options will be developed for managing capacity issues in those countries.

- A regional workshop will be organized to present the results of the bioeconomic modeling exercise to policymakers in 2005.

- Policy briefs and recommendations for technology adoption and optimal resource allocation in the milkfish industry in the Philippines and Indonesia will be published.

Output 3: Social, economic and policy implications of integrated agriculture-aquaculture technologies (jointly implemented by Policy and Freshwater Programs)

Achievements in 2001–2002

- Studies to analyze the economics of existing and emerging integrated agriculture-aquaculture (IAA) technologies in Bangladesh and Malawi were initiated.

- Detailed analyses of the socioeconomic profiles of various IAA technologies in Bangladesh were conducted and their roles in alleviating poverty and improving food security were assessed.

Plans for 2003–2005

- Detailed studies on the socio-economics of IAA technologies in five countries of Asia and Africa (Bangladesh, Thailand, Malawi, Egypt and Cameroon) will be conducted, including a) stakeholder analysis of user needs; b) economic analysis of alternative resource use options; c) analysis of factors affecting adoption and diffusion of various IAA technologies; and d) ex-ante analysis of potential adoption and impact of various pipeline IAA technologies.

Output 4: Disaggregated market models of fish and seafood products for developing improved policies on food security, poverty reduction and livelihood

Achievements in 2001–2002

- The Center and the International Food Policy Research Institute (IFPRI), in collaboration with FAO, made substantial progress in incorporating fish into the IMPACT global food model.

- Preliminary projections of production, consumption and trade to 2020 for eight aggregate categories of fish for 15 geographic regions of the world were made.

- A detailed and disaggregated assessment of fish supply and demand in nine major fish producing and consuming countries of Asia (i.e., Bangladesh, China, India, Indonesia, Philippines, Malaysia, Thailand, Vietnam and Sri Lanka) was initiated.

- Two special sessions on "Strategies and Options for Sustainable Aquaculture Development in Asia" in the World Aquaculture Society Conference on 23-27 April 2002, Beijing, China and "Fish in Food Security and Income in Developing Countries: Role of Growing Aquaculture and Changing Trade Regime" in the International Institute of Fisheries Economics and Trade (IIFET) Conference on 19-22 August, New Zealand were organized.

Plans for the 2003–2005

- The analysis of disaggregated fish supply and demand in Asia will be continued.

- The fish sector models for nine Asian countries will be developed and projections made for the supply of and demand for different fish species will be made.

- Assistance to nine Asian countries in developing country-specific action plans for poverty reduction among poor fish producers and consumers will be extended.

- New detailed studies of fish demand and supply in Africa and West Asia will be initiated and funding proposals for submission to a range of donors will be developed.

- The World Fish Model will be developed by the end of the MTP, with incorporation of results of the disaggregated analysis of fish supply and demand in Asia and Africa.

WORLDFISH CENTER THRUST 10 (=MTP PROJECT 10)
Aquatic resources planning and impact assessment

This thrust focuses on the development and application of methodologies and frameworks for analyzing impacts of aquatic resource research.

Output 1: Methodology and operational guidelines for assessing impact of aquatic resources research and development

Achievements in 2001-2002

- A paper on the methodology for assessing the impact of improved fish breeds was published in a special issue of the Aquaculture Economics and Management Journal.
- A framework for assessing the impacts of IAA technologies was developed.
- A workshop of the CGIAR's integrated natural resource management (INRM) group was hosted on the development of methods for assessing the impact of INRM research.

Plans for 2003–2005

- Work on the development of appropriate methodology for assessing the impact of INRM research will be continued.
- Work on the development of an integrated framework for assessing economic and environmental impacts of aquatic resources research and development will be initiated.

Output 2: Impact assessment of aquatic resources research and development

Achievements in 2001–2002

- A common research framework for monitoring and impact assessment of community-based fisheries management (CBFM) projects was agreed upon with partners.
- A common framework for participatory monitoring of aquatic resources use was developed.
- Training and technical support was provided to communities and partners on a fish sanctuary/ conservation proposal in Vietnam and Lao PDR.
- In Bangladesh, an impact survey for 15 sites (previous phase) was completed and a survey in 12 control sites (current phase) was conducted. A household census and baseline survey were completed for 125 water-bodies and 17 control sites.
- Baseline reports and formats for fisheries and household impact monitoring in Vietnam and Bangladesh were prepared.

Plans for 2003–2005

- Impacts of community-based fisheries management in Bangladesh and Mekong River Region will be evaluated in terms of household assets and access to resources, fish catches and fish consumption, income-expenditure patterns and institutional performance.
- A system for ex-post impact assessment with external auditing inputs will be developed and used in Bangladesh and Malawi.
- The potential impact of carp genetic research in Asia will be assessed.
- The impacts of integrated agriculture-aquaculture research in selected countries of Asia and Africa (Bangladesh, Malawi and Cameroon) will be analyzed.
- The impact of aquaculture production and marketing on livelihoods will be assessed in selected Asian countries.

WORLDFISH CENTER THRUST 11 (=MTP PROJECT 11)
Legal and institutional analysis for aquatic resources management

This thrust focuses on the analysis of the institutions for improved governance of aquatic resources. Participatory action research is used to improve planning for management of aquatic resources at local and national levels.

Output 1: Methods and framework for participatory, action-oriented research on governance of aquatic resources

Achievements in 2001–2002

- A policy brief on co-management of aquatic resources was published in collaboration with partners.
- A panel session on "Institution and Community Issues in Fisheries Management" at the 6th Asian Fisheries Forum was organized.
- Methodologies for assessing the legitimacy of fisheries co-management in Asia and Africa were tested in collaboration with partners.
- A framework for analyzing the impact of community involvement in the governance process of aquatic resources was developed.
- The key variables that influence compliance with rules and regulations in the Philippines and Indonesia under varying levels of co-management processes were analyzed.
- Exchange visits between Vietnam and Bangladesh to learn about community-based management were organized.
- Methods for participatory action planning and consensus building were developed and applied in Bangladesh and Vietnam.
- Training on co-management for NARS partners was carried out.

Plans for 2003-2005

- A global workshop on impacts of community-based management on resource sustainability, equity and efficiency will be organized.
- Training programs on the establishment of co-management systems for management of aquatic resources will be conducted.
- Scientific evidence on scale, legitimacy and compliance effects of alternative governance systems will be documented.
- Models of successful CBFM arrangements will be promoted.
- Work on co-management of river and lake fisheries will be expanded, especially in Africa.
- Socioeconomic monitoring protocols of selected marine protected areas (MPAs) in Southeast Asia and meso-America will be developed and disseminated among MPA managers.
- The participatory action plan development approach will be further developed, their impacts assessed and methods disseminated in Bangladesh and Mekong River Region.
- Participatory monitoring systems of aquatic resources use will be developed and tested.

Output 2: Policies and institutional arrangements for governance of aquatic resources

Achievements in 2001–2002

- The institutional arrangements for governing wetlands in Thailand, Cambodia, Lao PDR and Vietnam were examined and working groups formed to collect information on wetlands.
- Community based fisheries management (CBFM) experience in Bangladesh was reviewed and issues regarding the policies of leasing waterbodies were raised in various fora.
- Various approaches, models and co-management arrangements for trial in Bangladesh were identified and agreed with partners.
- Monitoring of institutional arrangements for CBFM in Bangladesh was initiated.
- Lessons on governance of aquatic resources were synthesized.
- Methods to facilitate consensus building for resource management in Bangladesh and the Mekong countries were developed and tested.
- The role of traditional authorities in determining legitimacy of community-based institutions in Malawi, Mozambique and Zambia was tested.
- The impact of resource scale and size of community groups on co-management performance in the Philippines was studied.
- Case studies on community participation and attitudes to co-management and the processes involved in Cambodia, Indonesia and Vietnam were documented.

Plans for 2003–2005

- A seminal paper on governance of aquatic resources will be published.
- Lessons from CBFM in Bangladesh will be published.
- Based on the piloting of community management arrangements and the assessment of their performance, action research on CBFM in over 100 sites in Bangladesh will be continued.
- The contribution of the co-management process to rule compliance and institutional sustainability will be documented.
- Action research on CBFM projects in Cambodia and several countries in Africa will be developed and initiated.

6.1.5 Partnerships, Information and Training Program (Partnerships and Training Program)

The Partnerships, Information and Training Program (PITP) strengthens existing collaborations and develops new partnerships with national institutions and agencies, regional and international organizations, advanced scientific institutions and other partners, in research and related activities and contributes to increasing the impact of the Center's research by communicating the Center's work to its partners and aquatic resource users, providing information services to support the work of the Center's staff, raising public awareness of fisheries issues, and by capacity-building among institutions. The two main thrusts of the program are: (i) improved partnerships and capacity-building among developing country institutions, (ii) access to information for sustainable development of fisheries and aquatic resources.

WORDFISH CENTER THRUST 12 (=MTP PROJECT 12)
Improved partnerships and capacity-building among developing country NARS

Output 1: Identification of national research priorities and development/strengthening of research partnerships and networks

Achievements in 2001–2002:

- An Expert Consultation on Research Priority Setting which was attended by senior aquatic managers and planners from 17 countries in the Asia-Pacific region and regional/international organizations was held.

- New collaborations and strengthened research partnerships were developed with national institutions in China, India, Malaysia, and Philippines and with regional/international organizations.

- The Sixth Steering Committee meeting of the International Network on Genetics in Aquaculture was held. Consultations were made on achieving the full benefits of fish genetic research through organization of workshops on (i) development of strategies and action plans for the distribution of improved fish breeds to small-scale farmers and (ii) biosafety and the environmental impact of genetic enhancement and the introduction of improved strains and alien species in Africa.

- Conclusions and recommendations from the "Expert Consultation on Biosafety and Environmental Impact of Genetic Enhancement and Introduction of Improved Strains/Alien Species in Africa" were published as "Nairobi Declaration" and widely disseminated to policy makers/planners, scientists in the region.

- Issues and constraints were identified and recommendations were formulated for maintenance and dissemination of improved fish breeds in member countries of INGA; countries have also been assisted in development of national plans for dissemination of improved fish breeds.

- Transfers of fish germplasm for direct use in aquaculture or utilization in breeding programs were coordinated.

- Establishment of GIFT germplasm (Nile tilapia) in Malaysia.

- Enhancement of synergy between genetic research being undertaken at advanced scientific institutions and developing country institutions.

- Scientists from 13 member countries of INGA attended a third course on quantitative genetics and breeding, and cross-country visits of scientists were organized.

- A revised version of the partners' database was developed.

- The project on "Development and Implications of Public-Private Partnership in Fish Genetic Research" was initiated.

Plans for 2003–2005:

- During this period, the program will continue to forge new partnerships and further strengthen existing partnerships and networks. Regular meetings with national institutionsand other stakeholders will be conducted in various countries/regions to identify strategic research agendas and priority areas for collaboration. The program will also organize Asia-Pacific Group of Fisheries and Aquatic Research (GoFAR) meetings, Steering Committee meetings of INGA, workshops on ecological risk assessment of the genetically improved/modified organisms, and training workshops for partner capacity enhancement. It will also continue to provide assistance in the development andimplementation of national fish breeding programs and coordinate transfers of improved germplasm between member countries of INGA.

Output 2: Enhancement of knowledge and research capabilities of national scientists and institutions.

Achievements in 2001–2002:

- A strategy for WorldFish Center training to enhance the research capabilities of developing country fisheries scientists and institutions was formulated and introduced.

- A new database on training programs undertaken by the Center and partners was developed.

Plans for 2003–2005

- During the MTP period, WorldFish Center will endeavor to achieve the national capacity development goals through implementation short training programs on the topics that are within the areas of specialization of the Center It will also provide qualified NARS scientists/ experts, M.S/PhD students and post doctoral fellows the opportunity to work with WorldFish Center scientists in specialized areas and contribute to the Center's research programs through research internships for a specific period. These efforts will be complemented by other activities of the new training unit which include the establishment of a training database and the archiving of training materials.

WORLDFISH CENTER THRUST13 (=MTP PROJECT 13)
Access to information for sustainable development of fisheries and aquatic resources.

Output 1: Sharing information and knowledge, communicating for outcomes and positioning research for sustainable development of fisheries and aquatic resources

Achievements in 2001–2002:

- Key staff for the four Units of the Information & Communication Division were recruited and plans and work processes for the Units were developed.

- The Information Services Unit provided technical information and reference services to on-site users and visitors. The Selective Fisheries Information Service (SFIS) responded to 156 requests. Most of the enquiries were from developing countries.

- Library linkages and cooperation were strengthened with other CGIAR libraries.

- The library provided on-the-job library and information systems training for three librarians from the Institute of Oceanography and the Research Institute for Aquaculture No. 3, Vietnam, and two librarians from the Research Institute for Marine Fisheries and the Research Institute for Aquaculture No. 3, Vietnam.

- The *Naga* processing system and monthly editorial meetings have brought *Naga* back on schedule.

- Center publications and information materials were exhibited at conferences and new publications were distributed to local and international libraries and fisheries institutions under the full-free exchange agreement.

- A Research Seminar series began in 2001 to disseminate research results and encourage dialogue on fisheries and aquatic resources research issues.

- Key public relations messages in three languages were developed and consistently applied throughout the Inauguration of the new headquarters.

- A strategic marketing workshop sponsored by the Ford Foundation was held at the Abbassa regional office in April 2001 and a second strategic marketing workshop was held in Penang February 2002 to enhance skills in diversifying center funding.

- The eCommunications Unit was set up to provide Internet and Web database services. Awareness of www.worldfishcenter.org has been widely promoted through search engines and various aquatic research websites.

- A 10-year global initiative, *Fish for All*, was launched to bring policy makers and opinion leaders from both the developing and developed countries into active participation and to address the world fish stock depletion crisis.

Plans for 2002–2005

- The Center will continue to improve its information services to partners and stakeholders as well as its own staff around the world. Cooperation and resource sharing with other information providers worldwide will broaden and deepen the availability and range of information resources. Strategies to provide access to information through web-based technologies will increasingly enable users to retrieve information at their desktops. Information and communications will increasingly be tailored and delivered to meet their specific needs.

- The Center will continue to provide the support role for the *Fish for All* initiative.

6.2 Highlights 2001–2002

Settling into the new Center headquarters in Penang was a major accomplishment for 2001-2002. The new headquarters provided the Center with operations and laboratory facilities to expand its research work in collaboration with partners.

At the program level the major highlights for the period 2001–2002 and new directions for 2003-2005 are enumerated in the following section.

Highlights for 2001–2002

- FishBase, the global biodiversity database, was enhanced with over one million records by pursuing participation of more museums, particularly in developing countries, by updating collection databases, and by repatriation of biodiversity data to ACP countries. FishBase now lists over 96 per cent of the estimated world fish species; it has been made available to over 160 countries; there were 18.1 million hits on the website in 2001 with 1.2 million users' sessions and 550 000 unique visitors.

- The ReefBase website now includes substantial data on the resources, status, threats and management of coral reefs worldwide, together with an interactive mapping facility to display much of this information. This material includes the national status reports produced by the Global Coral Reef Monitoring Network for more than 50 countries. In May 2002, the website was receiving over 12 000 hits per day.

- The semi-quantitative model for the management of water flows to optimize aquatic resources production in the Mekong Basin has been further refined and the present computer Bayesian model has clearly brought out the need for looking beyond fishery statistics, for identification of factors driving fish production.

- Natural spawning of African catfish was achieved through manipulation of the environment (water level, shelter). Further research is being conducted in Egypt, Cameroon and Malawi on identifying the nature of the responsible cues, in order to derive a reliable technique for reproduction of catfish in low-technology conditions.

- Convening the “International Workshop on Management of Tropical Coastal Fisheries in Asia” in March 2001 raised awareness about the serious plight of trawl fisheries in Asia. The workshop, which presented results of analyses from TrawlBase, highlighted the decline in coastal fishery resources to 10-30 per cent of original unfished levels. The relative abundance of the more valuable fishes has decreased sharply, accompanied by a proportionate increase in smaller, less valuable species. In conjunction with this, the Fisheries Resource Information System and Tools (FiRST) software for the analysis of the data using a variety of stock assessment software was produced by FAO and the WorldFish Center.

- The Action Phase of the ICRAN project to reverse the degradation of coral reefs was initiated in collaboration with six other partners and support from UNF. The project focuses on the concept of identifying “demonstration” sites where coral reefs are being managed sustainably in a variety of ways, and spreading the good practices to ”target” sites.

- The concept note for the CGIAR Challenge Program “Increasing Productivity in the Coastal Zone: reversing habitat degradation and advancing livelihood options”, was approved for progression to the pre-proposal stage. The Center coordinated the submission of the pre-proposal on behalf of a large group of partners.

- An international consultative workshop to identify future research direction in economic valuation and policy analysis for sustainable management of coral reefs was conducted and workshop proceedings were published.

- A method and model for the analysis of fisheries capacity was developed.

- Detailed analyses of socio-economic profiles of various IAA technologies in Bangladesh were conducted and their roles in alleviating poverty and improving food security assessed.

- Fish has been incorporated into the IMPACT global food model of the International Food Policy Research Institute.

- Projections to 2020 of production, consumption and trade for eight aggregate categories of fish for fifteen geographic regions of the world were made.

- Detailed and disaggregated assessment of fish supply and demand in nine major fish producing and consuming countries in Asia was initiated.

- Preliminary estimates of fish demand elasticities by species groups for Bangladesh, China, Indonesia and Thailand were made.

- A common research framework for participatory research and monitoring in community-based fisheries management (CBFM) projects was agreed upon with partners.

- The institutional arrangement for governing wetlands in Thailand, Cambodia, Lao PDR and Vietnam were examined and working groups to collect information on wetlands were formed.
- A synthesis workshop on governance of aquatic resources was conducted.

- Methods to facilitate consensus building for resource management in Bangladesh and the Mekong countries were developed and tested.

- New collaborations and strengthened research partnerships were developed with national institutions in China, India, Malaysia and Philippines and with regional and international organizations.

- Consultations were held on issues needed for achieving the full benefits of fish genetic research through organization of workshops on (i) development of strategies and plans for dissemination of improved fish breeds to small-scale farmers and (ii) biosafety and environmental impact of genetic enhancement and introduction of improved strains and alien species in Africa.

New directions 2003–2005

- A customized Philippine FishBase with theme-based applications will be developed and demonstrated in 2003. Based on this, work on developing similar databases in China and India will be initiated. Training of developing country collaborators with special emphasis on Africa will be carried out and customized database work will be initiated in two African countries. Spatial (GIS) functions in FishBase towards natural resources modeling, and spatial management e.g. biogeographic evaluation of species introductions, identification and analysis of conservation "hotspots" will be expanded.

- Development of response mechanisms to mitigate the adverse impact of alien species will be carried out through development of tools to assess risks, as will identification of factors leading to the establishment of invasive freshwater alien species, and development of management guidelines and policy recommendations will be made

- ReefBase will expand and update its information on coral reef status, threats and management to include comprehensive and current information for all countries with reef resources; create an on-line data access and summary analysis facility for all reef level data derived from the GCRMN network, and work with national counterparts to create coral reef information systems for each country or region, incorporating links between detailed national data and summary global information.

- The TrawlBase database will be expanded geographically to include data from Australia, Cambodia and China. Follow-up activities to assist more countries to enhance their information, assessments, capabilities and action programs for sustainable use of coastal fisheries resources and strengthen regional collaboration will be initiated.

- A major new initiative on water management for river fisheries will be made. This will draw upon work carried out to refine and implement the Bayesian model of Mekong fish resources and their environment, and to develop a multi-agent model of the Tonle Sap Great Lake fisheries in Cambodia. Based on this work, a generic Bayesian model for use in other river basins will be developed and linked with other fish-flow tools being developed by other institutions. These will be tested in the Mekong and in several other rivers in Asia, Africa and Latin America and will provide a major contribution to the Water and Food Challenge program. The Center will contribute to the development of an environmental flows requirement model in the Tonle Sap area and West Africa under the CGIAR Challenge program.

- In Bangladesh, further studies on community-based fish culture in seasonally fenced areas will be conducted. In the Mekong Delta, studies will be completed in 2003 and recommendations for policy makers for water flow management under multiple-use objectives formulated.

- The number of demonstration sites for the ICRAN project in Southeast Asia, the Caribbean, the Pacific and Africa will be expanded.

- The development of the full GEF proposal for targeted research on coral reefs will be coordinated.

- Collective experience for the CGIAR system and key partners will be used to identify how to reduce the impact of agriculture, forestry and watershed management on fish habitats in the coastal zone in a Challenge Program coordinated by the Center.

- Work on the economic valuation of Mekong River wetlands and other resources will be continued and work on river and lake fisheries will be developed in Africa.

- Methodologies for assessing the contribution of aquatic resources to livelihood in selected countries in Asia and Africa will be reviewed, designed and applied.

- The economic value of different stocks of major carp species in Asia will be assessed.

- Detailed studies on the socio-economics of IAA technologies in four countries in Asia and Africa will be conducted including stakeholder analysis of user needs, economic analysis of alternative resource use options, analysis of factors affecting adoption and diffusion of various IAA technologies and ex-ante analysis of potential adoption and impact of various pipeline IAA technologies.

- The analysis of disaggregated fish supply and demand in Asia will be continued and fish sector models for nine Asian countries will be developed and projections made for the supply of and demand for different fish species. The nine Asian countries will be assisted in developing country-specific action plans for poverty reduction among poor fish producers and consumers.

- New detailed studies of fish demand and supply in Africa and West Asia will be initiated and funding proposals for submission to a range of donors will be developed.

- The World Fish Model will have been developed by the end of MTP, with incorporation of results of the disaggregated analysis of fish supply and demand in Asia and Africa.

- Impacts of community-based fisheries management in Bangladesh and Mekong Region will be evaluated.

- The potential impact of carp genetic research in Asia will be assessed.

- The impacts of Integrated Agriculture-Aquaculture (IAA) research in selected countries of Asia and Africa (Bangladesh, Malawi and Cameroon) will be analyzed.

- A global workshop on the impacts of community-based management on resource sustainability, equity and efficiency will be organized.

- Training programs on the establishment of co-management systems for management of aquatic resources will be conducted.

- Scientific evidence on scale, legitimacy and compliance effects of alternate governance systems will be documented.

- Models of successful CBFM arrangements will be promoted.

- The contribution of co-management to rule compliance and institutional sustainability will be documented.

- Action research on CBFM projects in Cambodia and Mozambique will be developed and initiated.

- The institutional arrangements for governing wetlands in Thailand, Cambodia, Lao PDR and Vietnam were examined and working groups formed to collect information on wetlands and a synthesis workshop on governance of aquatic resources was conducted.

- Methods to facilitate consensus building for resource management in Bangladesh and the Mekong countries will be developed and tested.

- The contribution of co-management to rule compliance and institutional sustainability will be documented.

- Action research on CBFM projects in Cambodia and Mozambique will be developed. .

- Research planning meetings in the targeted countries will be held to identify the country's overall priorities and to determine how the Center's strategic research thrusts could address country/regional priorities and become more relevant to their priorities/needs.

- The Center, with its new training unit at HQ, will implement the new strategy for capacity-building among developing country NARS.

Africa agenda:

WorldFish Center in 2003 onwards is planning a major expansion of its Africa agenda to address the emerging critical situation on that continent as regards food security particularly in the areas detailed in Table IV.

6.3 Revisions from the MTP 2002–2004

Project titles

The Center's move to its new headquarters site in Penang Malaysia and the major changes that followed provided an opportunity for the center to revisit its research agenda to evaluate its ability to pursue its mission and vision given the opportunities provided by its new home in Penang.

The core issues of concern have not changed substantially. A decision was made to increase the *emphasis* on the adverse impact of alien species and on freshwater fisheries, elevating these activities to research projects in themselves rather than considering them as part of an existing project. Some other projects were *redefined* to better present the issues and needs. The changes are presented in the Table V.

Challenge Programs

The CGIAR has recently announced the establishment of collaborative "Challenge Programs" (CPs) to address environmental, food security and livelihood problems of regional or global significance. These Challenge Programs are designed to support research partnerships among international and national agencies, and CGIAR Centers. The programs are expected to have a longer-term horizon (seven to ten years), and to receive funding at the level of US$ 5-10 million per year. Details of the approach can be found at www.cgiar.org

Activities within each of the the Center's Projects are expected to be pursued through the Challenge Programs listed below.

The Water and Food Challenge Program (WFCP) is one of the three CPs selected for development in the first phase of this new way of working in the CGIAR. The Center has engaged intensively in this process, participated in a range of preparatory meetings, coordinated the working group on Aquatic Ecosystems and Fisheries, led the development of the background paper for this theme, and is a member of the Consortium that has been formed with the intention of carrying forward the Program. The proposal for the WFCP is now being considered by the Interim Science Council and a final decision on the CP is expected in October 2002 at the CGIAR AGM.

A concept note submitted to the CGIAR for a Challenge Program to address problems facing the coastal zone has been recommended for development as a pre-proposal. This program will focus on reversing degradation of coastal habitats and enhancing livelihood opportunities for coastal communities. As part of the pre-proposal development for the *Coastal Challenge Program*, a planning workshop entitled "Increasing productivity in the coastal zone: reversing habitat degradation and advancing livelihood options" was attended by 20 external delegates from national and regional agencies. Based on the outcomes of the workshop, a draft pre-proposal for the Challenge Program entitled "Making the Most of the Coast" has been prepared, circulated for review and submitted to the CGIAR.

In addition to these two CPs, the center is also involved in the development of segments of the Challenge Programs on *Climate Change* and *Animal Diseases* for which concept notes are being developed.

Table V. WorldFish Center Program Structure by Project and Outputs MTP (2003–2005) and (2002–2004)

Program	MTP Project (2002–2004)		MTP Project (2003–2005)		New Output	
	No.	Title	No.	Name	No.	Name
Biodiversity and Genetics	**1**	**Conservation of Aquatic Biodiversity**	1	Conservation of aquatic biodiversity	1	FishBase as a global biodiversity database
					2	Applications of FishBase for developing countries
					3	Decision making tools utilizing data on species and habitat diversity
					4	Utilisation of genetic diversity information for conservation and management of 'key' species
			2	Mitigation of adverse impact of alien species on aquatic biodiversity (NEW EMPHASIS)	1	Development of tools to assess risks and response mechanisms to mitigate adverse impact of alien species
	2	**Genetic Enhancement and Breeding**	3	Genetic Improvement and Breeding	1	Development of improved fish strains by national breeding programs
					2	Development and dissemination of methods for genetic improvements
Freshwa-ter			4	Strategies and options for realizing gains from sustainable freshwater aquaculture systems	1	Thorough understanding of target group needs and constraints
					2	Portfolio of new and improved aquaculture technologies
					3	Sustainable systems and guidelines, for the dissemination of aquaculture information and technology to fish farmers
	3	**Improvement of Freshwater Aquaculture**	5	Freshwater fisheries in an integrated land and water management context (NEW EMPHASIS)	1	Thorough understanding of target communities' needs and constraints
					2	Technological options in relation to trade-offs necessitated by the community level at which fishers operate
					3	Appropriate decision support tools and institutional arrangements for management of freshwater inland fisheries
Coastal	**004**	**Fisheries Resources Assessment and Management**	6	Increased and sustained coastal fisheries production (REDEFINED)	1	Guidelines for sustained, equitable harvests of wild stocks
					2	Aquaculture-based technology to increase the productivity of coastal fisheries

Table V (cont'd)

Program	MTP Project (2002–2004)		MTP Project (2003–2005)		New Output	
	No.	Title	No.	Name	No.	Name
Coastal (cont'd)	**006**	**Coastal Aquaculture and Stock Enhancement**	7	Restoration and protection of coastal habitat (REDEFINED)	1	Interventions to reduce damage to the coastal zone
	005	**Assessing and Limiting Coral Reef Degradation**	8	Knowledge bases and training for improved management of coastal resources (REDEFINED)	1	Knowledge bases for coastal resources, technology to improve production, and options for management
					2	Training materials to improve capacity for assessment of fisheries and habitats and decision analysis
Policy	**007**	**Economic Monitoring and Evaluation of Developing Country Fisheries**	9	Economic, policy and social analysis and valuation of aquatic resources in developing countries	1	Appropriate valuation methods of aquatic resources and their values for policy analysis
					2	Models of small-scale fisheries for improved management
					3	Social, economic and policy implications of integrated agriculture-aquaculture technologies
					4	Disaggregated market models of fish and seafood products for developing improved policies on food security, poverty reduction and livelihood
	009	**Aquatic Resources Research, Planning and Impact Assessment**	10	Aquatic resources planning and impact assessment	1	Methodology and operational guidelines for assessing impact of aquatic resources research and development
					2	Impact assessment of aquatic resources research and development
	008	**Legal and Institutional Analysis for Fisheries Management**	11	Legal and institutional analysis for aquatic resources management	1	Methods and framework for participatory, action-oriented research on governance of aquatic resources
					2	Policies and institutional arrangements for governance of aquatic resources
Partner-ships and Information	**010**	**Information and Capacity Building for Aquatic Resources Research in Developing Countries**	12	Improved partnerships and capacity-building among developing county NARS (REDEFINED)	1	Identification of national research priorities and development/strengthening of research partnerships and networks
					2	Enhancement of knowledge and research capabilities of national scientists and institutions

Table V (cont'd)

Program	MTP Project (2002–2004)		MTP Project (2003–2005)		New Output	
	No.	Title	No.	Name	No.	Name
Partner-ships and Information (cont'd)	**010**	**Information and Capacity Building for Aquatic Resources Research in Developing Countries (cont'd)**	13	Access to information for sustainable development of fisheries and aquatic resources (REDEFINED)	1	Sharing information and knowledge, communicating for outcomes and positioning research for sustainable development of fisheries and aquatic resources

SECTION B. FINANCING THE AGENDA

B.1 2001 Results and 2002 Development

The 2001 expenditure level was US$ 13.90 million of gross expenditures and US$ 13.12 million net of recovery of indirect cost. About 80 per cent of 2001 resources were utilized for programmatic activities. WorldFish Center ended the year with a deficit of US$ 0.56 million.

This is primarily due to the strengthening of the US Dollar, return of World Bank matching funds to the CGIAR Secretariat and reduction in donor pledges at short notice. Earned income declined from US$ 0.50 million to US$ 0.43 million. However, indirect cost recovery on restricted projects increased slightly from US$ 0.68 million to US$ 0.78 million.

The 2001 grant income from donors amounted to US$ 12.13 million in addition to US$ 0.43 million of earned income. Recovery of indirect costs from restricted projects amounted to US$ 0.78 million.

Grant income for 2002 is projected at US$ 15.04 million in addition to US$ 0.15 million in earned income. The earned income is projected to decline sharply due to the decline in global interest rates.

The 2002 expenditures are estimated at US$ 15.06 million compared to actual spending of US$ 13.12 million for 2001.

Resource allocation to programs for 2002 is projected to be around 78 per cent of the total available:

Table VI: Comparison of 2001* performance and 2002 current estimate

	2001 Actual (US$ million)	2002 Estimate (US$ million)
Sources of Funds		
Donor Funding	12.13	15.04
Earned Income	0.43	0.15
Total	**12.56**	**15.19**
Application of Funds		
Programmatic	9.03	12.44
Management and General Expenses	2.14	3.18
Headquarter Site Renovation	2.64	0
Depreciation	0.09	0.29
Less: Overhead Recoveries	(0.78)	(0.85)
Net Expenditures	**13.12**	**15.06**
Unexpended Balance	**(0.56)**	**0.13**

* Targeted project funding which follows the matching principle was under spent by approximately US$ 2.20 million in 2001. Actual grant income for the year (2001) was substantially higher.

The 2001 spending and 2002 current planned resource allocation by CGIAR activity are summarized below:

Table VII: Actual and planned resources allocation by CGIAR activity for 2001 and 2002

	US$ (million)		
	2001 Actual	2002	
		Estimate	%
Increasing Productivity	2.74	2.33	16
Protecting the Environment	6.31	5.61	37
Saving Biodiversity	0.11	0.09	1
Improving Policies	2.45	5.49	36
Strengthening NARS	1.51	1.54	10
Total	**13.12**	**15.06**	**100**

For the 2002 resources, 37 per cent were allocated to protecting the environment, 36 per cent to improving policies, 16 per cent to increasing productivity and 10 per cent to strengthening NARS. These allocations are consistent with the Center's long-term strategic direction.

Table VIII: Allocation of resources by outputs (Logical Framework Format) US$ (million)

	US$ (million)		
	2001 Actual	2002	
		Estimate	%
Germplasm Improvement	0.78	0.55	4
Germplasm Collection	0.11	0.09	1
Sustainable Production	8.27	7.39	49
Policy	2.45	5.49	36
Enhancing NARS	1.51	1.54	10
Total	**13.12**	**15.06**	**100**

B.1.1 Funding Trends

With continued efforts in fund raising and the harnessing of greater public awareness on the importance of aquatic resources management amongst its community of donors, the Center has consistently increased its share of resources within the CGIAR System since 1993. Funding has increased, in nominal terms, from US$ 9.60 million in 1996 to US$ 15.19 million in 2002 (expected), an increase during the five-year period of over 50 per cent. In real terms (in 2001 US$ at 4 per cent price change) the increase has been from US$ 11.67 million in 1996 to US$ 15.19 million in 2002, an increase of approximately 30 per cent.

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, the Center expects a reasonable steady growth in funding beyond the year 2003.

B.1.2 Inflation and Exchange Rates

The RM (Malaysian Ringgit) is presently fixed at the exchange rate of RM 3.80 to one US$. There is no indication that the RM will be liberalized in the near future. If the RM is liberalized its impact on the budget will be assessed.

Actual inflation in 2002 was around 2.7 per cent and is forecasted to be between 2.5-3.0 per cent in 2002-2003. The Center will monitor actual inflation in 2002 and assess its impact on the purchasing power of the budget.

Inflation on the US$ expenditures is expected to be around 2-3 per cent for 2002–2003.

B.1.3 Depreciation of Fixed Assets

The actual depreciation of existing WorldFish Center fixed assets for 2001 was US$ 0.09 million as against US$ 0.04 million in 2000. Most of the Center assets were recently purchased, and no investments were made in large equipment items except those for the laboratories.

B.1.4 Capital Fund

The purpose of the Capital Fund is to finance all Center core capital requirements. The balance of the Capital Fund up to 31 December 2001 was US$ 1.30 million, appropriated by the Board of Trustee for fixed assets renewal. The capital fund is expected to increase by US$ 0.29 million in 2002, which is equivalent to the project depreciation charge for the year.

B.1.5 Capital Investments

The Malaysian Government has made available to WorldFish Center on a long-term (60 years) nominal lease 5.2 ha of land with buildings on the land. The renovation of these buildings to international standards was completed in May 2001 and the move to the new headquarters was made in June 2001. The cost of renovation and setting up of the facility including office furniture and equipment amounted to US$ 3.8 million, listed down as follows:

	US$ (M)
Building renovation	2.64
Project management	0.24
Equipment and furniture	0.49
Other capital needs	0.43
Total	3.80

The renovation cost was spread over two years 2000 and 2001.

B.1.6 Working Capital (Days)

The working capital as of 31 December 2001 can support operations for 217 days compared to CGIAR norm of 120 days of operations.

B.1.7 Liquidity

The Center's liquidity continues to improve.

Table IX: Liquidity ratio analysis

	2000	2001	2002 Projected
Current Ratio (times)	2.17	2.13	2.12
Quick Ratio (times)	2.17	2.13	2.11
Cash to current assets (%)	52	49	61
Cash to Current Liabilities (%)	114	104	130

The Center is continuing its efforts to improve its liquidity position to absorb minor unexpected shocks and cash shortages. The Center is focusing attention on refining the cash flow by programming operating and capital expenditures to improve overall liquidity and spending patterns.

B.2 2003–2005 PLANS

B.2.1 Funding Requirements and Financing Plans

The 2002 funding level approved at AGM-2001 has been used as the basis for developing the plans for 2003 to 2005. The Financing Plan level has been adjusted to reflect the current estimate of WorldFish Center's operations for 2002.

The expected level of donor funding for 2002 is projected at US$ 15.04 million, in addition to earned income of US$ 0.15 million and indirect cost recoveries from restricted projects. The Center's projected operating levels (net of indirect cost recoveries) for 2002 to 2005 are:

Table X: WorldFish Center Operating Levels

	US$ (million)			
	2002	**2003**	**2004**	**2005**
Projected Donor Funding	15.04	15.40	15.94	16.51

A combined growth and inflation rate of 3.50 per cent has been incorporated into the plans for the years 2003, 2004 and 2005.

Earned income: Earned income is expected to be at the level of US$ 0.15 million for the duration of the plan due to the sharp drop in global interest rates. Improvements in interest rates will not come soon.

Indirect Cost Recovery: Most donors are resistant to meeting real costs (full cost of operations-direct and indirect) of the Center. Indirect cost recovery is a critical component for financing the Center's non-research activities and operations that are essential and critical support services to research. The CGIAR Secretariat has initiated a system wide indirect cost study to increase transparency and donor awareness. The Center's indirect cost recovery is expected to be around US$ 0.85 million for 2002. This is a marked improvement over previous years but indirect cost recovery is still well below the actual costs.

B.2.2 Operating Budget 2003–2005

The research activities and allocation of resources were determined by an in depth review of WorldFish Center programs and research projects at special program retreats, and a Center-wide review by Board and management was made. The five programs were allocated over 75 per cent of total resources consistent with the Center's priorities and strategies. The allocation of funds to the projects, sources 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): WorldFish Center carefully monitors the cost structure of operations to ensure that fixed costs are kept within a reasonable proportion of the annual budget. Approximately 35-40 per cent 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 the Center's research directions and consistent with CGIAR strategies and priorities (see Budget Table 2).

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

Personnel input: Center-hired Internationally Recruited staff (IRS) level is estimated at around 31 positions including post-doctoral fellows and visiting scientists. Additional positions are planned subject to funding availability in 2002 and beyond (see Budget Table 9).

Regionally Recruited Staff (RRS) level is approximately 13 positions. The RRS represents the Philippine senior national staff relocated to the new Penang headquarters in February 2000 and a few other positions at other regional research sites.

Nationally Recruited Staff (NRS) overall level will reach around 245 (all locations) including the staff at the Regional Center for Africa and West Asia (Egypt).

B.2.3 Capital Budget

The major capital requirements have been met. These include the renovation of the headquarters in Penang which was completed with office furniture and equipment at a cost of US$ 3.80 million. A fish tank research facility is now linked to the research laboratories at the headquarters. The Center will be budgeting modest amounts for laboratory and research equipment purchases as follows.

Table XI: WorldFish Center capital requirements 2003–2005, US$ (million)

	2003	2004	2005
Capital Needs (US$)	200	225	250

B.2.4 Financial Ratios

Management has been putting special efforts into improving and sustaining the liquidity position of the Center. The liquidity position of the WorldFish Center is shown in the table below.

Table XII: Financial ratio analysis 2000–2005

	2000	2001	2002	2003	2004	2005
Current ratio-times	2.17	2.13	2.12	2.18	2.17	2.11
Quick ratio-times	2.17	2.13	2.11	2.17	2.16	2.10
Working capital ratio-%	94	92	91	91	92	93
Cash/current assets-%	52	49	61	65	66	67
Working capital-days	287	217	181	172	172	175

B.2.5 Inflation and Exchange Rates

Combined annual weighted inflation in developed countries is projected to be around 2.5-3.5 per cent while local inflation is estimated to fluctuate between 2.5-3.0 per cent during the plan period. The Malaysian Ringgit (RM) is fixed at the rate of RM 3.80 for one US$. There are no indications that the RM will be liberalized in the near future. 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 had declined against major currencies, which has resulted in a positive impact on non-US dollar denominated contributions for 2002.

B.2.6 Financing Plan 2003

The confirmed and high probability funding for financing the Center operations in 2003 amounts to US$ 15.55 million. Included in this amount is US$ 1.14 million representing an 8 per cent matching contribution from the World Bank.

The projected unrestricted funding amounts to US$ 6.13 million and restricted/project funding is projected at the level of US$ 9.27 million.

The Center earned income is projected at US$ 0.15 million, substantially lower than previous years due to the sharp drop in the global interest rates.

Table 7a provides details of the funding and donor support for 2003 agenda.

Financing of 2003 Plan

	US$ (M)	**%**
Unrestricted support	6.13	39
Targeted /restricted Funding	9.27	60
Subtotal	15.40	99
Center earned income	0.15	1
Total	**15.55**	**100**

B.2.7 Summary of Financing Plan

The resource requirements over the plan period are based on the 2002 Financing Plan level approved at the AGM-01 and the best estimate of resources for 2003 which is the basis for this plan period. The 2003 plan is increased by a combined annual growth and inflation rate of 3.5 per cent for years 2004 and 2005.

B.3 FINANCIAL TABLES FOR 2003–2005

Table 1. WorldFish Center – 2003 Research Agenda Requirements by CGIAR Output (expenditure in US $ million)

	MTP Projects	Germplasm Improvement	Germplasm Collection	Sustainable Production	Policy	Enhancing NARS	PROJECT TOTALS
001.	Conservation of Aquatic Biodiversity			0.42	0.06	0.09	0.57
002.	Mitigation Against Adverse Impact of Alien Species on Aquatic Biodiversity			0.15	0.02	0.03	0.20
003.	Genetic Improvement and Breeding	0.35	0.02			0.07	0.44
004.	Strategies and Options for Realizing Gains from Sustainable Freshwater Aquaculture Systems			3.54			3.54
005.	Freshwater Fisheries in an Integrated Land and Water Management Context			1.32			1.32
006.	Increased and Sustained Coastal Fisheries Production			1.70			1.70
007.	Restoration and Protection of Coastal Habitats	0.05	0.03	0.46			0.54
008.	Knowledge Bases and Training for Improved Management of Coastal Resources		0.04	0.76		0.09	0.89
009.	Economic, Policy and Social Analysis and Valuation of Aquatic Resources in Developing Countries				0.91		0.91
010.	Aquatic Resources Planning and Impact Assessment				0.93		0.93
011.	Legal and Institutional Analysis for Aquatic Resources Management				3.16		3.16
012.	Improved Partnerships and Capacity Building Among Developing Country NARS	0.08				0.68	0.76
013.	Access to Information for Sustainable Development of Fisheries and Aquatic Resources	0.06				0.53	0.59
	OUTPUT TOTALS	0.54	0.09	8.35	5.08	1.49	15.55

Table 2. WorldFish Center Research Agenda – Allocation of Resources, 2001 to 2005
(expenditure in US $ million)

Allocation of Resources by Outputs
Logical Framework Format

Outputs:	2001 (actual)	2002 (estimate)	2003 (proposal)	2004 (plan)	2005 (plan)	
Germplasm Improvement (Activity: Germplasm Enhancement & Breeding, plus Networks as appropriate)	0.78	0.55	0.54	0.55	0.58	3.68%
Germplasm Collection (Activity: Saving Biodiversity, plus Networks as appropriate)	0.11	0.09	0.09	0.10	0.10	0.57%
Sustainable Production (Activity: Production Systems Dev & Mgmt, Protecting the Environment, plus Networks as appropriate)	8.27	7.39	8.35	8.65	8.95	49.04%
Policy (Activity: Improving Policies, plus Networks as appropriate)	2.45	5.49	5.08	5.26	5.44	36.47%
Enhancing NARS (Activity: Strengthening NARS - the three sub-activities, plus Networks as appropriate)	1.51	1.54	1.49	1.54	1.59	10.24%
TOTAL	13.12	15.06	15.55	16.10	16.66	100.00%

Table 2 (cont'd). WorldFish Center Research Agenda – Allocation of Resources, 2001 to 2005 (expenditure in US $ million)

Allocation of Resources by CGIAR Activity

	2001 (actual)	2002 (estimate)	2003 (proposal)	2004 (plan)	2005 (plan)	
Increasing Productivity	2.74	2.33	2.66	2.76	2.86	15.45%
of which:						
Germplasm Enhancement & Breeding	0.78	0.55	0.54	0.55	0.58	3.68%
Production Systems Development & Management	1.96	1.78	2.12	2.21	2.28	11.81%
Protecting the Environment	6.31	5.61	6.23	6.44	6.67	37.26%
Saving Biodiversity	0.11	0.09	0.09	0.10	0.10	0.57%
Improving Policies	2.45	5.49	5.08	5.26	5.44	36.47%
Strengthening NARS	1.51	1.54	1.49	1.54	1.59	10.24%
of which:						
Training and Professional Development	0.54	0.46	0.35	0.37	0.37	3.06%
Documentation, Publications, Info. Dissemination	0.48	0.57	0.61	0.63	0.65	3.79%
Organization & Management Counselling						
Networks	0.49	0.51	0.53	0.54	0.57	3.36%
TOTAL	13.12	15.06	15.55	16.10	16.66	100%

Table 3. WorldFish Center Research Agenda Project & Output Cost Summary, 2001 to 2005 (in US $ million)

		2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
001.	Conservation of Aquatic Biodiversity	1.85	1.23	0.57	0.59	0.61
002.	Mitigation Against Adverse Impact of Alien Species on Aquatic Biodiversity	0.27	0.20	0.20	0.21	0.22
003.	Genetic Improvement and Breeding	0.78	0.47	0.44	0.45	0.47
004.	Strategies and Options for Realizing Gains from Sustainable Freshwater Aquaculture Systems	2.95	3.09	3.54	3.66	3.79
005.	Freshwater Fisheries in an Integrated Land and Water Management Context	0.47	0.42	1.32	1.37	1.41
006.	Increased and Sustained Coastal Fisheries Production	2.07	1.57	1.70	1.76	1.82
007.	Restoration and Protection of Coastal Habitats	0.45	0.40	0.54	0.56	0.58
008.	Knowledge Bases and Training for Improved Management of Coastal Resources	0.97	1.05	0.89	0.92	0.95
009.	Economic, Policy and Social Analysis and Valuation of Aquatic Resources in Developing Countries	0.77	1.45	0.91	0.94	0.98
010.	Aquatic Resources Planning and Impact Assessment	0.22	0.76	0.93	0.97	1.00
011.	Legal and Institutional Analysis for Aquatic Resources Management	1.24	3.14	3.16	3.27	3.38
012.	Improved Partnerships and Capacity Building Among Developing Country NARS	0.55	0.65	0.76	0.79	0.82
013.	Access to Information for Sustainable Development of Fisheries and Aquatic Resources	0.53	0.63	0.59	0.61	0.63
	Total	13.12	15.06	15.55	16.10	16.66

Table 3 (cont'd). WorldFish Center Research Agenda Project & Output Cost Summary, 2001 to 2005
(in US $ million)

Summary by CGIAR Output:	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
Germplasm Improvement	0.78	0.55	0.54	0.55	0.58
Germplasm Collection	0.11	0.09	0.09	0.10	0.10
Sustainable Production	8.27	7.39	8.35	8.65	8.95
Policy	2.45	5.49	5.08	5.26	5.44
Enhancing NARS	1.51	1.54	1.49	1.54	1.59
Total	**13.12**	**15.06**	**15.55**	**16.10**	**16.66**

Institutional Cost Components:	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
Direct Project Costs	13.90	15.91	16.22	16.80	17.38
Indirect Project Costs (Overhead)	(0.78)	(0.85)	(0.67)	(0.70)	(0.72)
Total Project Costs					
Total	**13.12**	**15.06**	**15.55**	**16.10**	**16.66**

Table 4. WorldFish Center Allocation of Project Costs to CGIAR Activities, 2001 to 2005 (in US $ million)

	Project	Activity	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
001.	Conservation of Aquatic Biodiversity	Production Systems	0.37	0.25	0.11	0.12	0.12
		Protecting the Environment	1.01	0.68	0.31	0.32	0.34
		Improving Policies	0.19	0.12	0.06	0.06	0.06
		Strengthening NARS-Training	0.28	0.18	0.09	0.09	0.09
			1.85	1.23	0.57	0.59	0.61
002.	Mitigation Against Adverse Impact of Alien Species on Aquatic Biodiversity	Production Systems	0.05	0.04	0.04	0.04	0.05
		Protecting the Environment	0.15	0.11	0.11	0.12	0.12
		Improving Policies	0.03	0.02	0.02	0.02	0.02
		Strengthening NARS-Training	0.04	0.03	0.03	0.03	0.03
			0.27	0.20	0.20	0.21	0.22
003.	Genetic Improvement and Breeding	Enhancement & Breeding	0.62	0.38	0.35	0.36	0.38
		Saving Biodiversity	0.04	0.02	0.02	0.02	0.02
		Strengthening NARS-Networks	0.12	0.07	0.07	0.07	0.07
			0.78	0.47	0.44	0.45	0.47
004.	Strategies and Options for Realizing Gains from Sustainable Freshwater Aquaculture Systems	Production Systems	0.89	0.93	1.06	1.10	1.14
		Protecting the Environment	2.06	2.16	2.48	2.56	2.65
			2.95	3.09	3.54	3.66	3.79
005.	Freshwater Fisheries in and Integrated Land and Water Management Context	Production Systems	0.14	0.13	0.40	0.41	0.42
		Protecting the Environment	0.33	0.29	0.92	0.96	0.99
			0.47	0.42	1.32	1.37	1.41
006.	Increased and Sustained Coastal Fisheries Production	Production Systems	0.21	0.16	0.17	0.18	0.18
		Protecting the Environment	1.86	1.41	1.53	1.58	1.64
			2.07	1.57	1.70	1.76	1.82

Table 4 (cont'd). WorldFish Center Allocation of Project Costs to CGIAR Activities, 2001 to 2005 (in US $ million)

007.	Restoration and Protection of Coastal Habitats	Enhancement & Breeding	0.05	0.04	0.05	0.05	0.06
		Production Systems	0.25	0.22	0.30	0.31	0.32
		Protecting the Environment	0.13	0.12	0.16	0.17	0.17
		Saving Biodiversity	0.02	0.02	0.03	0.03	0.03
			0.45	0.40	0.54	0.56	0.58
008.	Knowledge Bases and Training for Improved Management of Coastal Resources						
		Production Systems	0.05	0.05	0.04	0.05	0.05
		Protecting the Environment	0.77	0.84	0.72	0.73	0.76
		Saving Biodiversity	0.05	0.05	0.04	0.05	0.05
		Strengthening NARS-Training	0.10	0.11	0.09	0.09	0.09
			0.97	1.05	0.89	0.92	0.95
009.	Economic Policy and Social Analysis and Valuation of Aquatic Resources in Developing Countries	Improving Policies	0.77	1.45	0.91	0.94	0.98
010.	Aquatic Resources Planning and Impact Assessment	Improving Policies	0.22	0.76	0.93	0.97	1.00
011.	Legal and Institutional Analysis for Aquatic Resources Management	Improving Policies	1.24	3.14	3.16	3.27	3.38
012.	Improved Partnerships and Capacity Building Among Developing Country NARS	Enhancement & Breeding	0.06	0.07	0.08	0.08	0.08
		Strengthening NARS - Information	0.24	0.29	0.34	0.35	0.37
		Strengthening NARS - Training	0.06	0.07	0.08	0.09	0.09
		Strengthening NARS - Networks	0.19	0.22	0.26	0.27	0.28
			0.55	0.65	0.76	0.79	0.82
013.	Access to Information for Sustainable Development of Fisheries and Aquatic Resources	Enhancement & Breeding	0.05	0.06	0.06	0.06	0.06
		Strengthening NARS - Information	0.24	0.28	0.27	0.27	0.28
		Strengthening NARS - Training	0.06	0.07	0.06	0.07	0.07
		Strengthening NARS - Networks	0.18	0.22	0.20	0.21	0.22
			0.53	0.63	0.59	0.61	0.63
		Total	13.12	15.06	15.55	16.10	16.66

Table 4 (cont'd). WorldFish Center Allocation of Project Costs to CGIAR Activities, 2001 to 2005
(in US $ million)

Summary by Undertaking:

	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
Increasing Productivity	2.74	2.33	2.66	2.76	2.86
Protecting the Environment	6.31	5.61	6.23	6.44	6.67
Saving Biodiversity	0.11	0.09	0.09	0.10	0.10
Improving Policies	2.45	5.49	5.08	5.26	5.44
Strengthening NARS	1.51	1.54	1.49	1.54	1.59
Total	**13.12**	**15.06**	**15.55**	**16.10**	**16.66**

Summary by Output:

	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
Germplasm Improvement	0.78	0.55	0.54	0.55	0.58
Germplasm Collection	0.11	0.09	0.09	0.10	0.10
Sustainable Production	8.27	7.39	8.35	8.65	8.95
Policy	2.45	5.49	5.08	5.26	5.44
Enhancing NARS	1.51	1.54	1.49	1.54	1.59
Total	**13.12**	**15.06**	**15.55**	**16.10**	**16.66**

Table 5. WorldFish Center Research Agenda, 2001 to 2005
Investments by Sector, Commodity and Region (in US $ million)

PRODUCTION SECTORS & COMMODITIES	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
1/ *Germplasm Improvement*					
Crops					
Commodity A					
Commodity B					
Commodity C					
Commodity D					
Livestock					
Trees					
Fish	0.78	0.55	0.54	0.55	0.58
TOTAL	**0.78**	**0.55**	**0.54**	**0.55**	**0.58**
2/ *Sustainable Production*					
Crops					
Commodity A					
Commodity B					
Commodity C					
Commodity D					
Livestock					
Trees					
Fish	8.27	7.39	8.35	8.65	8.95
TOTAL	**8.27**	**7.39**	**8.35**	**8.65**	**8.95**
3/ ***Total Research Agenda***					
Crops					
Commodity A					
Commodity B					
Commodity C					
Commodity D					
Livestock					
Trees					
Fish	13.12	15.06	15.55	16.10	16.66
TOTAL	**13.12**	**15.06**	**15.55**	**16.10**	**16.66**

REGION	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
Sub-Saharan Africa (SSA)	**3.94**	**4.52**	**4.67**	**4.83**	**5.00**
Asia	**7.61**	**8.73**	**9.02**	**9.34**	**9.66**
Latin American and the Caribbean (LAC)	**0.52**	**0.60**	**0.62**	**0.64**	**0.67**
West Asia and North Africa (WANA)	**1.05**	**1.21**	**1.24**	**1.29**	**1.33**
TOTAL	**13.12**	**15.06**	**15.55**	**16.10**	**16.66**

Table 6. WorldFish Center Research Agenda, 2001 to 2005
Expenditure by Object of Expenditures, Capital Investments and Capital Fund
(in US $ million)

OBJECT OF EXPENDITURE	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
Personnel	4.61	5.23	5.40	5.60	5.78
Supplies and Services	7.57	8.60	8.90	9.19	9.55
Operational Travel	0.85	0.94	0.96	1.01	1.03
Depreciation	0.09	0.29	0.29	0.30	0.30
TOTAL	13.12	15.06	15.55	16.10	16.66
CAPITAL INVESTMENTS	**2001 (actual)**	**2002 (est)**	**2003 (proposal)**	**2004 (plan)**	**2005 (plan)**
Physical Facilities					
Research					
Training					
Administration					
Housing					
Auxiliary Units					
sub-total	0.43	0.22	0.20	0.23	0.25
Infrastructure & Leasehold					
Furnishing & Equipment					
Farming					
Laboratory & Scientific					
Office					
Housing					
Auxiliary Units					
Computers					
Vehicles					
Aircraft					
sub-total					
TOTAL	0.43	0.22	0.20	0.23	0.25
CAPITAL FUND CASH RECONCILIATION*	**2001 (actual)**	**2002 (est)**	**2003 (proposal)**	**2004 (plan)**	**2005 (plan)**
Balance, January 1	1.64	1.30	1.37	1.46	1.53
plus: annual depreciation charge	0.09	0.29	0.29	0.30	0.30
plus / minus: disposal gains/(losses)**					
plus / minus: other					
minus: asset acquisition costs	(0.43)	(0.22)	(0.20)	(0.23)	(0.25)
equals: Balance, December 31	1.30	1.37	1.46	1.53	1.58

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

September, 2002

Table 7. WorldFish Center Research Agenda Financing Summary, 2001 to 2002 (in US $ million)

Member	2001 (actual)		2002 (est)	
Unrestricted Contributions	(US$)	(national currency)	(US$)	(national currency)
Australia	0.37	A$0.71	0.21	A$0.40
Belgium	0.08	BEF3.60	0.09	EURO0.09
Canada	0.22	C$ 0.34	0.22	C$0.34
China	0.01	US$0.01	0.01	US$0.01
Denmark	0.59	DKK5.00	0.53	DKK4.00
Egypt	0.30	US$0.30	0.30	US$0.30
European Union	0.77	EURO0.87	0.91	EURO0.93
BMZ, Germany	0.19	DM 0.41	0.23	EURO0.24
India	0.04	US$ 0.04	0.04	US$0.04
Japan	0.50	YEN61.00	0.25	YEN30.0
Netherlands	0.80	NGL 2.00	0.84	NGL0.91
Norway	0.22	NOK 2.00	0.26	NKR2.00
Philippines	0.03	PHP1.53	0.03	PHP1.46
Sweden	0.22	SEK 2.27	0.27	SKR2.70
Thailand	0.02	US$ 0.02	0.02	US$0.02
United States Agency for International Development	0.67	US$ 0.67	0.67	US$0.67
World Bank	1.30	US$ 1.30	1.50	US$1.50
Others	0.02	US$ 0.02		
subtotal	6.35		6.38	

Targeted Contributions	2001 (actual)		2002 (est)	
	(US$)	(national currency)	(US$)	(national currency)
APAARI	0.01			
Asian Development Bank	0.58		0.49	
AUSAID	0.01			
Australia	0.12		0.21	
Belgium				
California Academy of Sciences	0.18		0.08	
Canada (CCLF)			0.01	
CGIAR				
DANIDA	0.01		0.02	
DA-BFAR	0.03			
DFID	1.14		2.59	
European Union	0.50			
FAO	0.01		0.03	
Ford Foundation				
Germany BMZ/GTZ	0.31		0.67	
GEF			0.12	
IDRC	0.05		0.02	
IFAD	0.08		0.16	
IFPRI				
Japan				
McArthur Foundation	0.06		0.28	
New Zealand ODA	0.03		0.14	
Netherlands				
NORAD	0.07		0.23	
Oxfam	0.07		0.08	
Packard	0.05		0.14	
Rockefeller Brothers	0.02			
Sweden - SIDA	0.78		0.91	
SW-PRGA	0.01			
TAC Special Fund	0.02			
UBC	0.01		0.01	
UNEP			0.60	
UNFIP	0.31			
UNDP/TCDC	0.18		0.10	
USAID	1.09		1.49	
Others (INREF, Provinces of New Caledonia, MRAG, CTA)	0.04		0.28	
World Bank	0.01			
subtotal	5.78		8.66	
TOTAL CONTRIBUTIONS	12.13		15.04	

Summary Statement of Activity	2001 (actual)		2002 (est)	
Investor Grants	12.13		15.04	
+ Center Income (other revenues)	0.43		0.15	
= Total Revenues	12.56		15.19	
Less:				
Total Expenses	13.12		15.06	
Surplus (Deficit) of total revenues over total expenses	(0.56)		0.13	

Table 7a. WorldFish Center Research Agenda Financing Summary, 2002 to 2003 (in US $ million)

(FINANCING PLAN)

Member	2002 (est)		2003 (proposal)	
Unrestricted Contributions	(US$)	(national currency)	(US$)	(national currency)
Australia	0.21	A$0.40	0.24	A$0.45
Belgium	0.09	EURO0.09	0.08	EURO0.09
Canada	0.22	C$0.34	0.22	C$0.34
China	0.01	US$0.01	0.01	US$0.01
Denmark	0.53	DKK4.00	0.53	DKK4.00
Egypt	0.30	US$0.30	0.30	US$0.30
European Union	0.91	EURO0.93	0.91	EURO0.93
BMZ, Germany	0.23	EURO0.24	0.24	EURO0.24
India	0.04	US$0.04	0.04	US$0.04
Japan	0.25	YEN30.0	0.25	YEN30.0
Netherlands	0.84	NGL0.91	0.89	NGL0.91
Norway	0.26	NKR2.00	0.26	NKR2.00
Philippines	0.03	PHP1.46	0.03	PHP1.46
Sweden	0.27	SKR2.70	0.29	SKR2.70
Thailand	0.02	US$0.02	0.02	US$0.02
United States Agency for International Development	0.67	US$0.67	0.68	US$0.68
World Bank	1.50	US$1.50	1.14	US$1.00
Others				
subtotal	6.38		6.13	

Targeted Contributions	2002 (est)		2003 (proposal)	
	(US$)	(national currency)	(US$)	(national currency)
APAARI				
Asian Development Bank	0.49		0.42	
AUSAID				
Australia	0.21		0.29	
Belgium				
California Academy of Sciences	0.08			
Canada (CCLF)	0.01		0.02	
CGIAR				
DANIDA	0.02			
DA-BFAR				
DFID	2.59		3.14	
European Union			0.00	
FAO	0.03			
Ford Foundation			0.11	
Germany BMZ/GTZ	0.67		0.75	
GEF	0.12		0.14	
IDRC	0.02		0.03	
IFAD	0.16		0.11	
IFPRI				
Japan				
McArthur Foundation	0.28		0.22	
New Zealand ODA	0.14		0.16	
Netherlands				
NORAD	0.23		0.20	
Oxfam	0.08			
Packard	0.14		0.11	
Rockefeller Brothers				
Sweden - SIDA	0.91		0.23	
SW-PRGA				
TAC Special Fund				
UBC	0.01		0.01	
UNEP	0.60		0.46	
UNFIP				
UNDP/TCDC	0.10		0.00	
USAID	1.49		1.55	
Others (INREF, Egypt, Provinces of New Caledonia, Academia Sinica, FPF, Crawford Fund, MRAG)	0.28		0.51	
Challenge Program	0.00		0.81	
subtotal	8.66		9.27	
TOTAL CONTRIBUTIONS	15.04		15.40	

Summary Statement of Activity	2002 (est)		2003 (proposal)	
Investor Grants	15.04		15.40	
+ Center Income (other revenues)	0.15		0.15	
= Total Revenues	15.19		15.55	
Less:				
Total Expenses	15.06		15.55	
Surplus (Deficit) of total revenues over total expenses	0.13		(0.00)	

Table 8a. WorldFish Center Allocation of Member Financing to Projects by Output for the Year 2001 (in US $ million)

	Project	Member	Total
001.	Conservation of Aquatic Biodiversity	EU	0.50
		TAC	0.02
		GTZ	0.31
		CAS	0.18
		USAID	0.06
		UBC	0.01
		DFID	0.00
		Others	0.01
		Unrestricted+center inc.	0.76
		Total Project	1.85
002.	Mitigation Against Adverse Impact of Alien Species on Aquatic Biodiversity (New Emphasis)	Unrestricted+center inc.	0.27
		Total Project	0.27
003.	Genetic Improvement and Breeding	ADB	0.14
		DFID	0.09
		UNDP	0.18
		FAO	0.00
		Unrestricted+center inc.	0.37
		Total Project	0.78
004.	Strategies and Options for Realizing Gains from Sustainable Freshwater Aquaculture Systems	USAID	1.03
		FAO	0.01
		IFAD	0.08
		DANIDA	0.01
		DFID	0.36
		Unrestricted+center inc.	1.46
		Total Project	2.95
005.	Freshwater Fisheries in an Integrated Land and Water Management Context (New Emphasis)	DFID	0.01
		USAID	0.00
		FAO	0.00
		DANIDA	0.00
		Unrestricted+center inc.	0.46
		Total Project	0.47
006.	Increased and Sustained Coastal Fisheries Production (Redefined)	ADB	0.21
		DA-BFAR	0.03
		ACIAR	0.12
		NZMFAT	0.01
		SIDA	0.06
		UNFIP / UNEP	0.06
		World Bank	0.00
		DFID	0.30
		Others	0.01
		Unrestricted+center inc.	1.27
		Total Project	2.07

Table 8a (cont'd). WorldFish Center Allocation of Member Financing to Projects by Output for the Year 2001 (in US $ million)

007.	Restoration and Protection of Coastal Habitats (Redefined)	UNFIP / UNEP	**0.06**
		World Bank	**0.00**
		SIDA	**0.06**
		Unrestricted+center inc.	**0.33**
		Total Project	**0.45**
008.	Knowledge Bases and Training for Improved Management of Coastal Resources (Redefined)	World Bank	**0.01**
		SIDA	**0.18**
		UNFIP / UNEP	**0.19**
		MacArthur Foundation	**0.06**
		Packard	**0.05**
		Rockefeller Brothers	**0.02**
		ADB	**0.05**
		DA-BFAR	**0.00**
		Unrestricted+center inc.	**0.41**
		Total Project	**0.97**
009.	Economic, Policy and Social Analysis and Valuation of Aquatic Resources in Developing Countries	ADB	**0.18**
		OXFAM	**0.07**
		SIDA	**0.14**
		DFID	**0.01**
		IDRC	**0.05**
		Unrestricted+center inc.	**0.32**
		Total Project	**0.77**
010.	Aquatic Resources Planning and Impact Assessment	SIDA	**0.05**
		DFID	**0.07**
		SWPRGA	**0.00**
		Others	**0.00**
		Unrestricted+center inc.	**0.10**
		Total Project	**0.22**
011.	Legal and Institutional Analysis for Aquatic Resources Management	SWPRGA	**0.01**
		DFID	**0.28**
		SIDA	**0.29**
		Others	**0.02**
		Unrestricted+center inc.	**0.64**
		Total Project	**1.24**
012.	Improved Partnerships and Capacity Building Among Developing Country NARS (Redefined)	NORAD	**0.07**
		AUSAID	**0.01**
		APAARI	**0.01**
		DFID	**0.02**
		NZODA	**0.02**
		Unrestricted+center inc.	**0.42**
		Total Project	**0.55**
013.	Access to Information for Sustainable Development of Fisheries and Aquatic Resources (Redefined)	Unrestricted+center inc.	**0.53**
		Total Project	**0.53**

Center Totals

	Total
Total Targeted Funding	**5.78**
Total Unrestricted Funding	**6.91**
Total Center Income	**0.43**
Total Allocations	**13.12**

Table 8b. WorldFish Center Allocation of Member Financing to Projects by Output for the Year 2002 (in US $ million)

	Project	Member	Total
001.	Conservation of Aquatic Biodiversity	GTZ	0.57
		UBC	0.01
		CAS	0.08
		Unrestricted+center inc.	0.57
		Total Project	1.23
002.	Mitigation Against Adverse Impact of Alien Species on Aquatic Biodiversity (New Emphasis)	Unrestricted+center inc.	0.20
		Total Project	0.20
003.	Genetic Improvement and Breeding	DFID	0.12
		UNDP	0.10
		INREF	0.02
		Unrestricted+center inc.	0.23
		Total Project	0.47
004.	Strategies and Options for Realizing Gains from Sustainable Freshwater Aquaculture Systems	DFID	0.39
		USAID	1.49
		BMZ-GTZ	0.10
		Unrestricted+center inc.	1.11
		Total Project	3.09
005.	Freshwater Fisheries in an Integrated Land and Water Management Context (New Emphasis)	DFID	0.02
		CCLF	0.01
		Unrestricted+center inc.	0.39
		Total Project	0.42
006.	Increased and Sustained Coastal Fisheries Production (Redefined)	ACIAR	0.16
		NZMFAT	0.11
		UNEP	0.11
		Provinces	0.09
		GEF	0.06
		DANIDA	0.02
		Unrestricted+center inc.	1.02
		Total Project	1.57
007.	Restoration and Protection of Coastal Habitats (Redefined)	NZMFAT	0.03
		UNEP	0.11
		FAO	0.01
		GEF	0.06
		Unrestricted+center inc.	0.19
		Total Project	0.40
008.	Knowledge Bases and Training for Improved Management of Coastal Resources (Redefined)	UNEP	0.32
		MacArthur Foundation	0.28
		Packard	0.14
		Unrestricted+center inc.	0.31
		Total Project	1.05

Table 8b (cont'd). WorldFish Center Allocation of Member Financing to Projects by Output for the Year 2002 (in US $ million)

009.	Economic, Policy and Social Analysis and Valuation of Aquatic Resources in Developing Countries	ADB	**0.49**
		OXFAM	**0.08**
		SIDA	**0.36**
		UNEP	**0.06**
		IDRC	**0.01**
		ACIAR	**0.05**
		Unrestricted+center inc.	**0.40**
		Total Project	**1.45**
010.	Aquatic Resources Planning and Impact Assessment	SIDA	**0.14**
		DFID	**0.41**
		IFAD	**0.03**
		Unrestricted+center inc.	**0.18**
		Total Project	**0.76**
011.	Legal and Institutional Analysis for Aquatic Resources Management	DFID	**1.65**
		IFAD	**0.13**
		SIDA	**0.41**
		MRAG	**0.13**
		Unrestricted+center inc.	**0.82**
		Total Project	**3.14**
012.	Improved Partnerships and Capacity Building Among Developing Country NARS (Redefined)	NORAD	**0.23**
		FAO	**0.02**
		CTA	**0.04**
		IDRC	**0.01**
		Unrestricted+center inc.	**0.35**
		Total Project	**0.65**
013.	Access to Information for Sustainable Development of Fisheries and Aquatic Resources (Redefined)	Unrestricted+center inc.	**0.63**
		Total Project	**0.63**

Center Totals

	Total
Total Targeted Funding	**8.66**
Total Unrestricted Funding	**6.25**
Total Center Income	**0.15**
Total Allocations	**15.06**

Table 8c. WorldFish Center Allocation of Member Financing to Projects by Output for the Year 2003 (in US $ million)

	Project	Member	Total
001.	Conservation of Aquatic Biodiversity	EU	0.00
		TAC	0.00
		GTZ	0.08
		CAS	0.00
		USAID	0.00
		UBC	0.01
		DFID	0.00
		Others	0.03
		Unrestricted+center inc.	0.45
		Total Project	0.57
002.	Mitigation Against Adverse Impact of Alien Species on Aquatic Biodiversity (New Emphasis)	Unrestricted+center inc.	0.20
		Total Project	0.20
003.	Genetic Improvement and Breeding	ADB	0.00
		DFID	0.12
		UNDP	0.00
		Others	0.06
		Unrestricted+center inc.	0.26
		Total Project	0.44
004.	Strategies and Options for Realizing Gains from Sustainable Freshwater Aquaculture Systems	USAID	1.55
		BMZ/GTZ	0.46
		IFAD	0.00
		DANIDA	0.00
		DFID	0.31
		Unrestricted+center inc.	1.22
		Total Project	3.54
005.	Freshwater Fisheries in an Integrated Land and Water Management Context (New Emphasis)	DFID	0.00
		BMZ/GTZ	0.17
		Challenge Program	0.50
		CCLF	0.02
		Others	0.20
		Unrestricted+center inc.	0.43
		Total Project	1.32
006.	Increased and Sustained Coastal Fisheries Production (Redefined)	ADB	0.00
		ACIAR	0.16
		NZMFAT	0.13
		UNFIP / UNEP	0.09
		Challenge Program	0.18
		GEF	0.07
		Others	0.21
		Unrestricted+center inc.	0.86
		Total Project	1.70

Table 8c. WorldFish Center Allocation of Member Financing to Projects by Output for the Year 2003 (in US $ million)

007.	Restoration and Protection of Coastal Habitats (Redefined)	UNFIP / UNEP	**0.09**
		NZMFAT	**0.03**
		Challenge Program	**0.09**
		GEF	**0.07**
		AIMS (Australia)	**0.03**
		Unrestricted+center inc.	**0.23**
		Total Project	**0.54**
008.	Knowledge Bases and Training for Improved Management of Coastal Resources (Redefined)	Challenge Program	**0.03**
		SIDA	**0.00**
		UNFIP / UNEP	**0.26**
		MacArthur Foundation	**0.22**
		Packard	**0.11**
		Unrestricted+center inc.	**0.27**
		Total Project	**0.89**
009.	Economic, Policy and Social Analysis and Valuation of Aquatic Resources in Developing Countries	ADB	**0.42**
		UNEP	**0.02**
		SIDA	**0.09**
		DFID	**0.07**
		Ford Fdtn	**0.01**
		Unrestricted+center inc.	**0.30**
		Total Project	**0.91**
010.	Aquatic Resources Planning and Impact Assessment	SIDA	**0.03**
		DFID	**0.64**
		IFAD	**0.02**
		Ford Fdtn	**0.01**
		Unrestricted+center inc.	**0.23**
		Total Project	**0.93**
011.	Legal and Institutional Analysis for Aquatic Resources Management	IFAD	**0.09**
		DFID	**1.97**
		SIDA	**0.10**
		Ford Fdtn	**0.09**
		Others	**0.01**
		Unrestricted+center inc.	**0.90**
		Total Project	**3.16**
012.	Improved Partnerships and Capacity Building Among Developing Country NARS (Redefined)	NORAD	**0.20**
		DFID	**0.03**
		ACIAR	**0.10**
		IDRC	**0.03**
		Germany	**0.04**
		Unrestricted+center inc.	**0.36**
		Total Project	**0.76**
013.	Access to Information for Sustainable Development of Fisheries and Aquatic Resources (Redefined)	Unrestricted+center inc.	**0.59**
		Total Project	**0.59**

Center Totals

	Total
Total Targeted Funding	**9.27**
Total Unrestricted Funding	**6.13**
Total Center Income	**0.15**
Total Allocations	**15.55**

Table 9. WorldFish Center Research Agenda Staff Composition, 2001 to 2005

	2001 (actual)		2002 (est)		2003 (proposal)		2004 (plan)		2005 (plan)	
	Hired by:		Hired by:		Hired by:		Hired by:		Hired by:	
	center	other	center	other	center	other	center	other	center	other
Internationally-Recruited Staff (IRS)										
Research and Research Support	24	1	24		25		28		30	
of which:										
Post-doctoral Fellows										
Associate Professionals										
Training / Communications	1		1		1		1		1	
of which:										
Post-doctoral Fellows										
Associate Professionals										
Research Management	5		5		5		5		5	
of which:										
Post-doctoral Fellows										
Associate Professionals										
Total IRS	30		30		31		34		36	
Regionally-Recruited Staff (RRS)										
Research and Research Support	11		11		10		10		10	
of which:										
Post-doctoral Fellows										
Associate Professionals										
Training / Communications	1		1		1		1		1	
of which:										
Post-doctoral Fellows										
Associate Professionals										
Research Management	2		2		2		2		2	
of which:										
Post-doctoral Fellows										
Associate Professionals										
Total RRS	14		14		13		13		13	
Support Staff	210		242		245		247		248	
TOTAL STAFF	254	1	286		289		294		297	

Table 10. WorldFish Center – Financial Position: Statement of Cash Flows, 2001 and 2002 (in US$ million)

2001	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Opening Cash Balance	8,014	9,202	9,375	9,867	9,683	9,258	8,063	7,572	8,417	7,627	7,363	7,763
Receipts												
Grants:												
Unrestricted	1,504	721	118	370	841	292	385	319		26	974	1,255
Restricted	276	106	1,747	427	24	16	195	1,369	204	947	101	87
Earned Income	40	30	35	35	40	30	35	40	35	36	35	40
Disbursements												
Operations *	612	654	1368	971	1290	1488	1066	833	984	1243	685	1930
Capital Acquisition												
Other	20	30	40	45	40	45	40	50	45	30	25	40
Ending Cash Balance	9,202	9,375	9,867	9,683	9,258	8,063	7,572	8,417	7,627	7,363	7,763	7,175

* Includes HQ Renovation and minor capital

2002	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Opening Cash Balance	7,175	7,738	8,002	7,762	8,134	8,138	7,900	8,389	7,576	8,018	8,414	8,870
Receipts												
Grants:												
Unrestricted	1,185	-	339	862	300	440	1,241	310	276	176	471	950
Restricted	-	1,326	368	400	652	225	167	112	1,576	1,650	1,600	850
Earned Income	15	15	15	15	10	15	10	15	15	15	10	15
Disbursements												
Operations	607	1,042	922	860	918	878	884	1,075	1,380	1,340	1,600	1,930
Capital Acquisition								125		75		
Other	30	35	40	45	40	40	45	50	45	30	25	40
Ending Cash Balance	7,738	8,002	7,762	8,134	8,138	7,900	8,389	7,576	8,018	8,414	8,870	8,715

CURRENCY STRUCTURE OF EXPENDITURES

	2001 (actual)			2002 (estimate)			2003 (proposal)		
Currency	Amount	$ value	% share	Amount	$ value	% share	Amount	$ value	% share
US Dollar		9.18	70%		9.79	65%		9.33	60%
Malaysian Ringgit		2.63	20%		3.76	25%		3.89	25%
Others		1.31	10%		1.51	10%		2.33	15%
TOTAL		13.12	100%		15.06	100%		15.55	100%

Table 11. WorldFish Center Statement of Financial Position, 2001 to 2005 (in $'000)

Assets	2001 (actual)	2002 (est)	2003 (proposal)	2004 (plan)	2005 (plan)
Current Assets					
Cash & Cash Equivalents	7,175	8,715	8,825	9,230	10,130
Accounts Receivable					
Donors	3,012	2,810	2,880	2,750	3,100
Employees	193	156	115	120	130
Others	1,537	1,210	850	875	830
Inventories	4	10	15	15	15
Prepaid Expenses		70	90	100	110
Other Current Assets*	2,774	1,200	800	950	800
Total Current Assets	14,695	14,171	13,575	14,040	15,115
Fixed Assets					
Property, Plant, & Equipment					
Less: Accumulated Depreciation					
Total Fixed Assets - Net	657	780	690	630	580
Total Assets	15,352	14,951	14,265	14,670	15,695
Liabilities and Net Assets					
Current Liabilities					
Bank Indebtedness					
Accounts Payable					
Donors	2,979	2,800	2,625	2,470	2,100
Employees	137	150	85	90	100
Others	401	350	160	150	170
Advances from Donors	0	0	0	0	0
In-Trust Accounts	735	1,300	1,210	1,410	1,700
Accruals and Provisions	2,634	2,100	2,150	2,350	3,100
Total Current Liabilities	6,886	6,700	6,230	6,470	7,170
Long-Term Liabilities	478				
Total Liabilities	7,364	6,700	6,230	6,470	7,170
Net Assets					
Capital Invested in Fixed Assets					
Center Owned					
In Custody					
Capital Fund					
Operating Fund					
Other Funds					
Total Net Assets	7,988	8,251	8,035	8,200	8,525
Total Liabilities & Net Assets	15,352	14,951	14,265	14,670	15,695

* Based on the revised CGIAR Accounting Manual 1999

APPENDIX

PROGRAM DETAILS

BIODIVERSITY AND GENETIC RESOURCES RESEARCH PROGRAM (BIODIVERSITY AND GENETICS PROGRAM)

Thrust 1 (=MTP Project 1)*: Conservation of aquatic diversity*

Purpose/Objective

1. Aquatic biodiversity (genetic diversity within species, species diversity and ecological diversity) is restored, conserved and used in a sustainable manner.

The objective of this thrust is that research institutions, management agencies and NGOs use scientific tools and methods (in part, developed by the Center) for understanding, conserving and sustainably using aquatic biological diversity. The thrust will focus on the development of countermeasures to threats of aquatic diversity based on information collected on the species biology, habitat requirements and genetics. For freshwater systems, development of management models as decision-support tools will be another key area.

Gains/Impacts

1. FishBase evolves from a global biodiversity database to a management tool with options and modules for country-specific applications. Its scope is broadened from taxonomy and biology to resources management and biodiversity conservation. The diffusion of FishBase is improved and the range of its users is broadened to NARS and management bodies from developing countries.
2. Based on information collected in multiple disciplines like biology, sociology, economics, etc., identification and operation of freshwater sanctuaries is carried out in a scientific manner. This leads to promotion and implementation of freshwater sanctuaries as a way to protect heavily threatened river and wetland biodiversity.
3. The computer-based decision-support systems developed to assist in the management of freshwater resources are implemented and tested in Southeast Asia and in Africa before distribution to national partners.

Output 1: FishBase as a global biodiversity database

Activities:

- Maintenance and dissemination of FishBase as a Global Biodiversity Database on the world-wide web by WorldFish Center
- Expansion and further refinement of FishBase in collaboration with FishBase Consortium

Milestones:	
Year	**Milestones**
2003	• Core FishBase maintenance activities identified and a business plan developed for maintenance of all WorldFish Center databases on the web • Detailed program of work and business plan for the further expansion and refinement of FishBase as a Global Biodiversity Database by the FishBase Consortium developed
2004	• Maintenance plan for all WorldFish Center databases on web implemented • Set of collaborative activities related to FishBase with FishBase Consortium implemented
2005	• FishBase maintained on web • Continued collaboration on FishBase with FishBase Consortium

Output 2: Aapplications of FishBase for developing countries

Activities:

- Development of customized country FishBase solutions starting with the Philippines
- Development of customized country FishBase solutions for other countries
- Development of analytical and decision-support tools utilizing FishBase

Milestones:

Year	Milestones
2003	• Requirements and Philippine partners identified through joint meeting and workshops • Collaboration established with targeted organizations. • Based on the workshop with key NARS partners on developing customized country FishBase solutions, work on developing such databases in China and India initiated • "Species / Key Facts" matrices for ecological and community analyses further refined. Work on other analytical tools continued
2004	• Combined program of work with Philippine partners • Training manuals on building country-specific customized databases (data-encoding, validation, database linkages, related web-site development) developed • Training initiated for developing country NARS collaborators with special emphasis on Africa • Training on building country-specific customized databases and work on China and India databases continued. • International workshop on developing application based databases for fisheries and aquaculture conducted. • Database for aquatic invertebrates, especially commercial shell-fishes in these countries initiated based on use, experience and structure of FishBase • Analytical tools towards management of protected coral reef areas, in collaboration with the ReefBase team developed. Analytical tools on species identifications developed. • Spatial (GIS) functions in FishBase towards natural resources modeling, and spatial management e.g. biogeographic evaluation of species introductions, identification and analysis of conservation "hotspots" expanded.
2005	• Development of customized Philippine FishBase. Theme-based applications developed and demonstrated • Developing customized country FishBase databases in two African countries initiated. • Analytical tools on coastal zone management and fisheries management developed

Output 3: Decision-making tools utilizing data on species and habitat diversity.

Activities:

- Development of management plan for freshwater sanctuaries.
- Development of decision-support systems for management of freshwater resources

Milestones:

Year	Milestones
2003	• Project on freshwater aquatic sanctuaries developed under the Challenge Programme on Water and Food • Probability model relating fish production and environmental parameters used in the Mekong River Basin • Contribution to the Challenge Programme on Water and Food with projects on environment and resource protection in the Mekong Basin and in Africa. • Development of a generic Bayesian model for use in other river basins • Development of a multi-agent model of the Tonle Sap Great Lake fisheries (fish + users) in Cambodia • Development of methods to integrate in-stream flow assessment methodologies with fish-flow models and other decision support tools
2004	• Review of high priority conservation areas for tilapia species in Africa and recommendations for conservation measures • Study of the biodiversity of tilapias in Lake Nasser and of of the impacts of escapes from aquaculture upon the biodiversity of tilapia populations in the Nile initiated. • Submission of research proposals for the integration of existing models and diffusion thereof • Contribution to the development of a management model integrating environmental flow requirements, floodplain fisheries and decision support tool in the Tonle Sap area (Cambodia) • Contribution to the development and use of integrated river management models in Africa
2005	• Development of a plan and decision-making tool for management of fresh water sanctuaries based on species, habitat diversity information and socio-economic factors. • Creation of a user-friendly package combining different modelling approaches at different scales; training and distribution in Southeast Asia and Africa and South America.

Output 4: Utilization of genetic diversity information for conservation and management of 'key' species

Activities:

- Quantification of the impact of farmed fish escapes on wild stocks of carp
- Genetic and phenotypic characterization of domesticated and selected stocks of carp and tilapia
- Population genetics of giant clam and sea cucumber

Milestones:

Year	Milestones
2003	• Workshop on the effect of farmed fish escapes on wild stocks of carp conducted
2004	• Initiation of project on genetic and phenotypic characterization of domesticated and selected stocks of carp and tilapia. • Work initiated using genetic markers on quantifying introgression of farmed genome of common carp (China) and rohu (India) on natural stocks • Project on population genetics of giant clam and sea cucumber initiated
2005	• Effect of farmed fish on life history traits of escaped farmed fish quantified • Based on genetic and phenotypic parameters, identification of strains that need to be conserved and utilized more extensively for aquaculture and selection programs

Costs (US$ million):
2003: 0.57
2004: 0.59
2005: 0.61

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.

Collaborators
- Museums and centers of taxonomic expertise worldwide: the British Museum (Natural History), London; the MusÈe ? National d'Histoire Naturelle, Paris; the MusÈe Royal d'Afrique Centrale, Tervuren, the University of Kiel, Germany; the University of British Columbia, Canada; the World Conservation Union (IUCN); the FAO;
- 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,
- Students from the Institut Francophone d'Informatique (Hanoi), University Paris VI, University Paul Sabatier (France);
- University of Cape Town (South Africa), Griffith University (Australia), Imperial College (London) for environmental modelling
- NGO's such as GAPE (Global Association for People and the Environment, Laos)

CGIAR linkages
International Water Management Institute, International Rice Research Institute, International Food Policy Research Institute and Centro Internacional de Agricultura Tropical (collaboration through the Water and Food Challenge Program)

Funding sources:
Funds under Challenge Program on water and other potential funding sources like MacArthur Foundation, DFID, GEF, EU 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. WorldFish Center core.

Thrust 2(=MTP Project 2): Mitigation of adverse impact of alien species on aquatic diversity

Purpose / Objectives
1. To safeguard against the adverse impact of alien species on aquatic biodiversity.
2. To help countries to develop mechanisms for evaluating introduction of alien species for aquaculture

Alien species establishment has been identified as one of the main threats to biodiversity. There are many pathways through which alien species get established; some of these are intentional and others unintentional. With increased awareness, intentional introductions have been reduced. Among the unintentional introductions, ballast water and escapees from aquaculture are the main routes for establishment of alien species. Many of the improved strains are alien to developing countries. Earlier introductions of the same species have been considered invasive. However, not all species introduced for aquaculture establish in nature and become invasive. The absence of adequate tools to assess the risks and evaluate any adverse impacts of alien species at genetic, species, communities and habitat levels makes it difficult to draw up guidelines for safe introduction of alien species for aquaculture. Most of the developing countries are ill-equipped to address problems arising from of alien species introduction, due to the absence of a national strategy, institutional mechanisms, policy support and appropriate legal instruments. The purpose of this thrust is to carry out research to mitigate the adverse impact of alien species and to better equip the developing countries to handle alien species.

Gains / Impacts
1. With the help of tools to evaluate the impact of aquatic alien species, it would be possible to screen proposals for introduction of alien species in a more objective scientific manner than the present ad-hoc subjective way of handling them.
2. Countries which are pro active against invasive alien species. would be better equipped with response mechanisms.
3. The risk of introducing improved fish strains for aquaculture will be greatly reduced.

Output 1: Development of tools to assess risks and response mechanisms to mitigate adverse impact of alien species

Activities:
- Identification of factors leading to freshwater alien species introduction and development of tools to assess risks and evaluate impact

Milestones:

Year	Milestones
2003	• Project on freshwater aquatic alien species initiated
2004	• Workshop on aquatic alien species held
2005	• Socio-economic factors influencing alien species establishment identified • Development of tools to assess risks and evaluate adverse impact due to alien species

Activities:

- Development of national strategies and guidelines on aquatic alien species

Milestones:

Year	Milestones
2003	• Requirements and Philippine partners identified through interactions • Development of a national strategy and guidelines for Malaysia on aquatic alien species jointly with Malaysian partners initiated.
2004	• Guidelines on translocations of alien species and minimizing escape of farmed individuals developed
2005	• Response mechanisms to mitigate adverse impacts of alien species and escape of farmed individuals on aquatic biodiversity developed

Costs (US$ million):
2003: 0.20
2004: 0.21
2005: 0.22

Users:
The users will be decision-makers and policy-makers concerned with living aquatic resources and their environments and scientists in national institutions, in particular those participating in the International Network on Genetics in Aquaculture (INGA).

Collaborators:
NARS: specifically, organizations in INGA member countries, such as Bangladesh, China, India, Indonesia, Malaysia, Philippines, Thailand, Vietnam, Egypt, Ghana, Côte d'Ivoire and Malawi, Global Invasive Species Programme (GISP).

Linkages:
None specifically, but the Center's work in this thrust area will also be reported to the Systemwide Genetic Resources Program (SGRP) Links will also be explored with other CGIAR institutes having programs on alien species.

Financing Plan:
This is a new thrust area and funds will be requested under Global Environment Facility (GEF) WorldFish Center core funds.

Thrust 3 (=MTP Project 3): Genetic Enhancement and Breeding

Purpose / Objectives

1. To maintain and continuously improve fish strains for distribution to farmers, by developing and supporting National Breeding Programs
2. To minimize the risk of long term loss of genetic variability of aquaculture species, by ensuring that National Breeding Programs adequately manage population size and control inbreeding

Application of genetics to aquaculture has so far been limited. Most aquaculture stocks in current use are genetically similar to wild, undomesticated stocks. The potential for improvement among these stocks is virtually untouched. The project focus is on tilapias and carp, which together form the mainstay of many resource-poor small-scale farmers throughout the developing world. The project is developing research methods and strategies for domestication and genetic improvement

of tilapia and carp germplasm, and is assessing their potential socio-economic and environmental impacts. In this way, it is contributing to the initiation of national fish breeding programs. In cases where programs are already underway, the project will support and refine existing breeding programs, and ensure that farmers and consumers capture the benefits. Socio-economic impact studies, choice of farming systems and selection of traits for improvement will all contribute to the provision of genetically enhanced carp and tilapia for aquaculture. It would also help transfer the technology to the collaborating countries' scientists, extension officers, and most importantly to farmers.

In our endeavours to achieve genetic improvement for production traits, it is important to balance short and long-term gains. Excessive emphasis on short-term gains can result in reduced population size and an increase of inbreeding, which in turn can impact negatively upon long-term genetic improvement.

Gains / Impacts

1. The provision of better breeding stock to the world's major carp and tilapia farming countries and of methods for their safe and productive deployment, is expected to result in more stable fish production, and consequently in improved income among small-scale farmers. This can be expected to impact upon food security and poverty alleviation. The gains will be measured by socio-economic and environmental surveys jointly conducted with our collaborators.

Output 1: Development of improved fish strains by national breeding programs

Activities:

- Transfer of selective breeding (GIFT) technology for aquaculture improvement from the Philippines to Sub-Saharan Africa and Egypt
- Development of carp strains for aquaculture in Asia (Second Phase)
- Establishment of an International Breeding Centre at the Center to support developing country aquaculture geneticists

Milestones:

Year	Milestones
2003	• Second phase of the project 'Transfer of GIFT technology to Africa' emphasizing aspects of dissemination of the improved stock to farmers initiated • Project on 'Developing improved carp strains for aquaculture in Asia' submitted for funding • Proposal for funding an International Breeding Centre at the Center submitted
2004	• Evaluation of 2nd generation of selection completed • Methodology for multi-trait selection evaluated and multi-location evaluation of improved strains carried out • Aquaculture geneticists from developing countries utilise the expertise and facilities of the International Breeding Centre to analyse their data
2005	• Improved strains of tilapia developed by four collaborating partners ready for dissemination • Improved strains of carp developed by six collaborating partners ready for dissemination

Output 2: Development and dissemination of methods for genetic improvement

Activities:
1. Genetic enhancement of Nile Tilapia and utilization of F1 crossbred clones and YY males.
2. Selective breeding of tilapia for high and low input pond environments as a component of integrated farming
3. Training courses on genetic improvement
4. Publication of manuals on fish genetic improvement

Milestones:

Year	Milestones
2003	• Conduct further selection based on breeding values, compare the GIFT strain to local strains in a range of environments • Merit of YY male technology assessed in a commercial situation • Genetic parameters in high and low input environments in experimental ponds in Egypt estimated • Two workshops run (one in Africa and one in Asia) on the application of quantitative genetics to fish genetic improvement
2004	• Value of F1 clones as controls in a genetic improvement program assessed • Innovative approach for the selective breeding and recording of economically important traits (e.g. disease resistance) tested • Evaluation of 2nd generation of selection lines in high and low pond production environments completed
2005	• Molecular techniques (e.g. MAS) assessed and incorporated in breeding programs where appropriate • Selected tilapia strains disseminated to farmers • Evaluation of 3rd generation of selection lines in high and low pond production environments completed • Organise regional workshops to disseminate findings. • Training programs on quantitative genetics conducted, incorporating the most recent findings emanating from the Center's genetic research and development program • At least two persons complete their postgraduate studies in animal breeding and genetics in the context of the Center's program

Costs (US$ million):
2003: 0.44
2004: 0.45
2005: 0.47

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

Collaborators:
NARS: specifically, organizations in INGA member countries, such as Bangladesh, China, India, Indonesia, Malaysia, Philippines, Thailand, Vietnam, Egypt, Ghana, Côte d'Ivoire and Malawi.
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.

System Linkages:
None specifically, but the Center'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. WorldFish Center core funds.

FRESHWATER RESOURCES RESEARCH PROGRAM (FRESHWATER PROGRAM)

Thrust 4(=MTP Project 4): Strategies and options for realizing gains from sustainable freshwater aquaculture systems

Objectives:
1. To enable small-scale farmers in Africa and Asia to practice appropriate aquaculture on a sustained basis.
2. To strengthen NARES to promote appropriate aquaculture technologies through efficient and efficacious diffusion pathways.

Gains
1. Improved management of smallholder farms through better and widely available knowledge on the possibilities of integrating aquaculture into their farms for greater diversification and nutrient use efficiency.
2. Improved application of technical know-how of appropriate integrated agriculture-aquaculture development
3. Reduced poverty and improved quality of life among farmers through increased productivity from farms with aquaculture as a new component.
4. Increased productivity of fish from aquaculture to meet market demand ensuring the contribution of fish to food security.

Output 1: Thorough understanding of target group needs and constraints

Activities:
1. Malawi regional office for aquaculture support to SACCAR countries; Malawi aquaculture project for small farm diversification.
2. Zambia and Mozambique outreach activities from Malawi
3. Cameroon aquaculture project in forest margins
4. Bangladesh sustainable aquaculture project
5. Vietnam smallholder livelihoods project in the Mekong Delta

Milestones:

Year	Milestones
2003	• Malawi site will expand the implementation of the RET approach to cover the major aquaculture areas in Malawi and newly initiated activities in Zambia will be further supported. • In Mozambique, the RET approach and aquaculture development activities will be initiated in the Manica Province (unlike the Zambia activity, this activity is entirely dependent on external funding) • In Bangladesh, wealth ranking exercises will be conducted to select 360 households in four separate wealth strata, with which household-level assessments will be conducted using the RESTORE approach. These will serve as the baseline for subsequent improved aquaculture technology adoption trials, depending on the needs, constraints and selection of the cooperating farmers. • In Vietnam, farm households with homestead garden-ponds will be assessed using the RESTORE approach and additional studies on the theoretical suitability of improved aquaculture technologies will have been conducted.
2004	• In Bangladesh, impact of IAA on different income groups quantified and efficiency of dissemination pathways determined.
2005	• In Cameroon, in the final year of the project in 2005, an impact evaluation will be conducted on the impact of IAA adoption on small farm households in different combinations of market access and population density categories.

Output 2: Portfolio of new and improved aquaculture technologies

Activities:
1. Malawi aquaculture project for small farm diversification
2. Egypt on-station, on-farm and socioeconomic research
3. Cameroon aquaculture project in forest margins
4. Bangladesh sustainable aquaculture project
5. Vietnam smallholder livelihoods project in the Mekong Delta

Milestones:

Year	Milestones
2003	• In Malawi, the study on the identification of factors regulating nitrogen retention in IAA systems will be completed. • In Egypt, work is planned to study the role of fishponds in the nutrient dynamics of mixed farming systems. Work beginning in 2002 will evaluate the impact of tilapia in low and high environments on the nutrient dynamics of the pond. • Further work in Egypt will study fish farming economics and assess overall supply and demand of fish in the country, and identify market conditions under which future investment in aquaculture in Egypt will be fully viable. • In Egypt work will specifically assess the demand for fish and fish products from different sources (national aquaculture and capture fisheries and imports) through the course of the year, taking account of consumer preferences at different social and income levels; and determine the factors responsible for the decline in fish sale prices, in particular distinguishing between changing consumer preferences and market reaction to increasing supply. • In Bangladesh together with partner institutions, research will be conducted to solve production bottlenecks and clarify key aspects of IAA systems as identified with target beneficiaries to benefit them. Technologies appropriate to economic strata of target farmers will be tested on-farm in comparison across different sites and monitored with the RESTORE tool over three years. • In Vietnam, farmer-selected technologies for homestead garden ponds (e.g. polyculture of carp species with Nile tilapia (GIFT strain), freshwater prawn or marble goby will be tested in on-farm trials. Shrimp-fish polyculture options will be evaluated in low-salinity (< 12 ppt) brackishwater ponds in order to achieve greater species diversity and resilience of operations, among others against disease outbreaks and economic loss.
2004	• In Bangladesh specific on-farm and on-station studies on technology verification through sponsored research by NARS partners on specific technology improvements will be conducted. • In Malawi, research will investigate the water use efficiency of integrated agriculture-aquaculture systems in comparison to other small farm enterprises; towards understanding of drought resilience.
2005	• In Cameroon conclusions will be drawn from studies on the use of farm wastes specific to existing farming systems in the humid forest zone (i.e. existing and potential plant material, and animal manure) as nutrient inputs to ponds for profitability and sustainability, and on the reproduction and pond rearing of indigenous species.

Output 3: Sustainable systems, and guidelines for the dissemination of aquaculture information and technology to fish farmers

Activities:

1. Malawi regional office for aquaculture support to SACCAR countries; Malawi aquaculture project for small farm diversification.
2. Zambia and Mozambique outreach activities from Malawi
3. Cameroon aquaculture project in forest margins

4. Bangladesh sustainable aquaculture project; large-scale training and extension effort
5. Vietnam smallholder livelihoods project in the Mekong Delta
6. 'Recommendation Domains' project

Milestones:

Year	Milestones
2003	• In Malawi, training on participatory aquaculture research and extension for NGO personnel carried out. • In Bangladesh, over 500 extension workers and senior NGO staff of cooperating NGOs will be trained. 7000 additional farmers are to benefit every year directly from training and support from the partner NGOs, and an additional number in the same magnitude are expected to benefit through adoption of improved aquaculture technologies imparted by staff of associate NGOs whose extensionists have received training from the Center, but no financial support. • In Vietnam, in cooperation with the Department of Fisheries of Bac Lieu Province in the Mekong Delta, and the University of Cantho, efficient dissemination of IAA options to target farmers will be implemented. • During the MTP period, the BMZ-funded 'Recommendation Domains' project will be implemented, which will identify characteristics of successful aquaculture development pathways and conditions and formulate these in form of a useful tool for wider application. • Preparation of web-based and CD-ROM-based versions of two recent publications with FAO and IIRR, summarizing existing technologies for smallholder aquaculture.
2004	• Socioeconomic analysis of existing and emerging aquaculture technologies in Bangladesh, Malawi and Cameroon reported. • Constraints analysis and adoption studies of aquaculture technologies in Bangladesh, Malawi and Cameroon reviewed and reported.
2005	• Cameroon: recommendations from analyses of impact survey from final year of project.

Costs (US$ million):
2003 : 3.54
2004 : 3.66
2005 : 3.79

Users:
Policymakers, government agency managers, NARS, NGOs, resource managers, fish farmers, development workers, scientists, international and regional bodies in Asia and subSaharan Africa.

Collaborators:
NARS in Asia and Africa, ASIs in Germany, UK, the Netherlands, USA, Canada; FAO HQ and regional offices in Africa and Asia-Pacific.

CGIAR Linkages:
IITA, IRRI, ICRAF

Funding sources by donor name:
WorldFish Center unrestricted core funds, BMZ, Wageningen Agricultural University, USAID, DFID, CIDA, IDRC, and others to be identified.

Thrust 5 (=MTP Project 5): Freshwater fisheries in an integrated land and water management context

Purposes/Objectives:

1. To make available an improved portfolio of sustainable and appropriate technology options for integrated land and water management.
2. To produce improved knowledge of efficient and efficacious policies and local governance strategies.
3. To generate improved understanding of fish and fishery resources (biology, ecological roles and economic and social values).

Gains

1. Improved management of aquatic resources with better knowledge and more participatory resources management among inland small-scale fisheries operators (full-time and part-time).
2. Improve governance to provide incentives for application of technological know-how for integrated agriculture-aquaculture development.
3. Reduce poverty and improve quality of life among fishers and farmers through increased productivity.
4. Increase productivity of fish to meet market demand ensuring contribution of fish to food security.

Output 1: Thorough understanding of target communities' needs and constraints

Activities:

1. Research on communities of inland fishers in Malawi, Cameroon, Bangladesh and Vietnam

Milestones:

Year	Milestones
2003	• In Malawi and Mozambique GIS mapping of historical land use changes will be employed and water quality monitoring in the Mnembo Catchment, Mozambique will be conducted. Geostatistical mapping of the temporal and spatial distribution of *Barbus* species (locally known as 'matemba') around the mouth of the Mnembo River in Lake Chilwa (Malawi and Mozambique) will be conducted • In the Mekong Delta in Vietnam, studies will be completed in 2003 and recommendations for policymakers for water flow management under multiple-use objectives formulated. Monitoring of actual catch and effort of different fishing gears, and salinity and pH of canal water before, during and after sluice gate opening will provide data for better understanding of the role of brackishwater fisheries for landless poor. • In Bangladesh detailed studies will be initiated of communities' perceptions and constraints in respect to their access to indigenous fish species in fenced-off areas of community-based fish culture in floodplains. • In eastern India, in collaboration with local partners, a project proposal will be designed and funding sought.
2004	• In Bangladesh, further studies on community-based fish culture in seasonally fenced areas will be conducted. • In Malawi and Mozambique, studies will commence assessing the catch from Lake Chilwa on Malawian and Mozambican sides and set in relation to land use activities in the corresponding catchments.
2005	• In Cameroon, studies will be completed on the existing management of riverine fisheries communities and options for improvement. • Malawi and Mozambique, data analysis will commence on the fish catch vs. land use characteristics of lake Chilwa.

Output 2: Technological options in relation to trade-offs necessitated by the community level at which fishers operate

Activities

1. Research on communities of inland fishers in Malawi, Cameroon, Bangladesh and Vietnam

Milestones:

Year	Milestones
2003	• In Bangladesh, a new research initiative into the improvement of fish production (naturally occurring and stocked) in seasonally fenced areas will be implemented. • In eastern India, as a new site for FRRP and in collaboration with the national partners in West Bengal, trials will be conducted on community-based fish culture in seasonally flooded and fenced areas, following the achievements and experiences gained from recent work in Bangladesh and Vietnam. • In Vietnam in the Mekong Delta, a monitoring program of fish catch in canals vs. water quality and a range of management parameters will be implemented. • In Malawi, different land use management options will be monitored and set in relation to the corresponding fish abundance in their rivers and bays of Lake Chilwa.
2004	• In the Mekong Delta in Vietnam, the management options for the sluice gate operation for brackishwater inflow will be assessed towards optimised fish production through catch in canals, in relation to the other competing needs of other stakeholders.
2005	• Cameroon, studies of different management strategies of riverine fisheries will be completed. • In Bangladesh and eastern India (given adequate funding), results from trials of improved management of community-based fisheries and aquaculture in the same fenced-off waterbodies will be available.

Output 3: Appropriate decision-support tools and institutional arrangements for management of freshwater inland fisheries

Activities:

1. Research on communities of inland fishers in Malawi, Cameroon, Bangladesh and Vietnam

Milestones:

Year	Milestones
2003	• Social science studies will study the adoption patterns and agreed institutional arrangements among communities already implementing the community-based fish culture approach. The expansion of this community-based aquaculture approach in Bangladesh and Vietnam will be monitored. A similar research project is planned for eastern India. • In the Mekong Delta of Vietnam, modelling of fish availability as a function of flood control measures through sluice gate operation to enable brackishwater inflow vs. freshwater will produce guidelines to manage the water supply the benefit of the poor. The aim is to enable brackishwater canal fishery by the poor and low-intensity brackishwater shrimp culture (in polyculture with fish) by the average poor and other stakeholders.
2004	• In Cameroon, different management options in riverine fisheries will be tested.
2005	• In Bangladesh and eastern India, results from community-based fisheries and aquaculture in the same stocked and fenced areas will be available; this includes information on the production of 'native' small indigenous species fished by the poor throughout the year, and of improved stocking strategies of aquaculture species jointly managed by the communities (which include the poor landless fishers). • In Vietnam in the Mekong Delta, studies and management trials will be established on the canal fishery in relation to the managed influx of saltwater which is pulsed by periodic opening of sluice gates; agricultural land use options (integrated rice-fish-shrimp farming) will be tested; results will be included in an existing model maintained by IRRI.

Costs (US$ million):
2003: 1.32
2004: 1.37
2005: 1.41

Users:
Resource managers, full-time and part-time fishers and farmers, policy makers, NGOs, development workers, scientists in Asia, subSaharan Africa, NARS, government agency managers, development workers, regional and international bodies.

Collaborators:
WorldFish Center's Research Programs, NARS and NGOs in subSaharan Africa and South and Southeast Asia; ASIs in Canada, Germany, UK and USA.

CGIAR Linkages:
IITA, IRRI, IWMI

Funding sources by donor name:
WorldFish Center unrestricted core funds, DFID, CIDA-CCLF, BMZ, others to be determined

COASTAL AND MARINE RESOURCES RESEARCH PROGRAM (COASTAL PROGRAM)

Thrust 6 (=MTP Project 6): Increased and Sustained Coastal Fisheries Production

Objectives:

1. To restore coastal capture fisheries to more productive levels.
2. To use sustainable methods of aquaculture to increase production of coastal fisheries resources.

Gains/Impacts:

Improved livelihood opportunities for coastal dwellers and all coastal fisheries sectors. Improved availability of fish for consumers.

Output 1: Guidelines for sustained, equitable harvests of wild stocks

Activities:

1. Genetic analysis of stocks at different scales to identify whether they transcend administrative boundaries and require co-operative management.
2. Assessments of species composition and status (size structure and abundance) of multi-species fisheries.
3. Analysis of the catch levels required to restore stocks, maintain the productivity of key species at optimum levels, and distribute the resource equitably among sectors.

Milestones:

Year	Milestones
2003	• Genetic analysis of stocks of selected commercially important fish and invertebrates in SE Asia. • Publication of the Proceedings of the workshop on "Sustainable Management of Coastal Fish Stocks in Asia", commonly known as TrawlBase Phase 1. • Major research results from TrawlBase Phase 1 submitted for publication in scientific journals. • Continuation of the national working groups established during TrawlBase Phase 1 to implement TrawlBase Phase 2. • Initiation of TrawlBase Phase 2 to include Cambodia with an emphasis on increasing the spatial and temporal coverage of the trawl survey database. • Consultations with countries in the Caribbean to determine how best to assist them to improve the management of coastal fisheries, including the application of rectangular escape gaps and increased mesh size in fish traps, and identifying alternative livelihoods for fishers while inshore stocks are rebuilt through selected management measures. • Surveys of the abundance and size structure of invertebrates in the Arnavon Islands Marine Conservation Area in Solomon Islands six years after declaration of the MCA.
2004	• Analysis of stock structure of additional species in SE Asia, including spiny lobsters. • Identification of species jointly exploited by different fisheries sectors in SE Asia and synthesis of biological knowledge and status of these species. • Inclusion of data from Australia in TrawlBase and participation of Australian scientists in national training workshops on stock assessment. • Transfer of TrawlBase methods to Oman. • Implementation of agreed fisheries management research in the Caribbean. • Development of a proposal for a large-scale test of the effectiveness of MPAs as a fisheries management tool in collaboration with the Government of Malaysia and other partners. • Establishment of joint activities with SPC on the management of coral reef fisheries in the Pacific. • Initiation of new projects on fisheries management in the Caribbean (to be determined after consultation).
2005	• Preliminary interpretation of genetic population structure of different life history "types" of fish and invertebrates as the basis for co-operative management of stocks in SE Asia. • Identification of spawning biomass needed to restore stocks of key species in Asia and SE Asia to productive levels, and potential impediments to restoration resulting from current exploitation rates and patterns by different sectors. • Regional workshop to review resource analyses results using TrawlBase data and to assess their management implications. • Preliminary drafting of national action programs and regional collaborative support activities for sustainable management of coastal fisheries resources in Asia and SE Asia under TrawlBase Phase 2. • Improved capabilities of the national partner institutions for TrawlBase Phase 2 in coastal fisheries research and management.

Output 2: Aquaculture-based technology to increase the productivity of coastal fisheries

Activities:
1. Methods to improve productivity of wild stocks through restocking and stock enhancement.
2. Development of viable methods for environmentally sustainable aquaculture.

Milestones

Year	Milestones
2003	• Transfer methods for the hatchery production of sea cucumbers to the Asia-Pacific through a regional workshop. • Completion of a major review of restocking and stock enhancement of marine invertebrates for Advances in Marine Biology and development of guidelines for future research by The WorldFish Center on restocking and stock enhancement. • Production of a book on the "Status and Potential of Aquaculture in the Pacific". • Acquisition of funding to implement the Center's role as the provider of technology for the development of aquaculture in the Pacific. • Transfer of the demonstration pearl farm in Solomon Islands to the Government/private sector. • Transfer of methods for producing sea cucumbers to the Philippines. • Submission of proposal to ACIAR to continue research on the capture and culture of postlarval fish to supply the marine aquarium trade.
2004	• Initiation of new aquaculture projects in the Pacific in line with regional priorities and in partnership with SPC, USP and national agencies. • Transfer of methods for culturing pearl oysters to Papua New Guinea. • Implementation of research on aquaculture to create alternative livelihoods as part of a Challenge Program. • Assessment of the potential for aquaculture of spiny lobsters in the Caribbean based on the capture and culture of puerulus larvae.
2005	• Development of optimal release strategies for juvenile cultured sea cucumbers in the wild to restore stocks in New Caledonia. • Commencement of additional collaborative aquaculture projects with the provincial governments in New Caledonia to improve the livelihood of Melanesian communities.

Costs (US$ million):
2003: 1.70
2004: 1.76
2005: 1.82

Users:
Managers and policy makers for coastal fisheries will have clear targets for setting the catch levels, and the distribution of catches, required to restore harvests to more productive levels and distribute the gains equitably among sectors. Managers will also have better information on the basic biology and extent of key species, and a greater range of possible interventions for restoring stocks and increasing productivity further through the application of aquaculture technology.

Collaborators:
NARS and NGOs in Malaysia, Thailand, Taiwan, Vietnam, Indonesia, the Philippines, Sri Lanka, India, Bangladesh, Solomon Islands, Tonga, New Caledonia, BVI and Jamaica; ASIs in Australia, Canada and Denmark, and regional and global programs of FAO, SEAFDEC, SEARCA, SPC, IFREMER and TNC.

CGIAR Linkages:
The program will use the collective experience of IRRI, ICRAF, CIFOR and IWMI to identify how to reduce the impact of agriculture, forestry and watershed management on fish habitats in the Challenge Program
"Making the Most of the Coast". We will also collaborate with other CGIAR Centers on the Challenge Program on Climate Change, particularly in determining the effects on coral bleaching and the distribution of fish.

Funding Sources:
Australian Centre for International Agricultural Research
AusAID
WorldFish Center
NZAID
Provincial Governments of New Caledonia
Crawford Foundation

Thrust 7 (=MTP Project 7): Restoration and Protection of Coastal Habitats

Objectives:
1. To identify risks to the integrity of the coastal zone and develop effective systems for restoration and protection.

Gains/Impact
Increased area and quality of coastal habitats supporting fisheries, resulting in greater levels of production.

Output 1: Interventions to reduce damage to the coastal zone

Activities:
1. Analysis of unaddressed impacts on coastal aquatic habitats stemming from watershed management, agriculture, forestry and fishing.
2. Evaluation of interventions to mitigate such impacts and restore habitats.

Milestones

Year	Milestones
2003	• Establish and expand the number of demonstration sites for the ICRAN project in Southeast Asia, the Caribbean, the Pacific and in East Africa. • Commence the Reefs at Risk analysis for the Caribbean with WRI. • Establish a regional co-ordinating position for GCRMN at WorldFish Center headquarters. • Co-ordinate the development of the full proposal for the GEF targeted research proposal on coral reefs and contribute to the working groups on coral bleaching and remediation of coral reefs. • Use the collective experience of the CGIAR system and key partners to identify how to reduce the impact of agriculture, forestry and watershed management on fish habitats in the coastal zone in a Challenge Program co-ordinated by the Center.
2004	• Submit the full proposal for the GEF targeted research proposal on coral reefs. • Implement the "Coastal" Challenge Program (if approved)
2005	• Contribute the fisheries activities to the Challenge Program on Climate Change (if approved)

Costs (US$ million):
2003: 0.54
2004: 0.56
2005: 0.58

Users:
Managers and policy makers responsible for maintaining the integrity of the coastal zone will have an improved understanding of the factors that degrade coastal habitats, improved access to information, new options for reducing the impact of activities such as agriculture and forestry in watersheds, and materials for training local area managers in effective management practices. The emphasis of coral reefs, through ICRAN, the targeted research program and ReefBase will ensure that information for improved management of these productive yet fragile ecosystems is available. The use of the demonstration – target site approach will also enable people at the village level to benefit from the outputs of the project.

Collaborators:
ASIs in Australia, regional and global programs of SEARCA, WRI

CGIAR Linkages:
The program will use the collective experience of IRRI, ICRAF, CIFOR and IWMI to identify how to reduce the impact of agriculture, forestry and watershed management on fish habitats in the Challenge Program
"Making the Most of the Coast". We will also collaborate with other CGIAR Centers on the Challenge Program on Climate Change, particularly in determining the effects on coral bleaching and the distribution of fish.

Funding Sources:
WorldFish Center
United Nations Foundation

Thrust 8 (=MTP Project 8): Knowledge-bases and training for improved management of coastal resources

Objectives:

1. To equip all stakeholders with the information they need to evaluate alternative options for managing coastal fisheries resources effectively.

Gains/Impact

Improved access to information for managers and policymakers responsible for the coastal zone.

Output 1: Knowledge-bases for coastal resources, technology to improve production, and options for management.

Activities:

1. ReefBase.
2. TrawlBase.

Milestones

Year	Milestones
2003	• Expansion of ReefBase to update information on coral reef status, threats and management to include comprehensive and current information for all countries with reef resources. • Development of specialised themes for data acquisition and summary in ReefBase, including coral bleaching, economic valuations and MPA management. • Creation of an online data access and summary analysis facility in ReefBase for all reef level data derived from the Global Coral Reef Monitoring Network (GCRMN). • Further development (revision & re-programming) of the Fisheries Resource Information System and Tools (FiRST) software (version 2001).
2004	• Creation of coral reef information systems for 2 countries or regions to incorporate links between detailed national data and the summary global information in ReefBase. • Release of updated FiRST software (version 2004). • Expansion of the geographical and temporal scope of TrawlBase to include data from Australia and Cambodia using FiRST software.
2005	• Creation of additional national level coral reef information systems in collaboration with relevant national agencies. • Development of widely accepted data protocols and standards for coral reef information, and of widely applicable indicators of coral reef status and management effectiveness. • Completion of Phase II development of FiRST software with expanded data coverage and analytic modules.

Output 2: Training materials to improve capacity for assessment of fisheries and habitats and decision analysis.

Activities:
Training in coastal management, including training in how to use and contribute to TrawlBase and ReefBase.

Milestones

Year	Milestones
2003	• Establishment of a Regional Training Center in the Philippines for coral reef and coastal zone management to strengthen links with the UNDP Train-Sea-Coast Program. • Implement curricula for coastal zone management training programs in Vietnam and Indonesia. • Training on stock assessment and use of FiRST software (TrawlBase).
2004	• Develop additional training courses with national counterparts in other countries. • Training in the use of coral reef information systems for each country or region to incorporate links between detailed national data and the summary global information in ReefBase. • Conduct regional/national training workshops on stock assessment with participation of Australian scientists.
2005	• Deliver further training programs within other southeast Asian countries. • Conduct regional/national policy planning workshops under TrawlBase Phase 2.

Costs (US$ million):
2003: 0.89
2004: 0.92
2005: 0.95

Users:
ReefBase and TrawlBase will provide managers, scientists and a range of other stakeholders with the information they need to understand and address threats facing fish stocks and the habitats that support them. Managers will be the main beneficiaries of the project in Indonesia and Vietnam delivering training in coastal management.

Collaborators:
Regional and global programs of IUCN, WWF, GCRMN, WRI
Funding Sources
WorldFish Center
MacArthur Foundation
Packard Foundation
United Nations Foundation
United Nations Development Program

POLICY RESEARCH AND IMPACT ASSESSMENT PROGRAM (POLICY PROGRAM)

Thrust 9 (=MTP Project 9): Economic, policy and social analysis and valuation of aquatic resources in developing countries

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

Gains
1. Improve management of aquatic resources with better knowledge and more participatory resources management among coastal communities and small-scale fisheries operators.
2. Improve governance to provide incentives for application of technological know-how for integrated agriculture-aquaculture development.
3. Reduce poverty and improve quality of life among fishers and farmers through increased productivity.
4. Increase productivity of fish to meet market demand ensuring contribution of fish to food security.
5. Improve international trade policies enabling sustainable supplies of aquatic resources in developing countries.

Output 1: Appropriate valuation methods of aquatic resources and their values for policy analysis

Activities:
1. Policy analyses and economic valuation of coral reefs
2. Economic valuation of wetland resources
3. Economic valuation of carp species in Asia

Milestones:

Year	Milestones
2003	• Economic values of wetlands and their resources in the Mekong River Region estimated and published. • Economic values of coral reef ecosystems in the Caribbean and meso-America estimated. • Analytical techniques on measurement of values of various aquatic resources assessed and databases on these methodologies (e.g. coral reefs, floodplains, wetlands, fish genetic resources and aquatic biodiversity) developed. • Data by uses and non-uses and resource units segregated. Data gaps identified together with partners.
2004	• Recommended valuation methods disseminated. • Policy analysis and strategies for climate change adaptation recommended to regional agencies and stakeholders. • Seasonal socioeconomic values of aquatic resources in Cambodia estimated. • Seasonal constraints to access to aquatic resources by different stakeholders analyzed. • Secondary data on wetland resources and their users in selected Asian countries and on coral reefs in the Caribbean and meso-American countries compiled. • Contribution of aquatic resources to livelihood in Asia and Africa (e.g. Bangladesh, Mekong region, Malawi, Cameroon, Mozambique) assessed. • Policy recommendations for more efficient use of floodplains in the Mekong River Region disseminated to national partners and government agencies of riparian countries.
2005	• Livelihoods dependent on coral reef ecosystems better understood and policy recommendations drafted and shared with stakeholders and regional agencies, in particular those located in the Caribbean, East and Southeast Asia, East Africa and South Pacific. • Analytical frameworks on values of aquatic resources including carp genetic resources and Mekong wetlands conceptualized. • Information on economic values of different stocks of major carp species of genetic materials collected. • Values of aquatic resources incorporated into policymaking and implementation processes in the Mekong Region

Output 2: Models of small-scale fisheries for improved management

Activities:
1. Development of methods for measuring fishing capacity
2. Measurement of fishing capacity in Asian countries
3. Dialogue with policymakers and donor agencies on approaches for managing capacity in fisheries

Milestones:

Year	Milestones
2003	• Literature on the state-of-the-art of fishing capacity research in general and specific to five target countries compiled and reviewed. • Social and economic analysis of coastal fisheries reviewed and reported. • Alternative livelihoods in coastal communities analyzed and reported. • Policy briefs, technical reports and papers on excess capacity of small-scale fisheries along with recommendations published. • Fishing capacity in three Asian countries determined.
2004	• 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. • Expert meeting on managing fishing capacity in small-scale fisheries carried out.
2005	• Demonstration sites in three Asian countries for managing fishing capacity set up. • Analysis of alternative livelihoods for coastal communities in three Southeast Asian countries completed.

Output 3: Social, economic and policy implications of integrated agriculture-aquaculture technologies (jointly implemented by Policy and Freshwater Programs)

Activities:
1. Studies on adoption patterns of IAA technologies in Bangladesh, Malawi and Cameroon
2. Develop methodology for assessing the impact of INRM research

Milestones:

Year	Milestones
2003	• Socio-economic analysis of existing and emerging aquaculture technologies in Bangladesh reported. • Constraint analysis and adoption studies of aquaculture technologies in Bangladesh reviewed and reported. • Proposals on assessing the impacts of IAA technologies for selected countries in Asia and Africa developed.
2004	• Socio-economic analysis of existing and emerging aquaculture technologies in Malawi and Cameroon reported. • Constraint analysis and adoption studies of aquaculture technologies in Malawi and Cameroon reviewed and reported.
2005	• Policy analysis of aquaculture development and appropriate recommendations provided.

Output 4: Disaggregated market models of fish and seafood for developing improved policies on food security, poverty reduction and livelihood

Activities:
1. Incorporation of fish into IFPRI's World Food Model
2. Disaggregated analysis of fish supply and demand in Asia and Africa
3. Projection of fish supply and demand in Asia by species group

Milestones:

Year	Milestones
2003	• Fish incorporated into the World Food Model (IMPACT) and demand-supply for eight aggregated fish categories projected to 2020. • Demand-supply elasticities by disaggregated fish groups estimated and country-specific fish-sector models for nine Asian countries developed. • Demand-supply for different types of fish and seafood in nine Asian countries under alternative policy scenarios projected. • Survey of fish producers and consumers in Egypt and selected countries of West Asia initiated. • A study on production, consumption and accessibility of fisheries products in sub-Saharan Africa initiated. • 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 selected countries of West Asia and North Africa (WANA) identified.
2004	• Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poorer households in Asia recommended. • Economic profile of aquaculture and fisheries technologies in selected countries of WANA reviewed and analyzed. • Policies, institutions and support services for fisheries and aquaculture in selected countries of WANA reviewed and analyzed. • Results of the study on production, consumption, marketing and trade of fish and seafood in selected countries of WANA compiled.
2005	• Demand-supply elasticities by fish groups estimated and country-specific fish-sector models for selected countries of WANA developed. • Disaggregated World Fish Model developed. • Impacts of international trade regimes (e.g. WTO, eco-labeling, certification schemes) on aquatic resources sustainability, markets and welfare assessed. • Relative contribution of different types of aquaculture and capture fisheries on growth, equity and food security analyzed.

Costs (US$ million):
2003: 0.91
2004: 0.94
2005: 0.98

Users:
Policymakers, government agency managers, NARS, NGOs, regional and international bodies, resource managers, fishers, development workers, scientists in Asia, sub-Saharan Africa and the Caribbean

Collaborators:
NARS, GOs, NGOs, FAO, IFPRI, INFOFISH, MACC, WRI, CEMARE, MRC, IUCN, WWF, ICRAN, UNEP Regional Seas Program in Southeast Asia, the Caribbean, East Africa and South Pacific, ARIs in Canada, Caribbean, Denmark, U.K. and U.S.A.

CGIAR Linkages:
Links to IFPRI's World Food Model
'IMPACT', PRGA-CIAT, IITA, IRRI (potential)

Funding sources by donor name:
WorldFish Center unrestricted core fund, Sida, ADB, Oxfam, DFID, IFAD, IDRC, CORDIO, USAID, BMZ and others to be identified

Thrust 10 (=MTP Project 10): Aquatic resources planning and impact assessment

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

Gains
1. Improve impact assessment policies and methods
2. Increase stakeholders and coastal communities participation in the decision-making process
3. Increase awareness among stakeholders and coastal communities on the importance of conservation and the sustainable management of aquatic resources

Output 1: Methodology and operational guidelines for assessing impact of aquatic resources research and development

Activities:
1. Impact of INRM research in Bangladesh, Malawi and Cameroon
2. Impact assessment of improved carp species
3. Impact assessment of CBFM in Bangladesh and Mekong River Region

Milestones:

Year	Milestones
2003	• Methodologies for assessing the impacts of INRM tested in Bangladesh. • Integrated framework for assessing economic and environmental impacts of aquatic resources research and development conceptualized. • Consultation meetings with relevant scientists and agencies conducted. • Methodologies for assessing the contribution of aquatic resources to livelihood reviewed and improved.
2004	• Methodologies for assessing the impacts of INRM developed and tested in Cameroon and Malawi. • Methods for impact assessment of improved carp species designed and implemented.
2005	• Methodologies for assessing the impacts of INRM developed and tested in Cameroon and Malawi (continuation). • Indicators for assessing impacts of aquatic resources development projects on poverty developed. • Indicators for assessing impacts of INRM developed. • Sustainability indicators for aquatic resources developed. • Guidance provided to formulate new projects that include impact monitoring indicators.

Output 2: Impact assessment of aquatic resources research and development

Activities

1. Impact assessment of community-based fisheries management in Bangladesh and Mekong River Region
2. Impact assessment of aquatic resources management in deep flooded areas of Mekong and Bangladesh
3. Capacity building of Mekong regional partners on participatory community monitoring in natural resources management (NRM)

Milestones:

Year	Milestones
2003	• Impacts of CBFM (Phase 1) in 125 waterbodies in Bangladesh assessed and methods for assessing future impacts improved. • Key patterns and trends on livelihood dependence of poor people on fisheries in Bangladesh, Cambodia, Vietnam and Lao PDR reported.
2004	• Impact of improved carp species in Asia assessed. • Impacts of aquaculture and NRM research in Bangladesh assessed. • Impacts of CBFM in Bangladesh and Mekong River Region assessed using improved methodologies. • Impact of aquaculture production and marketing on livelihoods in selected Asian countries assessed.
2005	• Impacts of CBFM in Bangladesh, Vietnam and Lao PDR assessed. • Final evaluation of CBFM projects carried out. • Impact of devolution and co-management of aquatic resources assessed in Philippines, Indonesia, Cambodia, Vietnam, Thailand, Bangladesh, Malawi and Mozambique. • Impact of aquaculture and NRM research in selected African countries (e.g. Malawi and Cameroon) assessed. • Impact of aquaculture production and marketing on livelihoods in selected Asian countries assessed (continuation).

Costs (US$ million):
2003: 0.93
2004: 0.97
2005: 1:00

Users:
WorldFish Center scientific staff, Board and management, donors, NARS, policymakers, government agency managers, NGOs, regional and international bodies

Collaborators:
WorldFish Center Research Programs, ISNAR, ASIs, NGOs, SEAFDEC-Aquaculture Department, NARS in South and Southeast Asia and the Pacific

CGIAR Linkages:
INRM group, SPIA

Funding sources by donor name:
WorldFish Center unrestricted core funds, IFAD, DFID and others to be identified.

Thrust 11 (=MTP Project 11): Legal and institutional analysis for aquatic resources management

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

Gains:
1. Increased participation among stakeholders in the decision-making process on aquatic resources management.
2. Strengthening of institutional partners such as GOs, NGOs, and local institutions.
3. Capacity building among national institutions on policy formulation for sustainable aquatic resources management.

Output 1: Methods and framework for participatory action-oriented research on governance of aquatic resources

Activities:
1. Institutional analysis of wetland management in Mekong River Region
2. Workshops to improve national legal and institutional frameworks and to increase local capacity to manage wetlands and their resources
3. Document case studies on the applicability of co-management as a sustainable, efficient and equitable resource management strategy
4. Development of model(s) for participatory policy analysis of aquatic resources management

Milestones:

Year	Milestones
2003	• International workshop to disseminate research results from co-management projects in Asia and Africa conducted. • Institutional and legal frameworks for wetlands and aquatic resources management in the Mekong River region improved. • Methods for participatory planning at local and national levels for aquatic resource management developed. • Participatory action research on aquatic resources management with national partners (e.g. villages, communities, GOs and NGOs) undertaken in Bangladesh and Mekong River Region. • Process of co-management in larger fishery systems ("clusters") in Bangladesh established and documented. • National workshop on CBFM and wetlands in Bangladesh conducted. • Livelihood options and future income opportunities for next generation of fishing communities in Bangladesh assessed.
2004	• Research results from the co-management project disseminated in Asia and Africa. • Socio-economic monitoring programs developed for selected MPAs in meso-America and the findings shared and disseminated among MPA managers in the region. • Mid term review of CBFM in Bangladesh conducted. • Study of conflict and conflict resolution methods developed for fisheries in Bangladesh. • Livelihood options and future income opportunities for the next generation of fishing communities in Bangladesh assessed and implemented. • Changes in social capital and attitudes to cooperation among stakeholder groups in the pilot areas in Bangladesh and Mekong River Region assessed. • Model for participatory policy analysis of aquatic resources management developed and tested in Cambodia.
2005	• Expert meeting on devolution and governance of aquatic resources. • State-of-the-art conference on institutional analysis of aquatic resources management. • Workshop to disseminate model for participatory policy analysis of aquatic resources management to countries in the Mekong River Region. • Participatory monitoring systems of aquatic resource use developed and tested in Bangladesh and Mekong River Region.

Output 2: Policies and institutional arrangements for governance of aquatic resources

Activities:

1. Develop a process for livelihood strategy analysis and participatory planning
2. Assess fishery policy formulation process
3. Survey the media access of the fishers' community
4. Monitor the process, performance and impact of different governance models
5. Workshops to disseminate information on the applicability of co-management for policymakers and resource managers
6. Provide technical assistance to the co-management initiatives of NARS partners

Milestones:

Year	Milestones
2003	• Guidelines for policymakers on implementing co-management arrangements developed and published. • Lessons from research on governance of aquatic resources published. • Linkages and networks among institutions on wetland 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 local authorities and NARS completed. • Methods to facilitate consensus in resource management in Bangladesh and Mekong Region developed, tested and applied. • Recommendations to improve policies and institutional arrangements with national partners formulated. • Action research on CBFM in more than 100 sites in Bangladesh and in selected sites in Mekong River Region continued.
2004	• Action research on CBFM in more than 100 sites in Bangladesh and in selected sites in Mekong River Region continued. • Project review of CBFM in Bangladesh conducted. • Livelihood options and future income opportunities for next generation of fishing communities in Bangladesh assessed and applied. • Ways to link local community management over larger linked fisheries comprising rivers, floodplains and other wetlands in Bangladesh and Mekong River Region identified.
2005	• Action research on CBFM in more than 100 sites in Bangladesh and in selected sites in Mekong River Region continued. • Resilience of governance models evaluated in Asia and Africa. • Compliance, legitimacy and governance issues tested in three African countries. • Expert models of governance for use at local level developed. • Policies for CBFM generated and disseminated.

Costs (US$ million):
2003: 3.16
2004: 3.27
2005: 3.38

Users:
Resource managers, fishers, policy makers, NGOs, development workers, scientists in Asia, Sub-Saharan Africa, Caribbean

Collaborators:
NARS and NGOs in Bangladesh, Cambodia, Indonesia, Lao PDR, Malaysia, Malawi, Mozambique, Philippines, South Africa, Thailand, Vietnam, Zambia, Zimbabwe, ARIs in Canada, Caribbean, Denmark, U.K. and U.S.A., Mekong River Commission, AIT-Aqua Outreach, IUCN-Cambodia, Prince of Songkhla University, Wetlands International

CGIAR Linkages:
System- wide project on common property and collective action research (CAPRi), IFPRI

Funding sources by donor name:
WorldFish Center unrestricted core funding, Danida, Sida, DFID, NOAA

Users:
WorldFish Center scientific staff, Board and management, donors and NARS

PARTNERSHIPS, INFORMATION AND TRAINING PROGRAM (PARTNERSHIPS AND TRAINING PROGRAM)

Thrust 12(=MTP Project 12): Improved Partnerships and Capacity Building Among Developing Country NARS

Purposes/Objectives:
1. To strengthen existing collaborations and develop new partnerships with NARS, NGOs, regional/international organization, advanced scientific institutions and the private sectors
2. To build a critical mass of science capacity in developing countries

Gains:
1. Increased production of aquatic organisms through improved breeds and farming systems developed
2. Conservation of improved management of aquatic resources
3. Better informed NARS scientists and managers and thus improved aquatic resources management
4. Human resources development in developing countries through networking and partnerships.

Output 1: Identification of NARS research priorities and development/strengthening of research partnerships and networks

Activities:
1. International Partnerships
2. International Network on Genetics in Aquaculture (INGA)
3. Public-Private Partnerships in Fish Genetic Research
4. Network of Tropical Aquaculture and Fisheries Professionals (NTAFP)

Milestones:

Year	Milestones
2003	*International Partnerships:* • Partnerships with NARS, ASIs, IARCs strengthened and new partnerships developed; • Meeting with NARS institutions in China organized to identify research agenda/priority and establish collaborations; • Assistance provided in capacity building of NARS scientists; • Third meeting of Group of Fisheries and Aquatic Research (GoFAR) held; • Partnerships database developed and maintained *INGA:* • Workshop on ecological risk assessment for genetically improved fish breeds held • 7th INGA Steering Committee meeting organized; • Germplasm exchange among member countries facilitated/ coordinated; • INGA member countries assisted with implementation of national breeding programs; • Capacity of INGA member country scientists on breeding and genetics enhanced • Development of policy documents on issues related to biodiversity conservation and equitable distribution of benefits from genetic research • Assistance provided to Malaysian government in identification of constraints and formulation of plans for development of national tilapia industry • Assistance to INGA member countries in formulation of national plans for dissemination of improved fish breeds *Public-Private Partnership in Fish Genetic Research* • Data gathered to evaluate the effects on genetic research and development activities • Workshop to assess the performance/delivery of research outputs to end-users organized • Effects on investment/spending levels and their effectiveness assessed *NTAFP*: • Outputs of NTAFP members enhanced through publication of research findings in NAGA (Fishbyte/Aquabyte sections) and assistance in information searches; • Communications among fisheries professionals enhanced
2004	*International Partnerships*: • Partnerships with NARS, ASIs, IARCs strengthened and new partnerships developed; • Meeting with NARS institutions in Vietnam/Mekong basin countries to identify research priorities and establish collaborations; • Assistance provided in capacity building of NARS scientists *INGA:* • Annual INGA Steering Committee meeting organized; • Germplasm exchange among member countries facilitated/ coordinated

Year	Milestones
	• INGA member countries assisted with implementation of national breeding programs; • Capacity of INGA member country scientists on breeding and genetics enhanced
	Public-Private Partnership in Fish Genetic • Recommendations for better linkages between private and public sectors in fish genetic research enhanced *NTAFP:* • Outputs of NTAFP members enhanced through publication of research findings in NAGA (Fishbyte/Aquabyte sections) and assistance in information searches; • Communications among fisheries professionals enhanced
2005	*International Partnerships*: • Partnerships with NARS, ASIs, IARCs strengthened and new partnerships developed; • NARS research agenda/priority identified and research collaborations established; • Assistance provided in capacity building of NARS scientists *INGA:* • Annual INGA Steering Committee meeting organized; • Germplasm exchange among member countries facilitated/ coordinated; • INGA member countries assisted with implementation of national breeding programs; • Capacity of INGA member country scientists on breeding and genetics enhanced *NTAFP:* • Outputs of NTAFP members enhanced through publication of research findings in NAGA (Fishbyte/Aquabyte sections) and assistance in information searches; • Communications among fisheries professionals enhanced

Output 2: Enhancement of knowledge and research capabilities of national scientists and institutions

Activity

- Training and other Capacity Building Programs

Milestones

Year	Milestones
2003	• Implementation of short/long-term training programs • Proposal for research internship/organizing training programs submitted to donor for funding • Training database established and maintained
2004	• Implementation of short/long-term training programs • Repository of training materials established • Training database updated
2005	• Implementation of short/long-term training programs • Training database updated • Repository of training materials maintained

Costs (US $ million):
2003: 0.76
2004: 0.79
2005: 0.82

Users:
Global community concerned with aquatic resources research and management; NARS scientists and managers; policy makers and donors

Collaborators:
NARS from developing countries and advanced scientific institutions, regional and international organizations involved in living aquatic resources management worldwide.

CGIAR linkages:
SGRP for INGA ; none specifically for training but the Center contributes to CGIAR thrust on NARS capacity building

Funding sources by donor name:
The Government of Norway has provided the support to INGA until 2003; WorldFish Center core funds are the major source of support for the program's partnership and information network activities.

Thrust 13 (=MTP Project 13): Access to information for sustainable development of fisheries and aquatic resources.

Objectives:

1. To share information and knowledge among Center staff, partners and stakeholders through information and publishing services, alliances and sharing resources.
2. To raise awareness of global living aquatic resources issues and of the role of research in sustainable development of fisheries and aquatic resources.

Gains:

1. Center and partner scientists and stakeholders share information and knowledge on fisheries and aquatic resources.
2. Public, policy and donor awareness of the importance of research to sustainable fisheries and aquatic resource development.

Output 1: Sharing information and knowledge, communicating for outcomes and positioning research for sustainable development of fisheries and aquatic resources

Activities:

1. Information Services
2. Communications Unit
3. E-communications Unit
4. Public Awareness

Milestones:

Year	Milestones
2003	*Information Services:* • Cooperation and resource-sharing with other fisheries and aquatic libraries worldwide. • Presence in CGIAR virtual library initiative enhanced. • Needs of research offices to improve their access to information services reviewed. • An image databank developed. • Digital collections of Center's previously published publications created. • Information services in Abbassa office strengthened. • Collection development policy reviewed. • Information services to Center's partners provided. *Communications Unit:* • Publish WorldFish Center's publications catalogue in print and on-line. • Develop mailing list categories and assist with targeting communications. • Assist in the development of WorldFish Center's image database. • Develop corporate identity manual to establish guidelines for the use of names, marks or logos associate with the Center. • Revise publications manual for print and electronic communications. • Survey *Naga* readers and revisit editorial directions and policy. • Advise all contributors to *Naga* of the acceptance or rejection of their manuscripts within five months. *E-Communications Unit*: • Develop high profile public awareness strategy with the Center' website and strengthen Center's identity for the global and scientific communities. • Electronic media publishing of CD-ROMs to further improve the effectiveness of Center communications services. • Developing the Training Online-database for the Program's Training Unit *Public Awareness*: • Undertake needs analysis and organize training courses to develop media skills. • Increase coverage of the Center's work in the Malaysian media. • Develop key strategies messages in support of the resources mobilization action plan.

Year	Milestones
	• Develop regional and international media coverage, and program of opinion-editorial features. • Develop two backgrounder stories for Future Harvest. • Develop and refine an effective case statement and create collateral marketing materials for the Center's resource mobilization strategy. • Design communications program for the global voice initiative 'Fish for All'. • Target media and donor relations to build donor and potential donor support.
2004	*Information Services:* • Strengthen cooperation and resource-sharing with other fisheries and aquatic libraries worldwide and participation in CGIAR virtual library. • Procedures manual which will function as reference guides for library operating procedures prepared. • Digital collections of Center's previously published publications created. • Increase subscriptions to electronic information resources. • Information services in Malawi office strengthened. • Information services to Center's partners provided. *Communications Unit:* • Organize presentation skills and Powerpoint training to improve communication skills. • Advise all contributors to *Naga* of the acceptance or rejection of their manuscripts within four months. • Develop an online interactive information system for managing *Naga* contributions. *E-Communications Unit*: • Enable online enquiry, feedback and subscription mechanism at the website to receive public queries to Center's research and request for information resources. • Develop e-forum at the website for dialogue on fisheries and aquatic resources issues. • Provide complete information on Center's research and wider coverage of all regional offices work. *Public Awareness*: • Develop coverage of the Center in the regional and international media. • Develop regular opinion-editorial features in the regional and international media. • Develop two backgrounder stories for Future Harvest. • Develop information brochures for all regional offices. • Strengthen communications for 'Fish for All' and resource mobilization strategy.
2005	*Information Services:* • Develop library web pages as a gateway to specialized high quality sources of information. • Develop value-added information products. • Develop impact metrics for the Center's publications. • Develop information service policies for research offices. • Hold information services training course. • Host ASFA Board meeting and encourage countries in the region to become partners. • Information services to Center's partners provided

Year	Milestones
	Communications Unit: • Organize skills development training to improve communication. *E-Communications Unit*: • Enable and develop the Center's website to provide accessible and specialized information on global fisheries and aquatic resource management outputs by the Center. • Where appropriate, provide full range of Center's information resources in electronic media format of CD-ROMs to disseminate, thus reducing costs for both users and the Center. *Public Awareness*: • Increase news coverage of the Center, and the number of regular opinion-editorial features in the regional and international media. • Strengthen communications for 'Fish for All' and resource mobilization strategy.

Costs US$ (million):
2003: 0.59
2004: 0.61
2005: 0.63

Users:
Global community concerned with aquatic resources research and management; NARS scientists and managers; policy makers and donors.

Collaborators:
NARS, advanced scientific institutions, regional and international organizations involved in living aquatic resources management worldwide. Information sources such as other CGIAR centers, FAO, regional aquaculture and fisheries information centers.

CGIAR linkages:
Marketing Group and Information Professionals Group.

Funding sources by donor name:
WorldFish Center core funds.

WATER AND FOOD CHALLENGE PROGRAM

Stage of Development

The Water and Food Challenge Program (WFCP) is one of the three CPs selected for development in the first phase of this new way of working in the CGIAR. The Center has engaged intensively in this process, has participated in a range of preparatory meetings, has coordinated the working group on Aquatic Ecosystems and Fisheries, has led the development of the background paper for this theme, and is a member of the Consortium that has been formed with the intention of carrying forward the Program. The proposal for the WFCP is now being considered by the Interim Science Council and a final decision on the CP is expected in October 2002 at the CGIAR AGM.

Objective

The overall development objective of the WFCP is:

To increase the productivity of water for food and livelihoods, in a manner that is environmentally sustainable and socially acceptable.

In pursuit of this objective the WFCP has been developed and will be pursued by focusing upon five major themes:

1. Crop water productivity improvement
2. Multiple use of Upper Catchments
3. Aquatic Ecosystems and Fisheries
4. Integrated Basin Water Management Systems
5. The Global and National Food and Water System

WorldFish Center's role

The Center will seek to contribute to all five of the themes, but will coordinate the work to be undertaken on Aquatic Ecosystems and Fisheries, and it is here that most of the Center's own research will be pursued. Work under each of these five themes will however be funded through a competitive grants scheme. The decision-making process for project approval and grant allocation will be managed independently in order to provide transparency. This also allows those centers coordinating themes to compete fairly for the funds available for each of these areas.

Work under the Ecosystems and Fisheries theme will focus upon four major research area and questions within these.

1. Policies, Institutions and Governance

Key research questions include:

- What are the factors that influence people's access to, and control over, aquatic ecosystems and their resources?
- What kinds of governance systems and enabling policies and institutions foster equitable and sustainable management of aquatic ecosystems?
- How can capacity be built within national and local institutions to understand the livelihoods of poor people and their use of aquatic ecosystems, and take account of their needs in policy development and governance processes?
- What knowledge systems are needed to help build this capacity and support development and application of these policies, institutions and governance systems?

2. Valuation of Ecosystem Goods and Services, and the Costs of Degradation.

Key research questions include:

- What are the monetary and non-monetary values of the goods and services provided by different types of aquatic ecosystems, and what proportion of the household/community economy do they comprise?

- What are the social and economic costs of degradation of aquatic ecosystems and decline and loss of their goods and services?
- What are the appropriate tools to generate this information rapidly and for use by poor stakeholders?

3. Environmental Water Requirements

Key research questions include:
- What are the quantitative relationships between hydrological changes (including water quality) and the goods and services of aquatic ecosystems that are of high priority for food security and livelihoods?
- What appropriate methodologies exist or need to be developed for the determination, management and monitoring of environmental flow requirements in the different aquatic ecosystems?
- What are the specific freshwater requirements for coastal ecosystems?
- What quantity (and quality) of water is needed to sustain river fisheries?

4. Improving Water Productivity

Key research questions include:
- When and how can water productivity and livelihoods be improved by integrating fish production and harvest of other aquatic animals and plants into farming and irrigation/flood-prone systems?
- How do the monetary, social and nutritional values of these additional water-use benefits compare with those of crops?
- What new technologies can be designed to improve further the integration of fisheries into farming systems?

Tentative Costs

The total cost of the WFCP is estimated at some US$75 million over 5 years. It is anticipated that of this total some US$50 million would be available for grant funding over the course of the 5 years. While a pro rata sharing would imply some US$10 million for work on Ecosystems and Fisheries, the final distribution will probably be determined by a number of factors, of which the quality of proposals will be the most important. The Center will need to compete actively to obtain a portion of this funding for its work, but can realistically expect to receive several million dollars provided that the proposals are of the quality required.

In addition, it is anticipated that if the proposed budget is approved as submitted, the Center will receive some US$350 000 per year for the costs of coordinating the work on Ecosystems and Fisheries. An overhead of 4 per cent will also be levied on the budget of all CP projects under the Ecosystems and Fisheries theme, even when these are not implemented by the Center. Projects implemented by the Center will be subject to normal overheads.

Potential collaborators

The WFCP has been developed through an extensive process of consultation and collaboration and implementation will build upon this. A wide range of partnerships has already been developed through this process and will be expanded as the CP moves forward. Strong emphasis is being placed on building three way partnerships between NARES, IARIs, and CG Centers. Strong links with river basins development authorities are also being developed.

Potential CGIAR linkages

The key linkages will be with the CGIAR centres IWMI, IRRI, IFPRI and CIAT.

”COASTAL” CHALLENGE PROGRAM

Stage of Development

A concept note submitted to the CGIAR for a Challenge Program to address problems facing the coastal zone has been recommended for development as a pre-proposal. This program will focus on reversing degradation of coastal habitats and enhancing livelihood opportunities for coastal communities. As part of the pre-proposal development for the *Coastal Challenge Program*, a planning workshop entitled “Increasing productivity in the coastal zone: reversing habitat degradation and advancing livelihood options” was attended by 20 external delegates from national and regional agencies. Based on the outcomes of the workshop, a draft pre-proposal for the Challenge Program entitled “Making the Most of the Coast” has been prepared, circulated for review and submitted to the CGIAR.

The Challenge Program in brief

The value of the coastal zone - the dynamic interface between the land and sea – cannot be overstated. It provides the natural resource base for much of the economic development required to support the 50 per cent of the world’s population who live there. However, despite our great dependence on the coastal zone, we have generally failed to manage it in a sustainable, productive way. The result is that many of the earth’s coastal resources are in peril. The key problems are habitat degradation, ‘careless’ use of resources, and pollution.

The destruction and alteration of habitats is considered to be the greatest of all threats to coastal biodiversity. Sadly, this threat is being realized: at least half the world’s mangroves and coastal wetlands have been lost. Much of this damage has been due to the ’side effects’ of agriculture and forestry – runoff of nutrients, harmful chemicals and sediments. But coastal resources themselves have also been used inappropriately. This is particularly true for fisheries, where over-fishing and use of destructive methods have led to dramatic declines in coastal fish stocks. These assaults on the aquatic ecosystems that supply animal protein and livelihoods for the developing world have been made worse by a wide spectrum of land- and sea-based pollution, which further degrades the quality of habitats and renders fish products unsafe for human consumption.

Many organizations have mobilized to address these problems, e.g. the UNEP Regional Seas Programmes which were later strengthened by Chapter 17, Agenda 21 of the United Nations Conference on Environment and Development. However, the prominence of coastal and fisheries issues at the recent World Summit on Sustainable Development (WSSD) only goes to underscore that these resources are still in need of better management. The 10-point plan of action at WSSD called for the problems of over-fishing, unsustainable forestry practices and land-based marine pollution to be addressed. WSSD also highlighted the need for sustainable development of coastal resources and small island developing states, and integrated river basin management.

Although it is widely recognized that integrated coastal management (ICM) is needed to provide lasting solutions to the problems facing the coastal zone, many institutions are failing in this task due to inadequate legal and policy support; lack of technical ‘know-how’ on the part of managers; and poor co-ordination among sectoral agencies. Unsustainable development and reduced productivity, resulting in poverty and low well-being of coastal people, is all too often the outcome.

Science can help overcome these problems by providing governing institutions with the information they need to guard against degradation of habitats, ‘careless’ use of resources and pollution, and to develop and implement policies to address multiple use conflicts. This is the genesis of the Challenge Program.

To ensure that this Challenge Program addresses the needs of coastal managers, we held two rounds of consultations with ~90 agencies, including NARS, CGIAR centers, ASIs, NGOs and international/regional organizations. As a result of this process, we received clear guidance that the Challenge Program should focus on two themes and six Research Projects. These are:

Theme 1: Reversing degradation of coastal resources

1. Understanding material transfers from watersheds, and reducing 'downstream' effects of agriculture and forestry on coastal aquatic ecosystems.
2. Addressing non-optimal use of resources through valuation and "environmental payments".
3. Identifying and promoting ways to rehabilitate critical coastal habitats.

Theme 2: Enhancing livelihoods for coastal people

1. Understanding the factors determining livelihoods for poor coastal people.
2. Restoring production from capture fisheries.
3. Developing technologies for alternative or supplementary livelihoods for coastal people.

A broad and experienced group of agencies has expressed interest in designing and implementing these Research Projects in Southeast Asia and the Pacific. This partnership consists of five CGIAR Centers, eight regional/international organizations, three scientific organizations. The Nature Conservancy, and nine countries.

In addition to the group's ability to provide and harmonize the necessary science from watersheds and receiving waters, the partnership has three other features that should make it particularly effective. These are: i) ready access to appropriate research sites; ii) strong links to national decision making bodies; and iii) multiple contact points for building national and local capability.

The Challenge Program will pay special attention to delivering the results of the research to governing institutions, and the full range of people with an interest in 'making the most of the coast'. The international public goods stemming from the Program will be 'broadcast' using technology packages, handbooks, guidelines, manuals, newsletters, scientific journals, existing databases and the media. In addition, the Program will create three other ways to transfer the results to those who need them: we will establish a network for coastal zone management, strengthen regional ICM training centers, and build a website with a "feedback" page so that end-users of the research can provide comment on the effectiveness of the interventions that we develop, suggest further issues for research, etc.

The partnership is prepared to make a strong commitment to both the development of the full proposal, and implementation of the Challenge Program itself. Preliminary estimates of the additional funding that will be required to implement the Program are in the vicinity of $10 million per anum. Research Projects 1, 3, 5 and 6 are large and would require at least $2 million per year for 10 years. Research projects 2 and 4 are likely to need around $1 million per year, but for a shorter duration. In addition there will be the costs of operating the independent governance structure required to implement the Program effectively, consisting of a Board, Steering Committee, Co-ordination Unit and Technical Working Groups.

Plans for the development of the full proposal include workshops for the Technical Working Groups to design the Research Projects in detail, and for finalization of the governance arrangements and business plan. WorldFish Center will co-ordinate the development of the full proposal on behalf of the partnership.

CLIMATE CHANGE CHALLENGE PROGRAM

Stage of Development

The CP on climate change is at the pre-proposal stage in which a number of CGIAR centers and potential partners are organizing components of the general concept and are holding discussions on these.

Objective

Climate change from anthropogenic green house gas emissions is one of the most serious and far -reaching threats to modern society. Its impacts potentially affect all life on the planet. The most recent assessment by the Intergovernmental Panel on Climate Change (IPCC 2001a) indicates that the earth's surface has already warmed by about 0.6°C during the previous century, and suggests that a further warming of 1.5-5.8 °C will occur by 2100. This will have profound impacts on sea level, ocean circulation, the severity and frequency of weather events and patterns of rainfall.

Coral reefs, atolls and mangroves are listed in one of the IPCC reports as among those systems that will be especially vulnerable to climate change because of limited adaptive capacity (IPCC 2000b). Similarly, human systems which are especially sensitive to climate change include water resources, agriculture (especially food security) and forestry, coastal zones and marine systems (fisheries). The Climate Change Challenge Program provides a means to evaluate the effects of climate change and identify ways to mitigate its impact on terrestrial and aquatic systems.

WorldFish Center's role

The opportunity exists for the Center and the CGIAR to continue to expand its coordination and leadership role in coral reef and pelagic fisheries by bringing together many of the initiatives described above within a Challenge Program which focuses on how poor people can benefit from these various efforts, and by directly contributing our research and information management skills.

The proposed plan of activities is focused on the four major areas listed below.

1. Coordination, information management and dissemination on global climate change as it effects ecosystems
2. Assessment of the effects of global climate change particularly on coral bleaching and mortality
3. Policy recommendations
4. Modelling impacts and mitigation options

Tentative Costs

The costs of the Challenge Program of research on effects of climate change and its impact on terrestrial and aquatic systems is projected to be US$ 20 million per year for five years.

Potential collaborators

Regional networks, national governments, international organizations and NGOs, ASIs and NARS.

Potential CGIAR linkages

ICRAF will be the lead center for this program. The CP on Climate Change will involve CIAT, CIFOR, CYMMIT, CIP, ICARDA, ICRISAT, IFPRI, IITA, ILRI, IPGRI, IRRI, IWMI and WARDA.

CHALLENGE PROGRAM ON ANIMAL DISEASE

Stage of Development

The CP on animal disease entitled "Reducing poverty by eliminating market access constraints due to animal diseases" is in the pre-proposal stage, in which partners have been asked to comment. It has moved forward towards an encapsulation of the issues and the research.

Objective

There is overwhelming evidence that diseases are a major economic constraint to poor livestock farmers including fish farmers. Effective control of these diseases will lead to significant improvement in productivity and market opportunities, and thus reduce rural poverty. An appropriate and enabling policy environment will be required and capacity must be built to deliver disease control programs and enhance market opportunities for poor farmers.

The research programme will be targeted to three components:

1. Improvement and/or development of technologies and strategies for control of trade-limiting diseases
2. Development of policies that improve disease control and trade opportunities for poor farmers at domestic, regional and international levels
3. Development of delivery and dissemination mechanisms and strengthening regional capacities for sustainable delivery of policies and disease control strategies.

WorldFish Center's role

The Center's focus will be on the effects of disease on trade in aquatic products, and implications for developing countries. The research will develop appropriate policies and institutions to facilitate successful delivery of improved disease control technologies as part of an integrated package for enhancing farm animal productivity and access to markets for poor farmers at national and regional levels. Policy and institutional options for the feasible and reliable certification of smallholder-produced food products of animal origin, with respect to disease control and food safety standards will be developed.

Tentative Costs

The costs of the program of research on effects of fish disease and its impact on trade in aquatic products for poor farmers will be in the region of US$5 million over the next five years.

Potential collaborators

Regional networks, national governments and NARS within sub-regions. In addition international organisaton such as WTO, and FAO are potential collaborators.

Potential CGIAR linkages

The key linkages will be with the CGIAR centres of IFPRI and ILRI.

ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
ACP	Africa, Caribbean and Pacific
AGM	annual general meeting
AKVAFORSK	Norwegian Institute of Aquaculture Research
ARI	Advanced Research Institutions
ASI	Advanced Scientific Institutions
AusAID	Australian Agency for International Development
BMZ	Bundesministerium für Wirtschaftliche Zusammernarbeit und Entwicklung
BVI	British Virgin Islands
CAPRi	System-wide Initiative on Property Rights and Collective Agreements
CAS	catalogue of fishes
CBFM	community based fisheries management
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CIDA	Canadian International Development Agency
CIFOR	Center for International Forestry Research
CIMMYT	International Maize and Wheat Improvement Center
CIRAD	Coopération Internationale en Recherche Agronomique pour le Développement
CORDIO	Coral Reef Degradation in the Indian Ocean
CP	Challenge Program
Danida	Danish International Development Assistance
DFID	Department of International Development, UK
DSAP	Development of Sustainable Aquaculture Project
FAO	Food and Agriculture Organization
GAPE	Global Association for People and the Environment, Laos
GCRMN	Global Coral Reef Monitoring Network
GEF	Global Environmental Facility
GIFT	genetically improved farmed tilapia
GIS	Geographic Information System
GISP	Global Invasive Species Programme
GoFAR	Group of Fisheries and Aquatic Research
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IAA	integrated aquaculture and agriculture
IARC	International Agricultural Research Centre
ICARDA	International Center for Agricultural Research in Dry Areas
ICM	integrated coastal management
ICRAF	International Center for Research in Agroforestry
ICRAN	International Coral Reef Action Network
ICRISAT	International Crops Research Institute for the Semi-arid Tropics
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IFREMER	Institut Francais de Recherche pour l'Exploitation de la Mer (French Research Institute for the Exploitation of the Sea)
IIFET	International Institute of Fisheries Economics and Trade
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IMPACT	International Model for Policy Analysis of Agricultural Commodities and Trade
INGA	International Network on Genetics in Aquaculture
INRM	integrated natural resource management

IPCC	Intergovernmental Panel on Climate Change
IRRI	International Rice Research Institute
IRS	internationally recruited staff
ITMEMS	International Tropical Marine Ecosystem Management Symposium
IUCN	World Conservation Union
IWMI	International Water Management Institute
LMEs	large marine ecosystems
MCA	Marine Conservation Area
MNHN	Museum National d'Histoire Naturelle
MPA	marine protected area
MSSP	Multi-Sector Support Program
MTP	Medium Term Plan
NARES	National Aquatic Research and Extension Systems
NARS	National Aquatic Research Systems
NOAA	National Oceanographic and Atmospheric Administration
NRM	National Resources Management
NRS	nationally recruited staff
NTAFP	Network of Tropical Aquaculture and Fisheries Professionals
NZAID	New Zealand Agency for International Development
OECD	Organisation for Economic Cooperation and Development
RESTORE	research tools for natural resource management monitoring and evaluation
RET	research extension and training
RRS	regionally recruited staff
SACCAR	Southern African Center for Cooperation in Agricultural and Natural Resources Research and Training
SEAFDEC	Southeast Asian Fisheries Development Centre
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture
SFIS	Selective Fisheries Information Service
SGRP	System-wide Genetic Resources Program
Sida	Swedish International Development Cooperation Agency
SPC	Secretariat of the Pacific Community
SSA	sub-Saharan Africa
TCDC	Technical Cooperation among Developing Countries
TNC	The Nature Conservancy
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNEP-WCMC	United Nations Environmental Programme-World Conservation Monitoring Centre
UNF	United Nations Foundation
USAID	United States Agency for International Development
USP	University of the South Pacific
VRSAP	Vietnam river systems and plains
WARDA	West Africa Rice Development Association
WFCP	Water and Food Challenge Program
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WWF	World Wildlife Fund