WorldFish
CENTER

The WorldFish Center

annual report 2005/06

WorldFish Center Annual Report 2005/06

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WorldFish Center at a Glance

The WorldFish Center is an autonomous and nonprofit international research organization that works to reduce hunger and poverty by improving fisheries and aquaculture.

Now based in Penang, Malaysia, WorldFish was originally established in the Philippines in 1977 as the International Center for Living Aquatic Resources Management (ICLARM). In 1992 ICLARM became one of 15 research centers supported by the Consultative Group on International Agricultural Research (CGIAR). The CGIAR alliance mobilizes agricultural science to tackle poverty, foster human well-being, promote agricultural growth and protect the environment.

Major partners of WorldFish and the other CGIAR Centers include national agricultural research systems, international and regional agencies, conservation groups, non-governmental organizations (NGOs) and companies in the private sector. WorldFish activities are concentrated mainly in Asia, Africa and the South Pacific.

CONTENTS

STATEMENT BY THE BOARD CHAIRMAN

Sustainable Development Close to Home

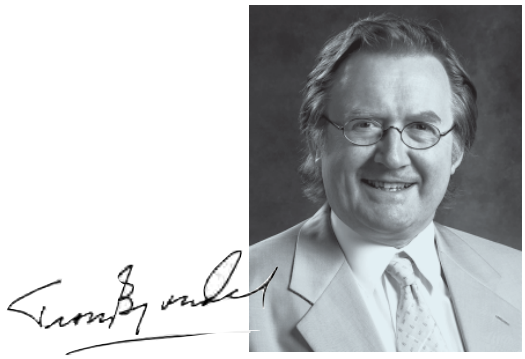
Sustainable development, a goal which underpins our efforts to reduce extreme hunger and poverty, is basically about managing natural resources well to provide a foundation for future progress. Achieving sustainable development is a formidable task for developing countries, in particular when it comes to influencing individuals' incentives so that this objective can be reached. It is also a challenge for organizations, like the WorldFish Centre, where demand for the work we do is great while resources are finite.

For the past year and a half, WorldFish has been mapping out a plan for strong, sustainable growth over the next few years, and putting into place the pieces needed to get us there. It is our firm belief that we need to grow as an organization if we are to help fisheries and aquaculture deliver on its potential to reduce poverty and hunger, and we have taken a number of exciting steps to help us achieve the growth we need.

Among those changes has been a revision of our strategy to provide greater clarity about where we are going and how we will get there, a restructuring of our research base to support a growth agenda and much greater focus on attracting resources by developing good ideas into fundable projects. Through strategic thinking and outreach by the Business Development Office, the Center is now engaged in a spirited give-and-take with partners who are also committed to tackling dire hunger and poverty. This collaboration and dialogue not only enhances the Center's ability to design and implement poverty-based solutions, but will help developing countries develop the capacity to do the job themselves.

The many changes underway are also aimed at increasing WorldFish's influence and impact. We saw the Center's growing authority well demonstrated at the NEPAD "Fish for All Summit" in Africa, where WorldFish played a key role in mobilizing high-level support for fisheries and aquaculture development to help tackle dire hunger and poverty in the region, where the need is greatest. The collaboration and commitment resulting from the Summit will make deep and lasting inroads.

As Chairman, I have been pleased to be part of the Center's progress toward becoming a much more efficient, stronger and more influential organization. I have no doubt the many recent changes and developments will enable WorldFish to sustain that success.



Trond Bjorndal
Board Chairman

STATEMENT BY THE DIRECTOR-GENERAL

Why Investments in Fisheries and Aquaculture Make Sense

An annual report is a good chance to look back on what has been achieved. But I'm struck by how much of what we accomplished over the past year positions WorldFish for challenges and opportunities ahead.

In 2004 we launched a number of initiatives aimed at strengthening our institutional foundation and research program. 2005 brought considerable progress and payoffs in these areas, as summarized elsewhere in this report. One of the most important activities of 2005, in my view, was the completion of our Strategy Update. Rooted in the Center's Mission, Vision and Values and guided by the Millennium Development Goals, the update provides a clear picture of our intended direction. Among other things, it clarifies our strengths on the research-to-development continuum, areas of scientific and geographic priority and characteristics that differentiate WorldFish from other research providers.

The long and thoughtful exercise that resulted in the Strategy Update left us better prepared to explain why investments in fisheries and aquaculture make sense. We know that in Africa, for example, carefully targeted investments in improved fisheries managemement and small-scale aquaculture technologies can improve income, nutrition and health. If US$30 million were invested in the recently launched Program for Sustainable African Aquaculture, it could increase Africa's aquaculture production by 10 percent annually, or 3 million tons over the next 15 years. This would generate $1 billion to $2 billion in revenue, create employment for up to 5 million people by 2020 and provide food security for millions more. It could also generate export value of $50 million to $100 million annually by 2020.

Strategic planning helps an organization improve its efficiency and impact. WorldFish depends heavily on partnerships to meet its mission, and I'm pleased that present and prospective partners have responded positively to the energy and clearer focus they see emanating from recent developments.

I am also delighted with our progress in establishing a strategic alliance with the International Water Management Institute, a CGIAR sister center. In early 2006, the Boards of IWMI and WorldFish agreed to jointly shared corporate services in the areas of finance, human resources and information and communications technology. I am confident that this arrangement, by aiding research collaboration, will allow the two Centers to achieve many synergies that lead to increased benefits for developing countries.

The huge impact of WorldFish's work was demonstrated to the wider world in 2005 by two prestigious events. In October, WorldFish scientist Dr. Modadugu Gupta capped an outstanding career by receiving the World Food Prize. A month later, the Tech Museum of Innovation in San Jose, California, recognized the Center's "super" tilapia, bred specially for low-input aquaculture, as a major technological achievement benefiting humanity. These achievements epitomize WorldFish at its very best, and made us all feel really good at knowing that our efforts make a positive difference in people's lives.

Stephen J. Hall
Director-General

PRIZES AND AWARDS

Lifetime Achievement Nets Dr. Gupta the World Food Prize

"I wanted to use my research in development, to change people's lives." That was the feeling that motivated Dr. Modadugu Gupta as a newly trained scientist in his native India more than four decades ago. In 2005, the fruits of that sentiment brought Dr. Gupta a career-capping achievement when he received the World Food Prize.

Dr. Gupta, who was Assistant Director General of WorldFish until his retirement in 2004, received the award for boosting fish production in several countries and giving poor people cheap, simple and environmentally friendly ways of raising freshwater fish for food and income.

The World Food Prize was established in 1986 by Nobel Laureate Norman Borlaug, architect of the "Green Revolution," to recognize outstanding achievements in improving the quality, quantity and

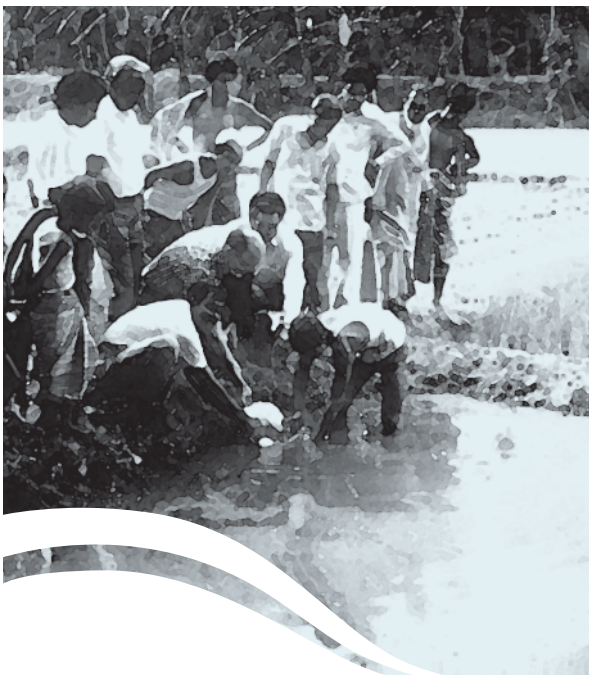
availability of food in the world. The prize, presented to Dr. Gupta on October 13 at a glittering ceremony in Des Moines, Iowa, includes a monetary award of US$250,000. Dr. Gupta said he plans to use the prize money to further his work, in consultation with farmers to determine their specific needs.

Today, poor rural families in many parts of South and Southeast Asia and Africa are using the methods that emerged from Dr. Gupta's work to grow fish in ponds, seasonally flooded fields and other bodies of water. The technologies, which incorporate yield-enhancing measures such as polyculture, specialized fish breeds and the recycling of farm waste, have helped boost freshwater fish production by as much as three- to five-fold in India, Bangladesh and Thailand. The technologies are now being adopted in African countries as well.

Dr. Gupta began his career when aquaculture was hardly known in India. Enrolling for a master's degree in 1958, he wanted to study fisheries, but no relevant programs existed so he had to major in zoology instead. "The very idea of fish research – teaching people how to catch fish — was not regarded as a science," he recalled.

Subsequent research in some of the world's most marginal areas — Calcutta, Vietnam's northeastern region, the war-scarred countryside of Laos and the monsoon-flooded fields of Bangladesh — gave him a firsthand look at the tremendous obstacles that the rural poor faced every day in their quest to provide for themselves and their families. The experience inspired him to make the results of his work as widely useful as possible.

"In my early years at WorldFish, when I started working with farmers and NGOs in Bangladesh, I was asked why I was doing development work instead of research," he said. "My answer was that science by itself will not help to increase production and improve the lives of rural poor. Science must take into consideration the socio-economic fabric and needs of the societies for whom the research is meant."



Dr. Gupta said he used "a bottom-up approach" to move research from the lab to the farm, working closely with farmers themselves to ensure that the technologies were locally appropriate and likely to win broad adoption. The result was an array of low-cost, low-input fish-farming practices adapted for various agro-ecological conditions in developing countries. Today, a number of countries and non-government organizations are incorporating the results of Dr. Gupta's work into agriculture and development programs.

Colleagues say Dr. Gupta's strong professional track record reflects his skill in promoting collaboration among researchers, local NGOs and farmers. "From the very beginning of his work in India, he was always the one for building teams and groups," said Dr. S. Ayyappan, Deputy Director-General for Fisheries of the Indian Council of Agriculture Research in New Delhi. "He's [been] successful because he's an excellent communicator who believes in teamwork and partnerships, in building complementarities."

Capacity-building is among Dr. Gupta's many professional achievements. Dr. Ayyappan credits him with "almost single-handedly" driving the success of the International Network on Genetics in Aquaculture. Numerous scientists, extension workers and farmers have developed technical competence in aquaculture through training programs established under Dr. Gupta's tutelage.

Since retiring from WorldFish, Dr. Gupta has been in demand as a consultant. Early in 2006, he reestablished his ties with WorldFish by accepting an appointment as a Senior Research Fellow.

WorldFish Gets Tech Award for Fish-Breeding Innovation

The development of a specialized process for breeding superior strains of tilapia and other fish brought WorldFish international recognition in an annual competition that spotlights technological advances benefiting humanity. The Center was named a 2005 Tech Awards Laureate for its GIFT technology (for "genetically improved farmed tilapia"), which has given poor farmers and consumers in developing countries hardier and more productive strains of fish suited for small-scale aquaculture.

The awards program, administered by the Tech Museum of Innovation in San Jose, California, honors individuals and organizations from around the world for technological innovation in five areas: economic development, education, equality, health and the environment. WorldFish was one of 25 finalists, or Laureates, selected from more than 300 applications from 64 countries. The five top winners, one in each of the five categories, shared a $250,000 cash prize.

Director General Stephen Hall and genetics researcher Dr. Raul Ponzoni represented WorldFish at the black-tie awards ceremony on November 9 in San Jose. Among the attendees were leaders from Silicon Valley, international development agencies, and the academic and research communities.

In presenting the awards, Jim Morgan, the chairman of Applied Materials Inc., said the Tech Award Laureates "exhibit the same pioneering spirit that has inspired the world's greatest inventions and innovations. Their breakthrough technologies are helping to provide basic needs and infrastructure, and the ultimate promise of their work is its power to have a positive impact on individuals and society."

Applied Materials is one of the major partners and sponsors of the awards program. Others include Santa Clara University 's Center for Science, Technology and Society; Intel; Accenture; Microsoft; Agilent Technologies Foundation; and Knight Ridder. WorldFish was one of five Laureates for the Accenture-sponsored Economic Development Award.

The GIFT technology emerged from a decade of research by WorldFish scientists and their collaborators from universities and fisheries institutes in the Philippines, Norway and Malaysia. The approach is an adaptation of technologies that have been used for decades to breed more productive strains of livestock and other animals. It entails selecting the best progeny in each generation with respect to certain desired characteristics, then using these superior specimens to breed the next generation. No transfer of genes between different species is involved.

The original GIFT fish, a Nile tilapia *(Oreochromis niloticus)*, and other strains developed through the pioneering technology grow faster and result in higher yields, even when raised in confined spaces and under resource-poor conditions typical of those in most developing countries. By helping farmers boost productivity, GIFT-derived fish pro-

vide a foundation for stronger livelihoods and for improved diets and nutrition among the poor. The GIFT technology and related training in the methods has spread to 15 countries in Asia, Africa and Latin America.

WorldFish is one of about a hundred Tech Awards Laureates that have been named since the program began. Launched in 2001, it was inspired in part by *The State of the Future* report issued by the Millennium Project of the American Council for the United Nations University. The aim was to galvanize support for the development of scientific and technological advances that significantly improve human welfare.

Located in downtown San Jose, in the heart of California's famous Silicon Valley, the nonprofit Tech Museum of Innovation offers a variety of programs that help people of all ages and backgrounds better understand the technologies that affect their daily lives. A major mission is to inspire young people to become future innovators in fields of technology.

Meredith Taylor, who was president of the museum until late 2005, said the awards are given "to shine a spotlight on the innovative work of those who dedicate their lives to using technology to help others." By celebrating the accomplishments of the museum's Laureates, she added, "we can encourage others to become social entrepreneurs who leverage technology to make the world safer, healthier and more equitable."

Two Enterprising Proposals Earn World Bank Funding

WorldFish scientists working in Malawi and Cameroon won monetary awards in 2005 from the World Bank under an annual competition held to encourage innovative approaches to development. The program, called the Global Development Marketplace, provides "seed" money to design and implement original projects that show strong promise of helping to meet pressing social or economic problems of the world's poor.

Dr. Randy Brummett, who is based in Cameroon, received US$150,000 for a project in which residents of Lower Guinean rainforest communities are learning sustainable ways of raising ornamental fish in local rivers to supply the international aquarium industry. By helping at least 150 small producers acquire commercially oriented aquaculture skills, the multi-stage project could benefit more than 4,000 residents of three communities. Returns to local communities of at least 500 percent is the projected goal.

Fish offered by Kribi Ornamental Fishers Cooperative

African rivers have a large diversity of ornamental fish – more than 200 fish species – although they tend to be low in abundance. Trade in these fish has been dominated by a few middlemen, who retrieve the specimens using practices that result in high rates of mortality (up to 85 percent).

The WorldFish project aims to develop a viable business model that river-based communities in Africa could adopt for sustainable production of ornamental fish. The potential benefit to local communities is high because the value of ornamental fish in international markets is as much as US$1.8 million per ton.

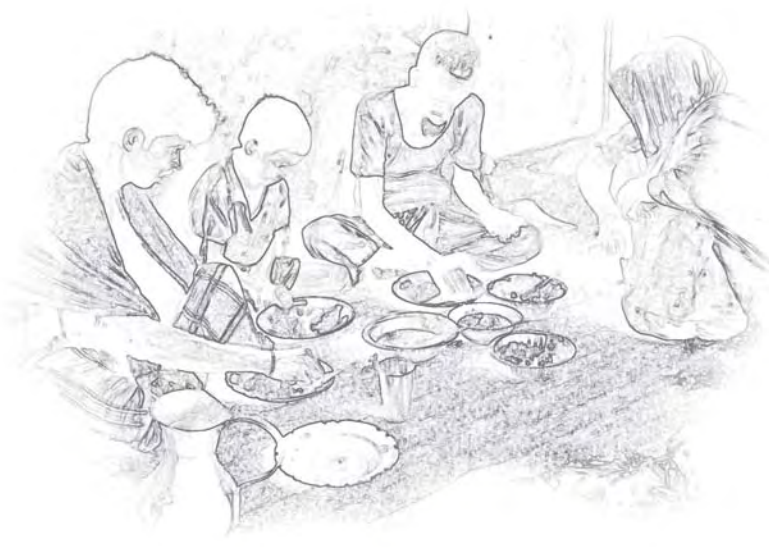
In Malawi, Dr. Daniel Jamu and his colleagues are using a US$20,000 award from the World Bank to develop techniques of small-scale aquaculture that are specially suited to the needs of poor African families affected by HIV/AIDS. The project, developed jointly with World Vision, targets households headed by orphans and widows, who generally lack the skills, labor and capital needed for conventional aquaculture. They also tend to be isolated and are distant from producer organizations and markets.

The research focuses heavily on designing methods of fish production that help HIV-affected families meet nutritional needs. Because fish is rich in protein, lipids, calcium, vitamin A and micro-nutrients, consuming it regularly not only aids the health of all family members, but can boost the effectiveness anti-retroviral drugs in those with HIV. Selling excess fish from home ponds also provides cash for medical care and regular household necessities.

Members of the Kribi Ornamental Fishers Cooperative. *The group of local fishers in the Kribi area of Southern Cameroon has been working since 2004 with the WorldFish Center and the Organization for the Environment and Development (OPED) to assume control over the production and trade of ornamental fish under methods that preserve the resource for future generations. The group is committed "to delivering high-quality specimens of rare and beautiful ornamental fish from local rivers (Lokoundji, Kribi, Lobe, Nyong and Mpolongué), conserving the rainforest and improving the lives of the people in our villages."*

Targeted to a thousand resource-poor households in the Chingale area of Zomba West in Malawi, the one-year project aims to raise family fish production, fish consumption and income by at least 25 percent. "Beyond the lifetime of the project," Dr. Jamu said, "these activities will also contribute to the development of cross-sectoral rural investment strategies aimed at strengthening the economic base of HIV/AIDS-affected populations."

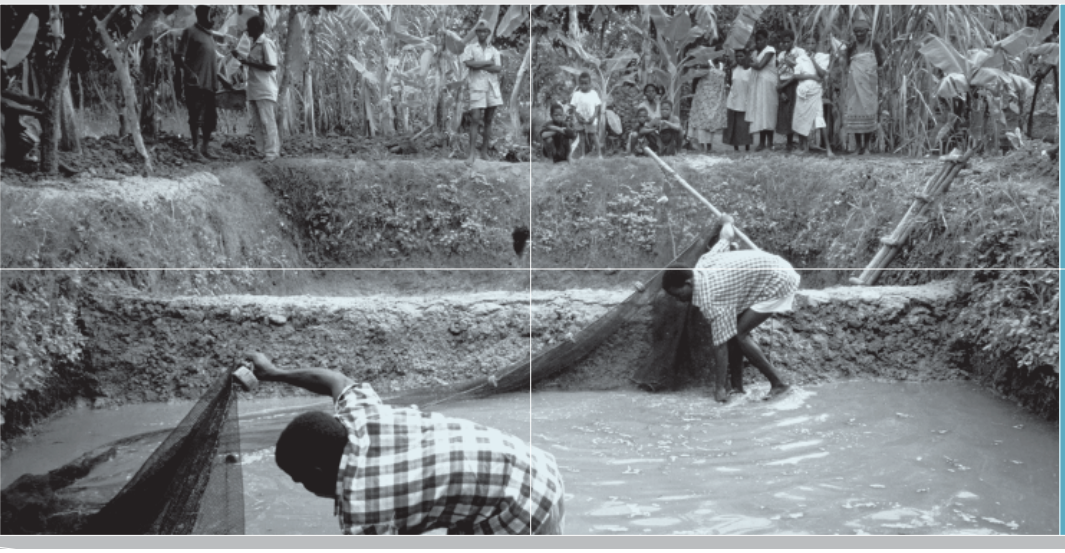
INSTITUTIONAL UPDATE



WorldFish Designs Pathway for Research and Growth

Strategic planning was a key activity at WorldFish in 2005, culminating in the development of a framework that will guide research activities and organizational growth over the next several years. Director-General Stephen Hall led the agenda-setting initiative, which was part of a sweeping internal review launched in 2004 with the aim of boosting the Center's impact through program and operational improvements. After many months of consultations and discussions, the results of the planning exercise were formalized in a 12-page policy document, *WorldFish Strategy Update,* which was issued in November.

Dr. Hall said the strategic planning was necessary to make sure the WorldFish Center applies its expertise and resources in the best way possible to meet its mission, particularly in light of changing priorities and expectations in the development and donor communities. Such changes, he noted, include stronger collaborative commitment to achieving the



Millennium Development Goals, increased demand for research assistance amid greater competition for funding and stricter demands for accountability.

"Every organization must adapt periodically to ensure its continued effectiveness and relevance," he said. "For the sake of WorldFish, and in the interests of its partners and investors, it was time to take a hard look at what we should be doing and where we should be going to maximize our ability to meet the needs of the poor people to whom our work is targeted."

The *Strategy Update* offers guidelines on the kinds of research activities that will help WorldFish increase its impact in working to reduce hunger and poverty. Program priorities were established in relation to geographic outreach; comparative strengths of the Center in relation to its partners and other development-oriented institutions; and available opportunities and resources, including existing and potential partnerships. The strategy-planning exercise "led us to identify a set of institutional strengths that we think funders and collaborators

WorldFish Thematic Goals

Growth

Rationale: To fulfill its global mandate and expand its impact, the WorldFish Center must grow in size and in its geographic presence over the next three to five years.

Excellence

Rationale: Excellence in science and in the way the Center operates must be a priority to meet the challenges that come with a commitment to growth.

Partnership

Rationale: The Center will not be able to grow unless it does so in partnership with others, so achieving this must be a strong priority.

should find compelling in weighing the WorldFish Center's merits as a science partner of choice," Dr. Hall said.

The *Strategy Update* points out, for example, that WorldFish can add greater value to partners' efforts through its ability to synthesize and integrate knowledge at the regional and global levels. Other noted advantages include the Center's international status, its own well developed anti-poverty research agenda and its proven ability to harness a broad range of support for development-related research, as demonstrated in the highly successful "Fish for All" initiative, launched in 2002 to raise awareness about the importance of sustainable aquaculture and fisheries in feeding the world's rapidly growing population.

Dr. Hall said the *Strategy Update* would be reviewed, modified and further developed as necessary to reflect shifting priorities and circumstances. "An organizational strategy can never be fixed in stone because of constantly changing conditions that affect our work," he said.

Strategic Alliance

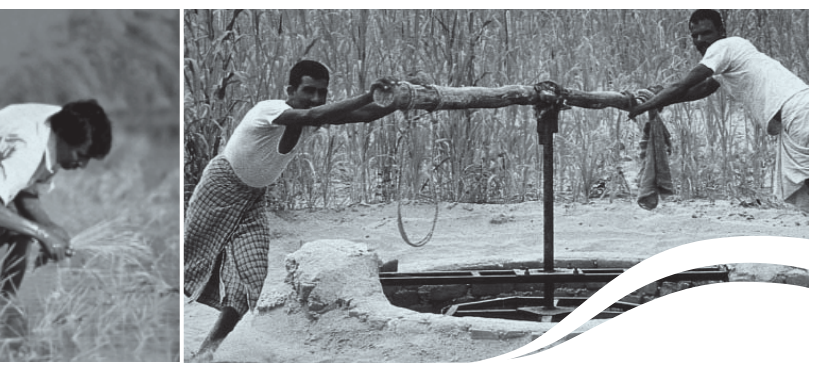
Developing carefully targeted alliances with other institutions that offer complementary skills and services is one of the strategies by which WorldFish hopes to achieve its goals more efficiently and effectively over the next several years. A major advance in this area in 2005 was an official agreement between WorldFish and another CGIAR center, the International Water Management Institute (IWMI) in Colombo, Sri Lanka, to share corporate services.

The joint venture, which is being phased in, entails an integration of selected operations to achieve cost savings and enhance services. The aim is for both the centers to share the benefits of investments in new technologies and equipment, as well as innovative approaches to communication and knowledge sharing. The arrangement includes a number of joint appointments at the senior level.

In the first quarter of 2006, WorldFish and IWMI aligned their respective information and communications operations under a new joint Information and Knowledge Group, with the Head

of the unit based at IWMI and the Deputy Head at WorldFish headquarters in Penang. Website and intranet development, library services, publications and database management are primary functions of the new group. Responsibility for core information technology services, including hardware and software purchasing and maintenance, network management and IT systems security, was transferred to the Director of Corporate Services, a new shared position. Also underway is the harmonization of finance and human resources policies and the pooling of resources in these areas, including the sharing of technology platforms such as SAP.

More collaboration by scientists from the two organizations is planned as part of the strategic alliance. Among the proposed issues for joint research are projects involving wetlands, agriculture and fisheries in the Mekong region; water use and poverty in the Nile and Ganges basins; integrated small-scale irrigation and aquaculture in Southern Africa; and geoinformatics support for WorldFish and IWMI scientists.



Cambodia Office

With WorldFish rapidly expanding its research activities in the Greater Mekong region, an important milestone in 2005 was the establishment of a new branch office in Phnom Penh, Cambodia. It provides a hub for the Center's work in Cambodia, Vietnam, Laos and Thailand.

Previously, several scientists affiliated with WorldFish were based in offices of Cambodia's Department of Fisheries under a project to strengthen the country's scientific capacity in the study and management of inland fisheries. The opening of the new office and a related expansion of the staff, which is headed by Dr. Blake Ratner, will accommodate a growing portfolio of research across the region on issues of aquaculture development, integrated wetlands management, local natural resource governance and policy-making in regard to fish production.

Systems Integration

The implementation of a SAP system by WorldFish in 2005 is aimed at making Center-wide reporting functions more efficient. Known officially as an "enterprise resource planning system," the customized software package allows integration of WorldFish data in several key areas: financial accounting, project management, travel arrangements and purchasing. Expected benefits include quicker turnaround time in basic transactions, greater transparency through online tracking and more effective budget planning.

The project got underway in March, followed by several months of installation and testing managed by a team from WorldFish, SAP Malaysia and JSPC-I Solutions. The final product, dubbed "SAPisces," was launched at WorldFish headquarters in Penang in September. Subsequently, the system was rolled out as well at WorldFish offices in Egypt.

In a Center-wide contest to name the new system, Dr. Warwick Nash of the New Caledonia office proposed the winning entry, "SAPisces." ("Pisces" means "fish" in Greek.)

Performance Goals

WorldFish's adoption of the new SAP system was part of a broad platform of institutional improvements that began in 2004 and continued in 2005. The measures include the establishment of corporate Key Performance Goals, which offer explicit targets for assessing performance and measuring outputs. An initial set of annual performance goals for 2005 was issued and posted on the Center's intranet site, FishNet, so that employees can directly monitor progress in achieving them.

The goals for 2005 stipulated specific objectives related to research programs; revenue and funding; donor, partner and employee satisfaction; project management; publication and public awareness; and training and development. Dr. Hall reported in March 2006 that of 32 goals for 2005 for which data were available, two-thirds (a total of 23) had fully met or reached at least 95 percent of their targets. Citing the considerable progress in research portfolio development and other areas, he said the results showed that "we have really started to put our strategy into action."

The corporate Key Performance Goals will eventually be linked to similar measures applicable to various departments and individuals. WorldFish is gradually revamping its performance management and appraisal systems to bring them in line with expectations and responsibilities laid out in the corporate goals.

External Review

Further guidance on measures to improve WorldFish performance and operations came from an External Performance Management Review sponsored by the Center's parent organization, the Consultative Group on International Agricultural Research (CGIAR). Conducted for each CGIAR research center every five to six years, these comprehensive EPMR reviews provide an independent and rigorous assessment of institutional health, research activities and development plans.

In late 2005 and early 2006, an international EPMR team representing the CGIAR's Science Council visited WorldFish headquarters and met with senior managers, research portfolio directors, members of the Business Development Office and other staff. The series of consultations included site visits to several of the Center's regional offices and research sites in Malawi, Egypt and Cambodia.

The EPMR panel's initial report, presented in January, was generally positive, especially because a number of the recommended changes were already being addressed by the broad program of reforms that the Center has been putting into place since 2004.

Board Reforms

Based in part on recommendations of the EPMR panel, WorldFish's Board of Trustees reviewed its own structure and governing functions, and adopted several changes during March 2006 meetings in Penang. Among the agreed changes were reducing the size of the Board to a minimum of eight members; abolishing the Program Committee and establishing a separate Science Advisory Body; and reconstituting the Nominating Committee as a Governance Committee with broader terms of reference related to ensuring that the Board operates effectively. The newly adopted policies also call for the Board to aim to meet four times a year (though not necessarily in person every time).

Broad Public Outreach Raises Center's Profile

Public knowledge of WorldFish and its achievements swelled in 2005 thanks to media outreach and a wide range of materials prepared by the Information and Communications Office. Clip files and media tracking showed that stories on WorldFish activities were done by newspapers, magazines, wire services, radio and TV outlets, and websites from around the world.

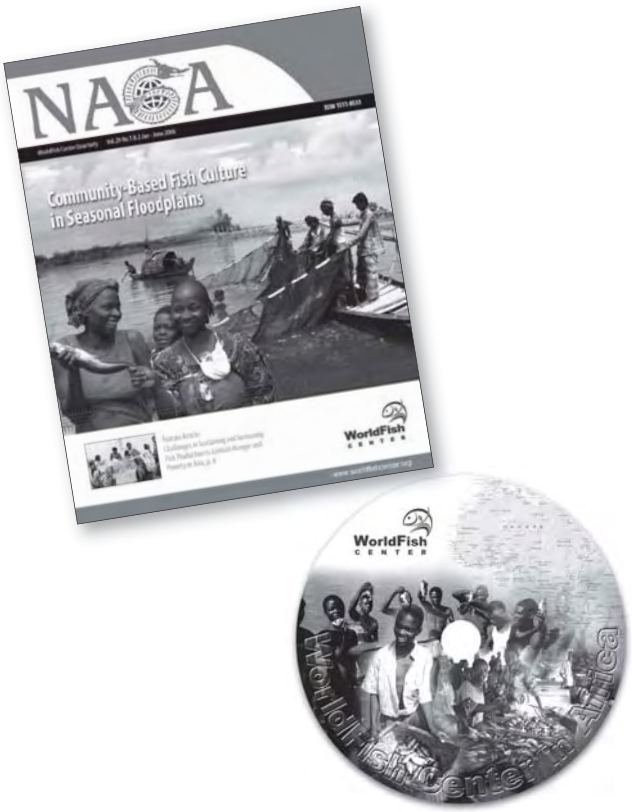
Special high-profile events for the year that resulted in heavy news coverage included the "Fish for All" Summit in Abuja, Nigeria, in August; the World Food Prize ceremony held in Des Moines, Iowa, in October; and the Tech Museum Innovation Awards ceremony held in San Diego, California, in November. Also garnering strong news interest in 2005 was a late December media campaign designed to highlight recommendations for rebuilding Asian fisheries devastated by the 2004 tsunami. Developed under the auspices of a scientific consortium in which WorldFish is a partner, the campaign was arranged to coincide with the first anniversary of the disaster.

For the Abuja Summit, staff in Penang and the Center's offices in Egypt jointly produced a broad suite of materials for delegates and the media. Media consultants based in Toronto, London and Abuja coordinated press relations, and regularly updated information about the conference was posted on the Center's "Fish for All'' website. Media coverage of the event was extensive, with articles generated in at least nine languages by reporters and correspondents from nearly three dozen countries in Africa, Asia, Europe and Central America. Documented coverage included reports by 36 news wires, 14 television and radio services, 19 newspapers and magazines, and more than 200 websites.

Throughout 2005, WorldFish was also well represented at more than half a dozen major regional and international meetings on fisheries research and development. In addition, the Information and Communication Office provided major assistance in planning media outreach for the Penang-based launch of the Millennium Assessment reports in March 2005.

Publications Output

The main editorial products issued during the year consisted of 14 technical publications (in print



or on CD-ROM), 37 brochures and booklets, and 22 posters. Many of the materials were custom designed for specific meetings and events, and a few were published in French, Japanese or Chinese as well as English. Among the publications were two double issues of the Center's peer-reviewed scientific journal, *NAGA*.

Managing the publications workflow became easier with the installation of a new online tracking system. It is being integrated with databases in the Office of Science Coordination to facilitate the monitoring of publication tie-ins with research programs, particularly in relation to achieving WorldFish's new Key Performance Goals.

As in other years, the staff produced a large volume of new or reformatted products for the CGIAR Annual General Meeting. Specially prepared materials for the 2005 AGM, which was held in early December in Marrakesh, Morocco, included new giant four-color banner-style displays for the main exhibition, as well as posters for the Science Forum.

Library and Online Services

In a pilot project aimed at delivering fisheries information more efficiently and cost-effectively, WorldFish explored a partnership to share library services with two other CGIAR institutes and the U.N. Food and Agriculture Organization's library and documentation division. A project manager from FAO and a regional coordinator from the International Water Management Institute (IWMI) made site visits to the participating centers during the year to survey library facilities, collections and usage patterns.

Based on the findings, WorldFish merged two of its publication databases, LIBRI and NAGA, into a single database collection (now known as FISHLIB); reduced its serials subscriptions to 57 print and online journals; and bar-coded on-shelf materials for greater automation. WorldFish scientists will still be able to access more than a hundred additional journals through other CGIAR centers. Remote-

access connectivity in the Center's outreach offices was improved so that researchers can retrieve scientific papers via two aggregate journal providers, Swets Information Services and Science Direct.

The Center's main website and its intranet site, FishNet, were both revamped in 2005 by an external vendor, following a comprehensive design and content analysis. The overhaul required technical upgrades that included the adoption of a new server and improvements to ease e-mail routing and database transfer capabilities. A decision was made to incorporate FishNet into the corporate web site to facilitate access by the Center's outreach offices. In addition, a content management system was installed to allow decentralized uploading of information by authorized WorldFish users. Refinements to both of the sites are ongoing, based on staff feedback.

In-House Campaign

Throughout 2005, the Communications Office conducted a variety of activities under a special campaign designed to keep WorldFish employees informed about developments in the Center's program of organizational transformation. Highlights included the development of a campaign logo, slogan and t-shirts, intended for use in presentations and team-building activities; publication of three issues of a campaign-related newsletter, *FishBytes;* "town hall"-style meetings focusing on aspects of the corporate change program; redesign of the in-house online information source, FishNet; and the design of a WorldFish screensaver, which highlights the Center's new Mission Statement, Vision and Corporate Goals. Assistance with strategic communications planning was provided to WorldFish directors and managers involved in the corporate change program.

Additional Support

Nominating documents and editorial services provided by the Communications Office were instrumental in helping WorldFish and its scientists collect several major awards during the year: the World Food Prize, an award for technological innovation in developing the GIFT fish for use in small-scale aquaculture and two Development Marketplace Innovation awards from the World Bank.

The office handled group and individual visits to WorldFish headquarters by 332 people in 2005. Related duties included organizing tours, arranging video screenings and talks, and distributing informational materials. Under a program sponsored by the CGIAR Marketing Group, three Chinese journalists visited the WorldFish Center in October. They represented the Chinese government's Academy of Agricultural Sciences and two major newspapers, *Science and Technology Daily* and the *People's Daily.* Besides meeting at headquarters with Director General Stephen Hall and several staff scientists, they toured the Center's tilapia-breeding facilities in Jitra, Malaysia. The knowledge they acquired will help raise awareness about WorldFish activities as the Center expands its research program in China.

WorldFish Mission, Vision and Values

Our Mission

To reduce poverty and hunger by improving fisheries and aquaculture.

Our Vision

To be the science partner of choice in delivering fisheries and aquaculture solutions for developing countries.

Our Values

- Our two most fundamental values are integrity and trust. We will trust each other to be honest and open, and hold one another accountable for honoring that trust.
- In the workplace, we will strive for fairness and equity. We will provide equal opportunities for all staff, recognize achievement, celebrate diversity and respect individual dignity. We will strive to practice effective leadership at all levels and empower staff so that they can give their best.
- In our work, we will search for excellence and innovation in all that we do. We will continually seek to improve the quality and efficiency of our products and services, and accept the need for risk taking and genuine mistakes as opportunities for learning. We will also value teamwork over individual effort, sharing knowledge amongst ourselves and our partners to build on our collective strengths and inter-dependencies.

PROGRAM HIGHLIGHTS

Summit Promotes Fish Farming to Fight Poverty in Africa

With fish consumption in sub-Saharan Africa falling, major investment in aquaculture is crucially needed to feed the region's fast-growing population. That was the key message that African leaders and fisheries experts embraced when they convened in August 2005 for a high-profile conference to discuss fisheries development in sub-Saharan Africa. The "Fish for All" Summit, held in Abuja, Nigeria, and organized by the New Partnership for Africa's Development (NEPAD), drew delegates from two dozen countries.

The four-day event, which included technical sessions on fisheries issues of regional interest, was held in Abuja at the invitation of Nigeria's president, Chief Olusegun Obansanjo. He and other heads of state and ministers from African countries issued a joint "call for action" advocating cooperation to expand sustainable aquaculture and improve fisheries to reduce hunger and support economic development in the region.

The statement, known as the "Abuja Declaration on Sustainable Fisheries and Aquaculture in Africa," identified 14 areas for joint action. The areas include efforts to expand fish-related trade opportunities, promote sustainable fishing through policy reforms, encourage entrepreneurship based on fish farming, empower fishing communities and increase expertise in fisheries management.

Emphasizing the importance of increased investment in aquaculture across the region, WorldFish scientists presented the results of analyses indicating that fish supply in Africa would have to increase by one-fifth over the next decade just to maintain the current level of consumption. Yet per capita fish consumption in the region (at 6.6 kilograms per person per year) is already below that in other parts of the world, and has been declining steadily for some time – the only area where this trend is seen. The decline stems from stagnation in the capture of wild fish in African waters coupled with fast growth by the continent's population.

Professor Richard Mkandawire, at right.

Aquaculture can help meet the shortfall, but fish farming in sub-Saharan Africa is currently so underexploited that it would need to rise by triple the present level to meet demand, Dr. Patrick Dugan, WorldFish's Deputy Director General, told the Summit participants. He noted that while 38 percent of all global fish production comes from aquaculture, the percentage in Africa is less than 2 percent.

Professor Richard Mkandawire, NEPAD's Senior Advisor for Agriculture, said the challenge ahead for the Summit delegates was "to ensure our ministers prioritize this very important issue."

The stakes are high because an estimated 200 million people in Africa, most of them among the world's poorest people, rely on fish as a main part of their diet. Fish provides them with an average of 22 percent of their total protein intake. With more than 10 million African families involved in small-scale fishing and fish-related activities, livelihood needs are also critically affected. Tapping aquaculture's potential benefits, WorldFish scientists stressed, can yield affordable protein and nutrient-rich food together with jobs and economic opportunities.

NEPAD, which was formed in 2002 to spur regional progress, is urging African countries to make

Acute Need in Sub-Saharan Africa

Africa is by far the world's poorest continent, with half of all people in sub-Saharan Africa living on US$1 a day. Widespread poverty in the region is magnified by the effects of the HIV/AIDS epidemic; an estimated 30 million people, 58 percent of them women, have HIV, and in several sub-Saharan countries at least one in five adults is infected.

Most Africans rely heavily on fish for animal protein. Fish constitutes 40 percent of the typical diet, and is the only source of protein for 200 million Africans. Fishing and related activities provide income for about 10 million Africans.

Small-scale fishers are suffering, however, because of steadily declining fish stocks. The waters off West Africa, for example, were once were among the richest fishing grounds in the world, but fish stocks there have crashed by 80 percent and the area is now as depleted as the North Atlantic. Despite spending longer periods at sea and extending their range farther out, low-tech fishers are catching smaller quantities of fish, and many of the fish they do catch are smaller than in the past – often too small even for human consumption. Most of the region's capture fisheries have reached or exceeded the limits of sustainable harvesting.

Aquaculture can play an important role in meeting the demand for fish as the productivity of capture fisheries declines, and fish farming has been expanding steadily in a few African countries, such as Egypt and Nigeria. But aquaculture is far from realizing its full potential across the continent, particularly in sub-Saharan Africa. The growth of aquaculture in the region has been hampered in part by inadequate research and development and too few extension activities. In collaboration with the New Partnership for Africa's Development (NEPAD) and a wide variety of other organizations, WorldFish is providing expertise to help countries in the region develop their aquaculture sectors and manage their fisheries for sustainable production.

small-scale aquaculture and fisheries improvement central elements of national development strategies, including plans aimed at meeting the Millennium Development Goals. NEPAD's support for increased investment in fish farming stems from the realization that meeting those global goals of hunger and poverty reduction isn't likely to happen unless alternative sources of fish are available.

WorldFish and the U.N. Food and Agriculture Organization partnered with NEPAD in organizing the "Fish for All" Summit in Abuja, which drew policymakers and representatives of development agencies, non-governmental organizations and the private sector as well as political leaders and fisheries experts. It was the latest of several highly successful "Fish for All" Summits held since WorldFish organized the first one in 2002 in Malaysia as a world forum aimed at galvanizing action to address looming shortages in global fish supply.

Technical Support in Abbassa

WorldFish's Regional Research Center for Africa and West Asia was established in Abbassa, Egypt, in 1996 to help Africa meet its urgent need for expertise in fisheries protection and improvements. Encompassing 53 hectares of water, including nearly 200 ponds ranging from 100 to 10,000 square meters each, the facility lies east of the fertile Nile delta, a 90-minute drive from Cairo. It is headed by Dr. Patrick Dugan, WorldFish's Deputy Director-General.

Scientists at the Abbassa complex work to develop simple, low-cost methods that improve seed (starter fish) production and raise the productivity of fish ponds to benefit poor African farmers. The primary areas of research are hatchery methods, production technologies, fish health and genetics.

Farm trials, demonstration projects, farmer outreach and training are central to the center's programs. Farm trials in Fayoum, for example, led to significantly higher aquaculture production over a five-year period beginning in 1999. The production rose from 600 kilograms per acre to 3,000 kilograms an acre.

Tilapia and catfish, both native to Africa, are the main species cultured at Abbassa. Popular for their highly palatable taste, these species are well suited to pond cultivation because they are easy to feed, are resistant to disease, grow rapidly and multiply abundantly. Tilapia currently make up about 40 percent of aquaculture fish production across Africa.

The center's work builds on a long history of aquaculture in Egypt, where fish have been cultivated since the time of the pharaohs. The earliest known depiction of the practice is a bas-relief carving from an Egyptian tomb dating from before 2000 B.C. It shows an Egyptian angling for fish — two specimens of Nile tilapia — in a garden fish pond, with his wife standing by to remove them.

Fish Ponds Offer an Oasis to Poor Farmers in Malawi

Malawi, one of the poorest countries in Africa, faces a daunting challenge in feeding its rapidly growing population. Most Malawians are subsistence farmers who have less than an acre of land on which to grow most of the food their families rely on throughout the year. Yet the land is often marginal, with soil that has been badly degraded. Furthermore, the country is prone to drought.

Farming conditions are so tough that even in the best of times, people struggle to get enough to eat. Because of the situation, Malawi usually needs massive imports of food aid every year to feed its 12.1 million people.

But thousands of poor farmers in Malawi have discovered that raising fish along with traditional crops can help them get much more out of their land. Through innovative methods of aquaculture pioneered by WorldFish scientists, many of the successful farms bloom like an oasis, even during extended dry periods.

In a recent impact assessment, researchers found that farms in Malawi where ponds for fish production had been added were significantly more productive and profitable than regular subsistence farms, and were more resilient during drought. This kind of farming, known officially as integrated agriculture-aquaculture, has enabled the participating farmers to feed their families better and increase their household wealth by selling excess fish.

The methods are environmentally sustainable, cheap to adopt and simple to practice, and are gaining broad support in Malawi. When the seeds of this project were sown more than a decade ago, only a hundred or so farmers in Malawi raised fish; today, the number is more than 4,000. Other African countries, including Zambia, Mozambique, Cameroon and Egypt, are now incorporating the practices into their own farming systems.

Blooming success: Fish-farming led to higher agricultural productivity.

If the approach were widely implemented, noted Dr. Daniel Jamu, a Malawi-born scientist who headed the project, "it could not only help feed millions of hungry people in Africa, but also ease pressures on dwindling stocks of fish in the wild."

In the on-farm assessment, researchers analyzed the output of more than 300 small farms in six areas of Malawi. On roughly half of the farms, the farmers had incorporated fish production into their regular farming operations over the past 15 years; the other half were farms of comparable size and conditions that did not take up fish-farming. The farms with fish ponds were 10 percent more productive overall and 50 percent more efficient, and had reduced nitrogen loss in soil. Their household income was 28 percent higher.

The fish-farming families also benefited from having a steady supply of fresh fish to supplement their daily diet. In the study, the adoption of fish-farming was associated with a 160 percent rise in per capita consumption of fresh fish. A related analysis suggested that the nutritional benefits could reduce

A Showcase for Fish-Farming

Friday Nikoloma, of Mlenga village in Malawi's Thyolo district, knew little about fish-farming when he decided to give it a try several years ago, out of personal curiosity. On a small patch of land he inherited, he constructed a pond, diverted water from a nearby stream and stocked the pond with fish *(Haplochromis sp)* from a river 60 kilometers away.

Friday Nikoloma: "I dream of sharing my best practices with other farmers outside this area."

He was happy to have fish swimming in his pond. Production, however, remained at a subsistence level. Then, a team of researchers and extension agents from the Department of Fisheries and the WorldFish Center encouraged Mr. Nikoloma to think bigger. After completing a training course sponsored through funding from the USAID's Office for Disaster Preparedness, he expanded his fish-farming enterprise to a commercial scale. Today, he owns six ponds, and in 2005 his net annual income from fish sales alone was US$7,200.

One of his innovations is a sprinkler system that works by gravity. "I use the pond water to irrigate my maize, tomatoes, bananas and other vegetables in the lean [dry] months, which makes me able to grow crops all year round," he said. From fish-farming, he has diversified into the production of chickens and small ruminants that provide manure for his ponds.

Eager to bring neighboring farmers on board, Mr. Nikoloma established a "farmer field school" where he shares his knowledge with others. He also sells them fingerlings so they can get started. More than 200 farmers have directly benefited. Fish-farmers in the area organized a marketing cooperative that has helped them enjoy economies of scale and earn higher prices for their fish in urban markets.

These days, "I don't require food aid," Mr. Nikoloma noted proudly. He enjoys the status of being a respected farmer in his village — so successful that he even owns a cell phone to improve communication with his customers.

childhood malnutrition – a serious problem in Malawi and throughout sub-Saharan Africa – by approximately 15 percent.

Equally important, the study revealed that the combined farming approach cushioned the impacts of drought and famine because pond water can be used for emergency irrigation of seedlings and vegetables can be grown in the residual moisture at the bottom of the ponds. The study found that Malawian farms with fish ponds were 18 percent more productive during drought than conventional farms.

The higher agricultural output achieved in integrated agriculture-aquaculture stems largely from the recycling of nutrients and water from the fish ponds. Farmers start by digging ponds in which to grow fish, such as tilapia, that thrive on crop residue, household food scraps and other organic farm waste, without the need for costly fish feed. Manure from other farm animals — goats, chicken and rabbits — enriches the ponds.

The pond water sediment, in turn, makes a good fertilizer for field crops, fruits and vegetables. Besides growing the dietary staples that their families eat every day, many farmers add cash crops, such as bananas and guava, around the banks of their ponds and sell the produce for extra income. By using this approach, some rural families in Malawi have increased their farm profits by six-fold.

Farmers helped develop and test the methods. Project partners were the Malawi government, the University of Malawi, ActionAid, World Vision, Christian Aid for Relief and Development and OXFAM.

The integrated agriculture-aquaculture methods in Malawi have steadily boosted the country's total production of fish from small-scale aquaculture, which has increased from a mere 90 tons a year in 1986 to more than 1,000 tons a year. Using yield data from the Malawi project, researchers have projected that sub-Saharan Africa could produce an extra 3.75 million tons of fish a year if integrated agriculture-aquaculture were practiced on as little as one percent of the 250 million acres that the U.N. Food and Agriculture Organization has identified as suitable for the approach. That potential gain is four times the total catch of all inland capture fisheries in Africa.

Cameroon Study Highlights Need for Market Access

A WorldFish research project in the forest margins of Cameroon has demonstrated how important market access is to small farmers seeking to improve farm profits through aquaculture. Researchers and extension workers provided technical training to a group of 100 farmers from four villages in Central Cameroon over a period of five years, with the aim of promoting aquaculture-based livelihoods in the region. The farmers' access to markets for cultured fish varied widely.

Recent findings from the study showed that the fish farmers who had good access to markets were able to translate their newly acquired skills fairly quickly into higher farm productivity and income, as well as better nutrition for their families. In comparison, the farmers with little or no access to markets were also successful in terms of fish production, but they failed to realize similar economic benefits in the short term.

"The comparison indicates that if market access by rural producers can be improved, the resulting cash benefits are likely to encourage the growth of aquaculture among small and medium farmers in Cameroon," said Dr. Randy Brummett, a WorldFish scientist who led the research.

Over the five-year period, the productivity of farm-based fish ponds rose five-fold, from 498 kilograms per hectare to 2,525 kilograms. The number of active fish farmers in the study areas increased from 40 to 137, and cash returns from aquaculture increased by 16 times.

But the farmers with good market access had comparatively much higher economic returns, with their aquaculture-derived income rising from cfa49,000 up to cfa870,000 [US$1= 519.564 XOF (Communauté Financière Africaine Francs BCEAO)] over the project period. Because the fish-farming families that lived in peri-urban areas had greater access to freezers, they also had more fish on hand for personal consumption than rural families (26 percent versus 17 percent, respectively). The ability to store fish for later use translated into better family nutrition.

The project was implemented using a research model that entails farmer participation. Research-extension teams – whose members included WorldFish aquaculture experts, economists from the International Institute of Tropical Agriculture (IITA), researchers from Institut de Recherche Agricole pour le Développement de Cameroun (IRAD) and technicians from Ministère de l"Elevage, des Pêches et des Industries Animales de Cameroun (MINEPIA) – worked directly with farmers and NGOS providing aquaculture information and training. A network of NGOs was established to spread the knowledge and impacts beyond the target villages. Surveys indicate that even farmers who did not participate directly in the research project benefit from it. Today, 262 small-scale farmers with 870 ponds produce 14.4 tons of fish annually for markets in Yaoundé.

Pilot trials under the project are aiding NGO-led efforts to develop a framework by which small rural fish producers in Cameroon, and eventually other parts of Africa, can increase market access as the basis for building sustainable aquaculture businesses.

Focus on Livelihoods Urged in Rebuilding After Tsunami

Even before the December 2004 tsunami wiped out many coastal areas of Asia, economic and social development in poor fishing communities lagged because few livelihood opportunities were available. Most coastal dwellers depended on fishing for a large part of their income, but environmental degradation and over-fishing depleted fish stocks to the point that most fishers found it harder and harder to make a living.

Despite the dismal situation, some fishing villages in affected areas of Indonesia have more boats and fishing gear today than they did before the disaster struck, according to a survey by the Consortium to Restore Shattered Livelihoods in Tsunami-Affected Nations (CONSRN). WorldFish and other members of the consortium have urged relief agencies and governments in the region to change their tactics in rebuilding shattered coastal communities.

"The focus should not be only on rebuilding boats, it should be on rebuilding the basis of their economic livelihood," said Dr. Madan Dey, a WorldFish scientist who announced the findings of the CONSRN survey on December 26, the first anniversary of the tsunami. "What is needed is a shift in the mindset," to focus on building and empowering the affected communities rather than just giving them handouts, boats and new fishing gear, Dr. Dey explained.

CONSRN is advising the Indonesian government on the revitalization of 18 villages in six districts of Aceh. When WorldFish and several partner organizations assessed damage in the Indonesian province after the tsunami hit, they concluded that 10 percent of all fishers in the area were killed and more than 9,600 boats were destroyed. A year later, Dr. Dey noted, "we did a survey in some villages in Aceh and found there were more boats there than before the tsunami."

In policy statements, CONSRN warned that despite good intentions and a flood of money from the international community, post-tsunami rehabilitation efforts are likely to fail without clear coordination and a coherent strategy. "Worse still," CONSRN said, misguided relief efforts "may imperil the longer term livelihoods of the communities they are seeking to help."

CONSRN cited trends showing that aquatic resources in coastal waters of Indonesia were already subject to over-fishing before the tsunami because of an excessive number of available boats and related gear. Short-term rehabilitation efforts, the group stressed, should be guided by a long-term vision that aims to ensure the sustainability of local fish populations. Recovery assistance by FAO and other CONSRN members includes reviewing and coordinating donor agencies' proposed plans to rebuild devastated fishing communities, and providing

technical expertise on sound fisheries restoration and development.

Dr. Dey said part of the vast investment in rebuilding the devastated coastal areas should be used to help restore the productivity of the region's fisheries. At the same time, he added, survivors need retraining and education programs to develop alternative means of livelihoods.

Among its recommendations, CONSRN said the region's fishing industry should be rebuilt at a level commensurate with sustainable productive capacity of local fisheries. It called for tighter control over fishing through measures such as vessel registration systems and ceilings on the number of boats that could operate in certain areas.

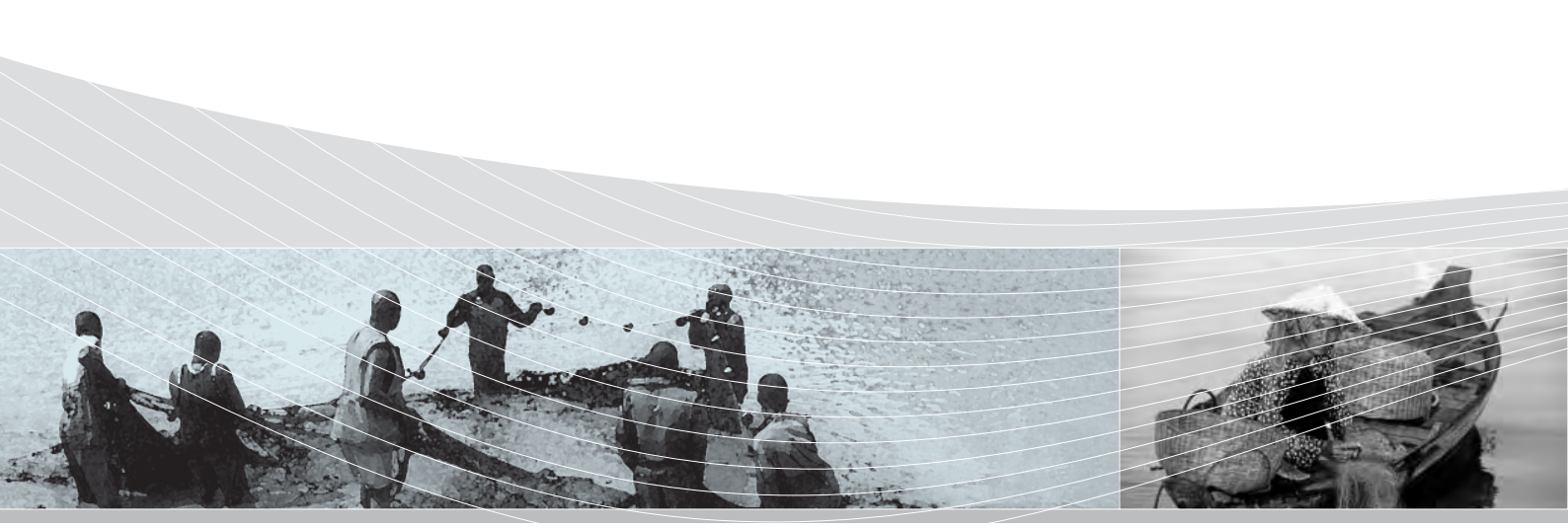
Avoiding the mistakes of past reconstruction efforts, CONSRN said, requires planners to address the vulnerabilities of costal communities that undermine their resilience. "The rehabilitation of livelihoods after the tsunami should be seen as an opportunity to strengthen and revitalize coastal communities" through fundamental social, economic and environmental changes, the group concluded (see sidebar). "The process," CONSRN said, "must be well planned at the operational level and be participatory, involving consultation and collaboration with the community."

Besides the WorldFish Center, CONSRN members include the Asia Pacific Fishery Commission, the U.N. Food and Agriculture Organization's Regional Office for Asia and the Pacific, the Network of Aquaculture Centers in Asia-Pacific, the Southeast Asia Fisheries Development Centers and the Bay of Bengal Program-Intergovernmental Organization.

New Foundation for the Future

Calling for structural changes to revitalize devastated fishing communities in Asia, the Consortium to Restore Shattered Livelihoods in Tsunami-Affected Nations (CONSRN) said reforms should include measures that:

- Clarify fishing rights and tenure
- Reduce fishing capacity
- Protect costal ecosystems
- Improve equitable market access
- Reduce vulnerability to natural hazards
- Rebuild community organizations
- Invest in education and training
- Build disaster preparedness
- Integrate coastal communities into national economic development



"Public Goods" Databases Aid Research and Management

Authoritative information and reliable analytical tools are critical in understanding the state of the world's aquatic resources and managing them for conservation and long-term benefits. Two award-winning online global databases developed by WorldFish and hundreds of partners are among the most powerful and popular sources available for information on fish, fisheries and coral reefs.

The remarkably comprehensive FishBase has detailed information on nearly all the world's known fish – 28,600 species. Millions of records are included, compiled with the help of more than 900 co-developers ranging from the European Commission and the U.N. Food and Agriculture Organization to museums in Sweden, Canada, France, Germany and Central Africa. Fish biology, taxonomy and ecology are covered, along with related subjects such as aquaculture and global fish distribution patterns.

Constantly upgraded since it was established in 1988, this "electronic encyclopedia" has interactive features and links to other sources that enable users to convert raw data into detailed assessments of the world's fisheries. With much of the information accessible in various languages, the service is especially important to researchers, policy makers and resource managers in developing countries where fish-related data are scarce or not easily available.

In 2005, the number of discrete visits to FishBase exceeded 14 million a month. Although FishBase is now administered by a consortium of research organizations, WorldFish continues to play a primary role in its ongoing development. In 2004 the Center received the CGIAR's award for Outstanding Scientific Support Team for its work with a variety of partners in creating and improving FishBase.

Similarly successful, ReefBase provides valuable information for monitoring and managing the world's coral reefs. Damage to reefs is not only threatening one of the planet's richest sources of biodiversity, but also has grave implications for the welfare of poor costal dwellers in many developing countries who depend heavily on reefs for food and income. Assessments indicate that as much as 88 percent of all reefs in Southeast Asia, which has 30 percent of the world's total, are at serious risk.

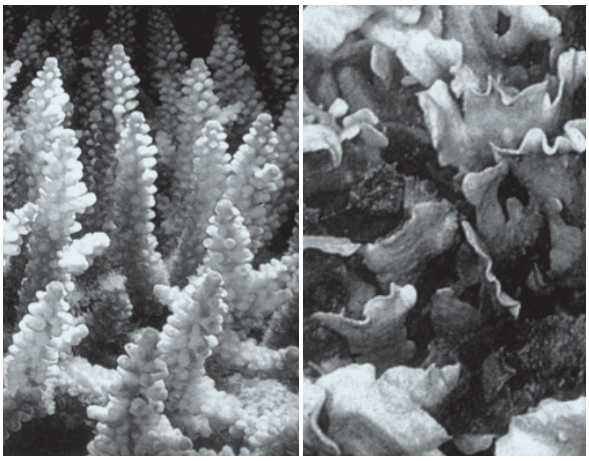
Launched in 2002, ReefBase was developed jointly with the International Coral Reef Action Network. The content encompasses a broad spectrum of information about coral reefs in nearly 100 countries and territories. ReefBase has become so central to coral reef management and protection efforts that it recently began hosting the websites of two umbrella organizations that represent coral reef monitoring interests in more than 80 countries: the Global Coral Reef Monitoring Network and ReefCheck.

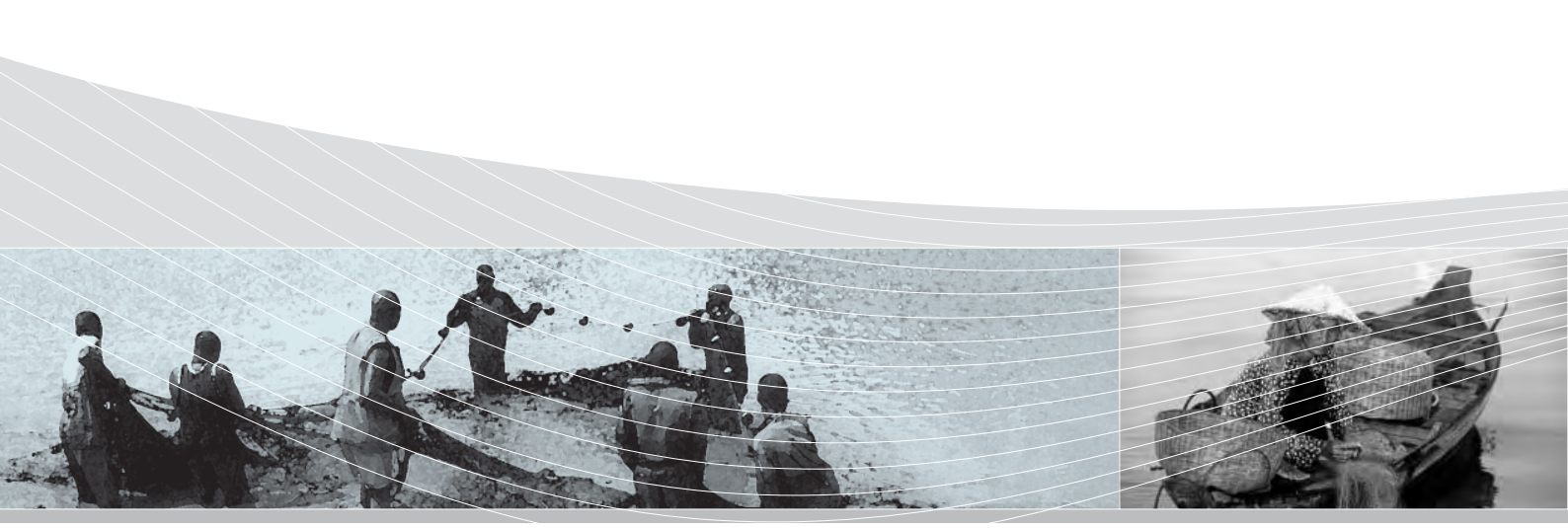
Thanks to content support from major research institutions including the U.S. National Aeronautics and Space Administration (NASA) and the U.S. National Oceanic and Atmospheric Administration (NOAA), ReefBase users can access resources such as full-resolution satellite-derived maps of all the world's coral reefs and key data on coral bleaching. The site's interactive GIS-based mapping tool was judged the "best online mapping application" in 2004 in a competition organized by *Directions* Magazine and Microsoft.

In early 2005, shortly after the December 26 tsunami in Southeast Asia, scientists and organizations around the world relied heavily on ReefBase for assessments of environmental damage to coral reefs and impacts on coastal communities. Teams organized by ReefBase's partner institutions conducted post-tsunami field observations. The findings, documented in more than 170 papers along with related photos and interactive maps, heavily informed a comprehensive status report prepared by the Global Coral Reef Monitoring Network.

Also in 2005, ReefBase furthered its efforts to beef up socioeconomic survey data available on the site by working with NOAA and the Managed Marine Area Network to develop appropriate database systems and related protocols for incorporating such information. Another initiative that will expand ReefBase's utility is adding a portal for centralized access to information relevant to the management of coral reef fisheries. Guidelines for the portal design framework and content were discussed at a December workshop in Nouméa, New Caledonia, that was held by WorldFish and the Secretariat of the Pacific Community with funding from the MacArthur Foundation.

Other content improvements included scanning and compiling all the scientific papers from the past eight International Coral Reef Symposia. The proceedings of these meetings, which are held every four years, provide one of the most authoritative and comprehensive pictures of coral reefs and issues affecting them. In late 2005, ReefBase began revamping features of the site to improve navigation and refine the available information. The number of users was on track to break the 10,000 mark in 2006.





Breeding Program Builds Better Fish for Added Benefits

Selective breeding of cattle and other livestock has long been practiced to improve quality and productivity. Yet applying such techniques to develop better breeds of tropical finfish – which make up about 90 percent of all global aquaculture production — is a relatively new phenomenon, introduced only in the last three decades. As a pioneer in these efforts, WorldFish has given developing countries better strains of tilapia, carp and other fish staples that feed people more reliably and are easier for farmers to produce.

The Center's influence has been felt widely in the transfer of fish-breeding technology and in the growth of national fish-breeding programs in Asian, Pacific, African and South American countries. In Asia alone, a modified strain of Nile tilapia *(Oreochromis niloticus)* developed in WorldFish's Genetic Improvement of Farmed Tilapia (GIFT) program is now being grown in 13 countries. An impact study by the Asian Development Bank found that in the four countries it surveyed (Bangladesh, the Philippines, Thailand and Vietnam), GIFT and GIFT-derived strains accounted for 68 percent of total tilapia seed produced in 2003.

GIFT fish are bred specially to help meet the nutritional and income needs of resource-poor farmers and their families. Developed in a decade of research by WorldFish scientists and their collaborators, GIFT tilapia grows 30 to 60 percent faster than other strains and can reach market weight at up to 30 percent lower production costs. These attributes mean higher profits, as well as better food security, for small-scale rural producers.

The selective-breeding technology that produced WorldFish's GIFT tilapia draws on naturally occurring genetic variation in species. Today, the methods are being used in 15 countries to improve a variety of fish species. Six Asian countries, for example, have been working to develop and disseminate genetically improved strains of commercially important carps (including silver barb in Bangladesh and Thailand, rohu in India, and common carp in China and Vietnam). Continuous improvement of the GIFT tilapia led to 15 percent gains in growth per generation over five generations; the response in rohu carp has been 17 percent increased growth per generation over three generations.

Egypt, Cote D'Ivoire, Malawi and Ghana are using the selective-breeding techniques to develop tilapia, catfish and other fish species with superior growth and survival traits. Additional countries in Africa also are eager to adopt the GIFT technology, which was recognized by global technology leaders in 2005 as a "breakthrough" achievement that benefits humanity by helping the rural poor improve their quality of life (see p. 9).

The International Network on Genetics in Aquaculture (INGA) has played a major role in disseminating the GIFT technology, exchanging germplasm and training scientists from developing countries in

applied fish breeding and genetics. Building collaborative linkages to establish and strengthen fish genetic improvement programs in its 13 member countries is another mission of INGA, which was founded in 1993 and is coordinated by WorldFish.

In September 2005, WorldFish and the China Academy of Fisheries organized a major workshop in Shanghai to consider strategies for expanding the development and dissemination of improved fish breeds in INGA's member countries. "While significant progress has been achieved, the member countries are now at a critical stage of their breeding programs, needing guidance with regard to their future directions," said Dr. Raul Ponzoni, head of WorldFish's genetic improvement research program. Such assistance, he added, is critical to ensure that the gains from research and development are sustained, and that improved fish strains are disseminated effectively so that the targeted end users obtain the maximum benefits.

The discussions in Shanghai focused on the requirements for effective implementation of fish genetic improvement and dissemination programs; the current status of such programs in INGA-affiliated countries; and constraints to further progress. An important outcome of the workshop was the drafting of country-specific action plans for genetic improvement of selected species.

Customized programs are needed, Dr. Ponzoni explained, to address the particular priorities, conditions and resources of different countries. Production systems, for example, vary widely, as do environmental conditions, preferences for certain fish species, the availability of stock and institutional capacity, among other things. "We have to make sure that traits we improve are those of importance in the actual production system," Dr. Ponzoni said.

Passing the Taste Test

Faster growth, stress and disease resistance, cold water tolerance and greater feed efficiency – these are among the desirable traits that scientists seek to enhance in fish genetic improvement programs to boost productivity and farmers' return on investment. At the same time, good flesh quality and flavor are essential for new strains to gain widespread acceptance.

Regular taste tests have been an integral part of WorldFish's program to develop genetically improved tilapia for low-input fish farming. In April 2005, the Center's staff at headquarters in Penang participated in the latest round of blind taste tests at a special lunch in the cafeteria. The taste testers sampled fillets of GIFT tilapia and, for comparison, of popular and commonly available red tilapia. The GIFT fish had been grown at a privately run farm in Malaysia before being shipped to WorldFish headquarters in Penang, where they were reared in tanks for three months until they reached about 400 grams.

The GIFT and red tilapia entrées – prepared sweet-and-sour style – were rated for their flavor and flesh quality (specifically, in regard to smell, general appearance, color, texture and juiciness). Overall, the lunchers reported no major detectable differences in the taste and quality of the GIFT tilapia and the red tilapia. "Delicately flavored" and "not too oily" were among the favorable responses. (In an earlier taste test, the culinary judges had indicated a preference for the texture of the GIFT fish compared with that of red tilapia.)

Dr. Raul Ponzoni, a WorldFish geneticist who organized the taste tests, said the results indicate that selective improvement of the GIFT tilapia "has not resulted in undesirable effects on flesh quality." Besides being hardy and fast-growing, he noted, the GIFT tilapia "has an eating quality at least as good as that of red tilapia."

Benefits of Coral Reefs Tapped Through Eco-Friendly Methods

World trade in aquarium fish is big business, and most of the stock is obtained from tropical seas in developing countries. But there is growing concern that escalating demand could irreparably harm coral reefs by subjecting them to over-harvesting and destructive methods of capture. WorldFish research in the Solomon Islands is addressing the problem by developing new, environmentally friendly ways of producing reef organisms for export.

While the islands' remote location has left the region's reefs relatively undisturbed — the Solomon Islands has been designated a biodiversity "hotspot" – the isolation poses major problems for rural families because jobs are scarce. The country is desperate for economic development after years of civil war, and exploiting readily available marine resources is a logical avenue. With the help of researchers, the residents of several villages are finding that sustainable methods of cultivation can offer a good means of livelihood, while protecting the region's reefs.

Traditionally, aquarium-bound reef fish and invertebrates are captured at a mature stage, often through harmful practices such as the use of dynamite and poisons. The alternative harvesting approach developed by the WorldFish scientists entails capturing cleaner shrimp, spiny lobsters and other specimens early in their life cycles, when a normally high rate of mortality would otherwise occur, and then rearing them to a size suitable for the aquarium trade. They can be collected at a distance from reefs, thereby averting coral breakage and other damage.

Most reef organisms, after they hatch from eggs, spend several weeks or months floating amid plankton in the water column. Eventually they return to the reefs to settle and grow. These returning "settlers" are plentiful at first, but undergo a high rate of death from predation and other natural causes. In the WorldFish project, villagers retrieve the tiny marine organisms at the "pre-settler" stage, which does not affect natural replenishment of the fish populations.

The research, which has been supported by Australia, New Zealand and the Solomon Islands, began several years ago near Gizo, in the Western Province of the Solomon Islands. First, scientists had to determine how, where and when high-value marine species could be retrieved as settling juveniles. Next, they designed and tested locally appropriate methods for capturing and culturing individual specimens in good condition. Crest nets were specially adapted for harvesting cleaner shrimp at low tide. Spiny lobsters (known as puerulus) are captured at a late larval stage in coconut-log segments that have been drilled with holes and placed near reefs. Both methods have minimal environmental impact.

Related work in the region has led to the development of sustainable aquaculture techniques for the production of other aquarium products, including giant clams and corals. Together, the projects have demonstrated that villagers can create profitable artisanal fisheries for the cultivation of several high-value marine species that are popular for home aquariums.

In the Solomon Islands project, research results indicate that a single family could operate an economically viable small business by cultivating 150 marine specimens a month. Villagers from four islands have attended workshops and training sessions to learn about this economic opportunity, and the technology is being transferred to other sites in the Pacific.

Exporters say they're keen to obtain more aquarium stock from suppliers who are using the eco-friendly approach because it produces specimens that are more accustomed to being handled and hand fed, which increases their survival and eases the adjustment to home aquariums. The environmental benefits of the approach are potentially widespread because 75 percent of the world's coral reefs are in developing countries where villagers' dependence on extractive industries for livelihoods is putting many reefs at risk.

Spiny lobsters held by relative of Maraki Arobaio

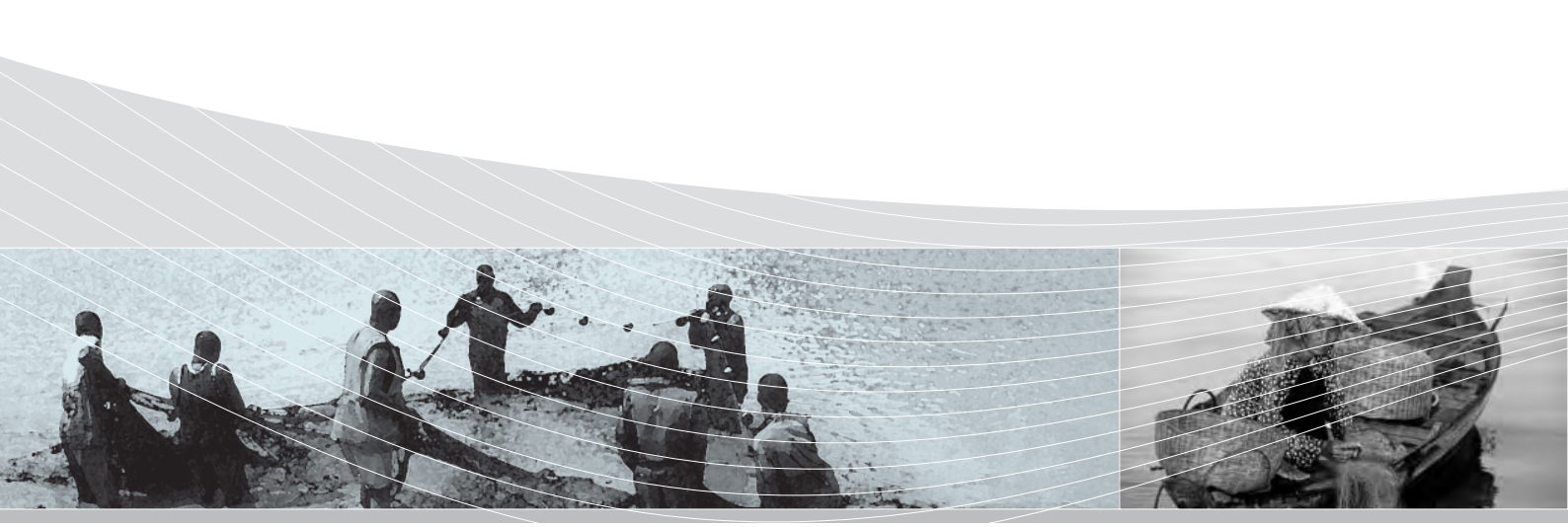
"Farming" in the Pacific

When Maraki Arobaio sets off for his "farm," he hops into his family's dugout canoe. His destination is an uninhabited island not far from his small village near Gizo, in the Western Province of the Solomon Islands. There, he produces banded shrimp and spiny lobsters that sell briskly to traders who supply world aquarium markets. Mr. Arobaio was one of the first people in the area to embrace environmentally sound cultivation methods developed by WorldFish researchers.

His "farm" is a 5-by-3-meter area of shallow water near shore, where crest nets are anchored with wooden supports. Mr. Arobaio collects the shrimp and lobsters in these nets and in specially fashioned pieces of coconut logs placed in a neighboring lagoon.

He camps out at the site when the tide and weather are suitable for working the crest nets. He uses recycled 500-milliliter clear plastic drink bottles to individually culture the banded shrimp, which fight to the death when grown en masse. The lobsters are placed among coral rock in buckets with mesh inserts to facilitate water flow. Each day, Mr. Arobaio cleans the containers and feeds the animals until they have reached export size.

Each specimen brings the equivalent of about US$1. Producing up to 300 specimens a month, Mr. Arobaio earns an income ten times the average wage in rural areas of the Solomon Islands. His wife, children, brother and other family members help out, and the enterprise is doing so well that two other men from the village have joined them.



Helping Hand Strengthens Cambodian Fisheries Institute

Inland fisheries in Cambodia produce an estimated 77 percent of the country's total fish production, and are the main source of food and livelihoods for the rural poor. Nearly 70 percent of all the animal protein that Cambodians consume comes from fish and other aquatic resources. Millions derive a living from fish-related activities.

Over the last decade, however, Cambodia's fisheries became increasingly threatened from pressures including over-fishing, destructive fishing practices, habitat pollution related to urbanization and industrial growth, and the expansion of agriculture. Conflicts over access to fisheries and their resources have risen. Addressing these problems has been difficult because of weak governance structures.

Beginning in 2003, the WorldFish Center provided a two-phase program of technical assistance to help Cambodia better manage its fish resources. The project, which was funded by the Asian Development Bank and managed through WorldFish's regional office in Phnom Penh, was designed to improve the operations of the Inland Fisheries Research and Development Institute (IFReDI).

The Kingdom of Cambodia established IFReDI in October 2002 to provide scientific information needed to support decisions aimed at sustainable development of the country's inland fisheries sector. Under the 18-month program of technical assistance, which was completed in January 2006, IFReDI staff honed skills in institute management, biological and socioeconomic research, technology transfer and policy development. A variety of teaching approaches was used to provide knowledge and experience in related areas such as the preparation and dissemination of research results, international standards of budgeting and accounting, library and online operations, human resource development and property management.

The timing of the project coincided with the adoption of government laws and policy reforms intended to ensure that "Cambodia and its people are able to enjoy sustainable social and economic benefits from the exploitation and farming of living aquatic resources," as envisioned in the country's Fisheries Sector Policy. Included in the reforms are measures, approved in May 2005, that give communities greater control over local fisheries.

To help support the realization of that goal, the recently completed second phase of the technical assistance program emphasized "the linking of research to practice." As part of the training activities, IFReDI staff interacted regularly with fishers and other villagers in provinces surrounding the Tonle Sap Lake. The most intensively fished lake in the world, Tonle Sap supplies 60 percent of Cambodia's inland fish production, and is directly important to the welfare of more than a million people.

A related study by IFReDI scientists and their international advisers, *Socioeconomic and Livelihood Values of the Tonle Sap Lake Fisheries,* offered the first synopsis of how heavily dependent the rural people in the region are on the lake and its resources for food and income. A key message from the findings was the need for policymakers to address the issue of secure resource access by the rural poor in efforts to achieve sustainable management of Tonle Sap Lake and its aquatic resources.

Other major products generated by the project included a two-volume set of biological reviews on

20 commercially important fish species in Cambodia; refinements of the BayFish-Tonle Sap modeling tool and instructions for its use, published as a CD-ROM; and a simple field guide for identifying key catfish species in Cambodia. In addition, several policy briefs examined social, economic and ecological implications of recently issued government directives on community fisheries.

A culminating activity of the project was a national conference, "Prioritizing Fisheries for Cambodia's National Development and Community Aspirations," held in Sihanoukville in February 2006. The participants proposed recommendations for the sustainable development of Cambodia's fishery resources, which were subsequently submitted to the Council of Ministers and Parliament for input into policy making and legislation.

Among the final recommendations of the technical assistance project were proposed changes in IFReDI's governance structure to give the institute greater autonomy and flexibility in dealing with its various constituencies and make operations more transparent. The proposed changes were approved and implemented soon after the project ended.

Bountiful Mekong Region

Inland fisheries in Cambodia and the wider Mekong area are exceptionally important by global standards, with Cambodian fisheries the most intensive worldwide in terms of catch per person. Per-capita fish consumption in the Mekong region is the highest in the world, with fish and other aquatic animals providing poor rural families with 70 percent or more of the protein in their diet.

Despite the regional importance of fish as a food staple, only about 12 percent comes from aquaculture. "At the moment, it is wild [aquatic] resources, rather than aquaculture, that provide food to millions in the region," said Dr. Eric Baran, a WorldFish scientist based in the Center's Phnom Penh office. In his 2005 synopsis report, *Cambodian Inland Fisheries: Facts, Figures and Context,* Dr. Baran said fisheries priorities in the region should focus most heavily on protecting and optimizing natural aquatic resources, which are under threat particularly from encroaching development and over-fishing.

"That's not to say that aquaculture will not have a significant role in the future," Dr. Baran explained. "But with 96 percent of aquatic resources in Cambodia being wild, it will take at least a decade before the situation turns in favor of aquaculture."

In the meantime, he said, slowing down the decline of fisheries in the region is crucial to avoid disrupting the natural supply of food to the poor. In his report, Dr. Baran called for a four-part strategy to achieve that through:

- better integration of the value of natural and aquatic resources in policies;
- actual protection of wild resources and control of fishing activities;
- promotion and development of an aquaculture sector independent of capture fish supply; and
- improved land and water management through institutional initiatives.

Protecting inland fisheries in the region is also important from an ecological standpoint. The entire Mekong River system is among the top three rivers in the world in terms of overall aquatic biodiversity, surpassed only by the Amazon and the Zaire. In Cambodia alone, 847 species have been recorded, including 477 kinds of freshwater fishes.

Empowered Farmers Boost Fish Production in Bangladesh

Despite strides in poverty reduction over the past decade, Bangladesh remains one of the world's poorest and least developed countries. A third of its 140 million people live below the poverty line, and many are landless. With a large part of the country covered by floodplains, rivers and other interior wetlands, fish production is vitally important for food and livelihoods. It is also a major sector of the national economy, accounting for 5 percent of GDP and 6 percent of export earnings.

For three decades, Bangladesh has been a dynamic laboratory for the development and testing of transferable aquaculture technologies by WorldFish and its predecessor organization. Research done collaboratively with the Bangladesh Fisheries Research Institute and numerous other partners has addressed many aspects of small-scale aquaculture, from the improvement of native fish strains to the development of participatory methods for managing inland fisheries. Training in marketing, distribution and other business facets of fish production is also being provided to support the Government of Bangladesh's promotion of enterprise development among rural fish farmers.

Projects aimed at helping farmers acquire the skills needed to increase fish yields from seasonally flooded rice fields, backyard ponds, local ditches and other waterbodies have paid big dividends in terms of improved family welfare. Women in Bangladesh, who have few economic opportunities, have been enthusiastic adoptees of WorldFish's innovative technologies; it is estimated that 60 percent of all the country's small-scale fish producers today are women.

Scores of local NGOs have played an indispensable role in disseminating the techniques in rural Bangladesh. Under a five-year project funded by the U.S. Agency for International Development and completed in 2005, hundreds of NGO staff members and extension workers who were trained in improved aquaculture methods held more than 50,000 demonstrations for large numbers of farmers. Production record books for 2003 showed that farmers who benefited from the training courses increased fish yields in ponds and rice fields by three times or more over harvest levels achieved before the project began.

According to a WorldFish analysis, farmers in Bangladesh who integrated carp production into rice farming have not only increased fish yields but also increased rice production by 10 percent, while reducing the cost of rice farming by 10 percent. Moreover, the positive results were achieved with limited use of pesticides and insecticides.

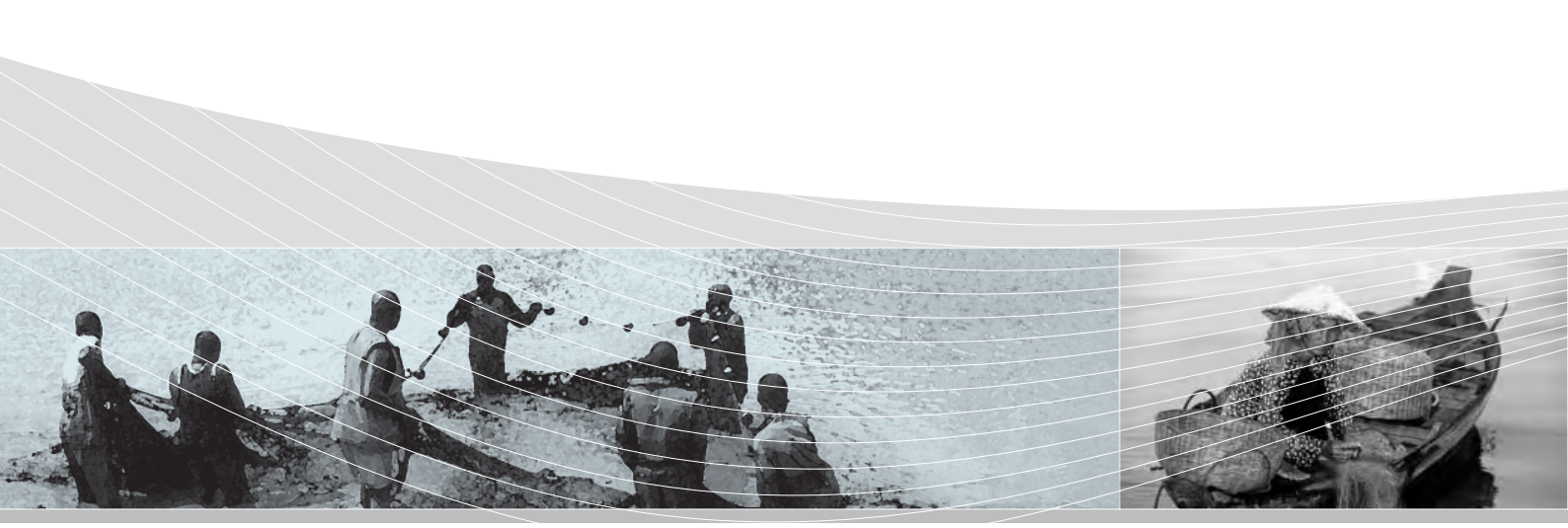
Bangladesh has also been a major field site for the development of institutional mechanisms for local management of community-based fisheries. The goal is to empower communities by giving them the means to make informed and appropriate decisions on how the fisheries they depend on day to day are to be used, and the aquatic resources safeguarded for ongoing productivity.

There is strong interest in this research as many national governments move to decentralize control over fisheries and other natural resources under strategies to reduce poverty and reverse environmental degradation. Empowering farmers and fishers is a lengthy and complicated process because natural resource management in general is complex, involving an interplay of issues related to ownership and access, unclear or contradictory institutional frameworks, different community characteristics and other factors. While no single model can work for every location, WorldFish's research in Bangladesh offers some of the most complete lessons so far available on establishing and sustaining appropriate governance structures capable of achieving sustainable fish production, more equitable access and environmental conservation.

WorldFish has been investigating a variety of different approaches to community-based fisheries management in Bangladesh for more than a decade. The U.K. Department for International Development (DFID) has been one of the chief supporters of this work; altogether, funders and partners, representing a diverse array of skills, number more than 50.

A two-phase collaborative research project on community-based fisheries management in Bangladesh that was launched in 1994 has been so successful that the CGIAR called it an "eminently replicable model for contemporary rural development." The results show what highly effective stewards rural people can be when given the know-how to manage local fisheries for sustainable production and conservation.

Under the project, 30,000 households in Bangladesh formed management committees responsible for governing the use of 110 open-water fisheries. Legal, financial and technical advice and assistance came from local and national NGOs. On-the-ground results were remarkable. The management committees implemented various measures aimed at boosting fish production and restoring degraded habitats.



In nearly half the waterbodies, fish sanctuaries were established; other initiatives included voluntary freezes on fishing during breeding season and restocking of depleted waters. When results were assessed in 2003, researchers found that fish production has risen significantly, by up to six-fold, and in some cases the revitalization of endangered species increased local fish diversity by as much as 30 percent.

Participatory management models emerging from this and similar projects are being examined for their applicability to fish-dependent communities in other countries. The International Fund for Agricultural Development, for example, is helping to fund the transfer of knowledge from the work in Bangladesh to fisheries communities in Vietnam. Can Tho University and the provincial Department of Agriculture and Rural Development are implementing the approaches in An Giang province, to support the regional government's promotion of fish sanctuaries.

Fish From Rice Fields

With many mouths to help feed, Shafiqual Islam is well practiced in rice cultivation. His extended family in a remote village of Bangladesh's Mymensingh District numbers 13.

In 2002, Mr. Islam was enthusiastic about the prospect of farming more profitably when he enrolled in a local aquaculture training course offered by the Social Association for Rural Advancement (SARA), an NGO. In the course, he learned basic techniques for raising fish in his rice field, and diversifying even further by growing fruits and vegetables on dikes surrounding the field.

Mr. Islam began his new enterprise by digging a small ditch in a corner of his farm plot, which is roughly a quarter of a hectare. Under the guidance of a field assistant from SARA, he and his brothers planted a high-yielding variety of rice in the field, and gourds and vegetables on the dikes. When the rice stalks were about a month old, they stocked the rice field with fingerlings of rohu, katla, common carp, silver carp and sharputhi.

Three months later, the leafy vegetables and gourds were ready for harvesting. Mr. Islam used some to feed his family; the rest he sold at market. As an unexpected bonus, the diversified method of farming even increased the rice yield, with Mr. Islam and his brothers harvesting 25 percent more than in previous years.

In June 2003, they were ready to reap their first fish "crop." Even after the added costs of fish production and crop diversification were factored in, Mr. Islam's net profit in 2003 jumped considerably from previous years – a delightful bounty, and the foundation of a much brighter future.

Low-Value "Trash Fish" Get New Respect in Asia

For many decades, certain categories of fish had little economic value because of their small size, poor quality or limited appeal to consumers. Today, however, these so-called "trash fish" are rapidly gaining favor, especially as overall stocks of fish decline.

Efforts to manage coastal fisheries for sustainable production requires scientific knowledge of trash fish populations and how they are exploited, yet such information has been scarce. A 2005 study led by WorldFish researcher Dr. Ilona Stobutzki has provided some of the first available information on trash fish in Asia, specifically in coastal areas of Thailand and Malaysia.

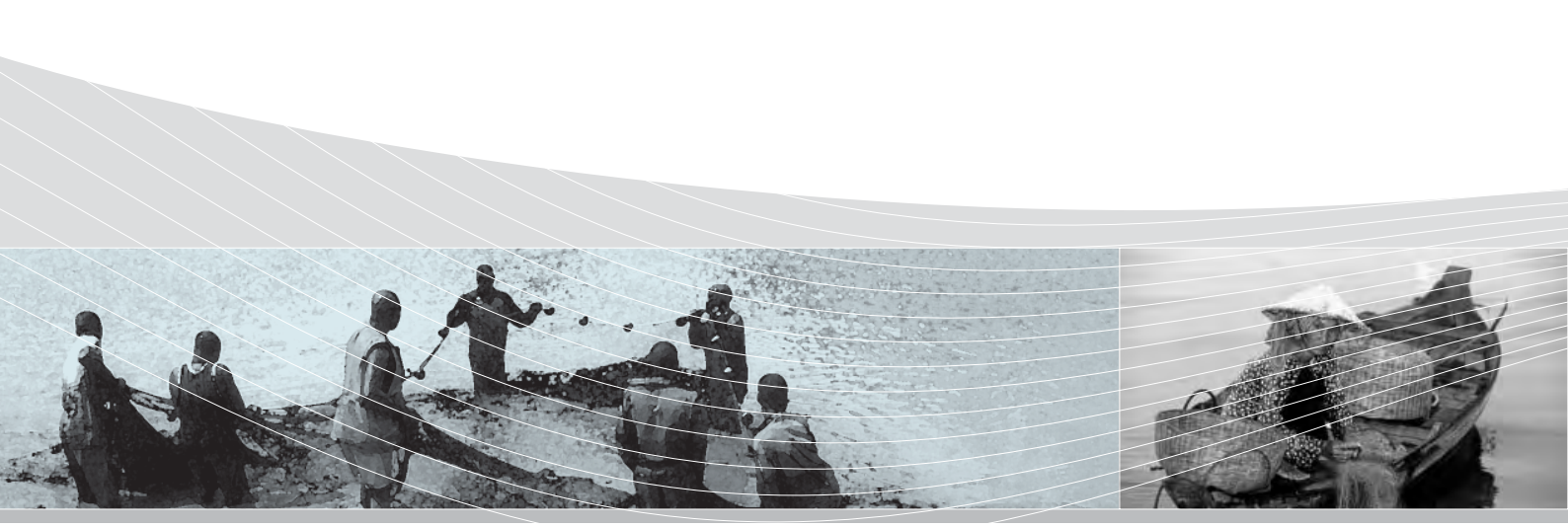
The project, done jointly with Thailand's Southern Marine Fisheries Research and Development Center (SMDEC) and Malaysia's Fisheries Research Institute, was designed to provide insight into how the growing demand for trash fish affects capture fisheries. The researchers looked at the composition, sources, commercial uses and market values of trash fish in the two nations, and the findings were incorporated into a regional synthesis report on trash fish in Asia. Funding for the project came from the U.N. Food and Agriculture Organization. The results were presented in June 2005 at a regional workshop in Hanoi, Vietnam, sponsored by FAO and the Asia-Pacific Fishery Commission (APFIC).

Fish make up a large part of the animal protein in typical Asian diets, and trash fish are increasingly being sought for human consumption as fish in general become more scarce. A large share of the growing demand for trash fish, however, comes from the region's burgeoning aquaculture sector, which uses low-value and poor-quality fish, including by-catch from trawling, to feed high-value marine species grown largely for export markets (mainly carnivorous marine fish, crabs and lobsters).

Most Asian countries are promoting large-scale aquaculture to generate foreign exchange and feed their populations. In 2002, Asian countries produced 88 percent of the world's total fish production from aquaculture. "With aquaculture expected to grow steadily in Asia and other parts of the world, the pressure on trash fish populations will intensify," said Dr. Stobutzki.

The trash fish study builds on earlier WorldFish analyses of coastal aquatic resources in eight Asian countries (Bangladesh, India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand and Vietnam). The analyses, prepared under a four-year Asian Development Bank project, assessed changing trends in fish supply by using data collected in trawl surveys from the 1920s to the present. The findings pointed to an alarming decline in fish stocks overall, most dramatically in the Gulf of Thailand and off the east coast of Malaysia. The analyses also showed that as the relative abundance of larger, more valuable species has fallen sharply, there has been a proportionate increase in catches of smaller, less valuable species.

"Given the general widespread over-fishing and over-capacity in the region, this should raise concern for trash fish species," Dr. Stobutzki and her colleagues warned in the new study. It revealed that of 96 families of trash fish identified in Asian waters, many families have decreased heavily in



relative abundance. In the Gulf of Thailand, for example, 21 of the 22 trash fish families that were examined had significant declines (the exception being whitings). A few families of trash fish in the region, including cardinal fishes, cornet fishes, lefteye flounders and moon fishes, were stable or declining at slower rates.

The study also indicated that the composition of trash fish populations has changed through time as new markets have developed. Among these additional markets are the production of livestock feeds and value-added products such as fish sauce and surimi.

As demand for trash fish increases on a number of fronts, Asian countries face the challenging task of deciding how to manage their trash fish populations to balance social and economic benefits associated with different patterns of harvesting and use. Today, the kind of information needed to assess those tradeoffs is still woefully inadequate, the researchers said.

Among their conclusions, the researchers recommended that the aquaculture sector shift from its heavy reliance on trash fish as fish food. "These aquaculture farms should be encouraged to move towards more efficient feeding techniques," they urged. Currently, the report noted, it takes 5 kilograms of trash fish to produce one kilogram of fish from aquaculture. Moreover, aquaculture farms tend to demand higher quality trash fish, which could be used instead for direct human consumption.

FiRST and TrawlBase for Fisheries Analysis

Fisheries managers in Asian nations are benefiting today from a valuable assessment tool called FiRST, which was developed by WorldFish under a project sponsored in the late 1990s by the Asia Development Bank. It was undertaken to help developing countries acquire the information they needed to safeguard coastal fish stocks.

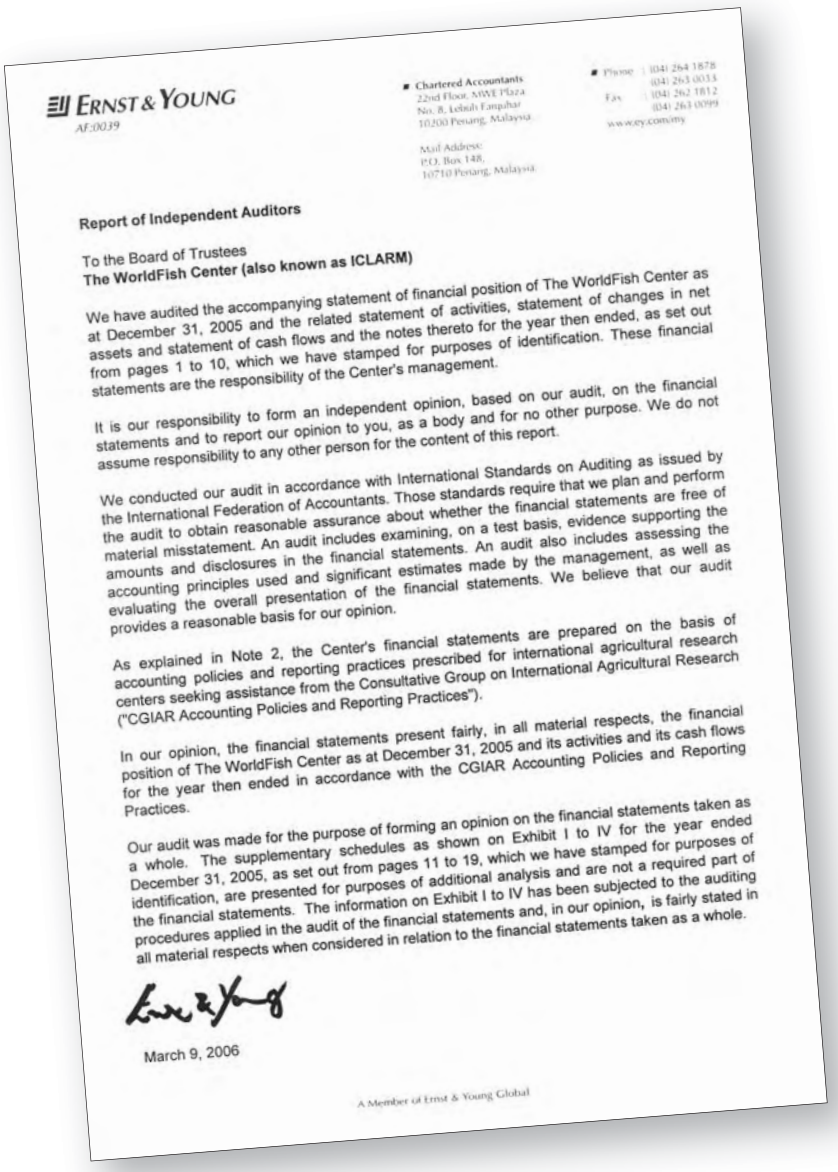
FiRST— shorthand for Fisheries Resources Information System and Tools — is a software system for the storage and analysis of data from trawl surveys conducted in Asian waters since the 1920s (TrawlBase). The data make it possible to assess coastal fish stocks and related ecological conditions as a foundation for policies aimed at putting Asian fisheries on a more sustainable track.

In Asia, as in many parts of the world, the output of capture fisheries is leveling off or declining. This is a critical issue because fish are important to food security, employment and income in the region. Providing from 25 percent to 70 percent of the animal protein intake of Asians, fish are a particularly important protein source for people in poor coastal communities. Given the rapid population growth and economic development in Asia, managing fish stocks for long-term productivity is vital.

FiRST has been used to clarify the causes and rates of ecological change in Asian fisheries, and to demonstrate achievable goals for the restoration and management of coastal ecosystems. Analyses using the TrawlBase historical data, for example, indicated that resource biomass has declined to less than 10 percent in some areas of Asia over the past eight decades.

The current version of FiRST contains trawl survey data from more than 20,000 hauls across the eight partner countries (India, Indonesia, Malaysia, Bangladesh, the Philippines, Sri Lanka, Thailand and Vietnam), along with published data from Myanmar, Pakistan and Singapore. FiRST can be used to calculate exploitation ratios for the most abundant species, examine species assemblage patterns, construct preliminary ecosystem models for selected regions and do bioeconomic modeling of fisheries.

ANNEXES



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Report of Independent Auditors

To the Board of Trustees
The WorldFish Center (also known as ICLARM)

We have audited the accompanying statement of financial position of The WorldFish Center as at December 31, 2005 and the related statement of activities, statement of changes in net assets and statement of cash flows and the notes thereto for the year then ended, as set out from pages 1 to 10, which we have stamped for purposes of identification. These financial statements are the responsibility of the Center's management.

It is our responsibility to form an independent opinion, based on our audit, on the financial statements and to report our opinion to you, as a body and for no other purpose. We do not assume responsibility to any other person for the content of this report.

We conducted our audit in accordance with International Standards on Auditing as issued by the International Federation of Accountants. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by the management, as well as evaluating the overall presentation of the financial statements. We believe that our audit provides a reasonable basis for our opinion.

As explained in Note 2, the Center's financial statements are prepared on the basis of accounting policies and reporting practices prescribed for international agricultural research centers seeking assistance from the Consultative Group on International Agricultural Research ("CGIAR Accounting Policies and Reporting Practices").

In our opinion, the financial statements present fairly, in all material respects, the financial position of The WorldFish Center as at December 31, 2005 and its activities and its cash flows for the year then ended in accordance with the CGIAR Accounting Policies and Reporting Practices.

Our audit was made for the purpose of forming an opinion on the financial statements taken as a whole. The supplementary schedules as shown on Exhibit I to IV for the year ended December 31, 2005, as set out from pages 11 to 19, which we have stamped for purposes of identification, are presented for purposes of additional analysis and are not a required part of the financial statements. The information on Exhibit I to IV has been subjected to the auditing procedures applied in the audit of the financial statements and, in our opinion, is fairly stated in all material respects when considered in relation to the financial statements taken as a whole.

March 9, 2006

A Member of Ernst & Young Global

FINANCIAL SUMMARY

WorldFish Center seeks to ensure that its operating service strategy is built on a client-oriented culture dedicated to delivering carefully targeted services to meet the broad range of needs of its internal and external clients. WorldFish Center adopts the cost-conscious approach and ensures the delivery of high-value services at costs comparable to, or less than, the market. Senior management, the Board, the internal auditor and the external auditor Ernst & Young provide the financial management and oversight of the Center.

The Center's total income in 2005 was US$13.45 million, and level of income in 2004 was US$15.03 million. This income was distributed as follows (in millions)

Total Income

Unrestricted	US$ 7.27
Restricted	US$ 6.03
Other Income	US$ 0.15

The Statement of Financial Position, the Statement of Activities and the Statement of Cash Flows summarize WorldFish Center's finances in 2005. These Financial Statements are presented below. A complete, audited financial statement by Ernst & Young is published separately and can be requested from the Director General of Corporate Services.

STATEMENT OF FINANCIAL POSITION
(US Dollar '000)

		As at 31 Dec 2005	As at 31 Dec 2004
ASSETS			
CURRENT ASSETS			
Cash and cash equivalents	3	4,101	7,162
Investments	3	8,452	7,061
Accounts receivable			
Donors	4	2,643	2,135
Employees		102	109
Other CGIAR Centers		37	35
Others	5	498	1,120
Other current assets	6	63	405
Total current assets		15,896	18,027
NON-CURRENT ASSETS			
Property and equipment,net	7	652	366
Other assets	8	130	104
TOTAL ASSETS		16,678	18,497
LIABILITIES AND NET ASSETS			
CURRENT LIABILITIES			
Accounts payable			
Donors	9	4,122	3,127
Employees	10	130	107
Other CGIAR Centers		267	208
Others	11	1,313	2,396
Accruals and provisions	12	1,626	1,739
Total current liabilities		7,458	7,577
NON-CURRENT LIABILITIES			
Accounts payable - employees	13	320	333
TOTAL LIABILITIES		7,778	7,910
UNRESTRICTED NET ASSETS	14		
Designated		2,492	2,998
Undesignated		6,408	7,589
TOTAL NET ASSETS		8,900	10,587
TOTAL LIABILITIES AND NET ASSETS		16,678	18,497

STATEMENT OF ACTIVITIES
(US Dollar '000)

	Note	For the Years Ended December 31				
			Restricted		Total	
		Unrestricted	Temporary	Challenge Programs	2005	2004
REVENUES, GAINS AND OTHER SUPPORT						
Grants	Exh. I	7,272	5,498	530	13,300	14,146
Other revenues		146	-	-	146	879
Total revenues, gains and other support		7,418	5,498	530	13,446	15,025
EXPENSES AND LOSSES	Exh. II					
Program-related expenses		5,629	5,498	530	11,657	11,818
Management and general expenses		4,095	-	-	4,095	2,981
Subtotal expenses and losses		9,724	5,498	530	15,752	14,799
Indirect cost recovery		(619)	-	-	(619)	(793)
Total expenses and losses		9,105	5,498	530	15,133	14.006
NET (DEFICIT) / SURPLUS		(1,687)	-	-	(1,687)	1,019
MEMO ITEM						
Operating expenses – by nature of classification						
Personnel costs		4,441	1,872	198	6,511	6,460
Collaborator/Partnership costs		12	1,492	140	1,644	2,485
Supplies and services		3,150	1,469	97	4,716	3,438
Operational travel		1,277	573	95	1,945	1,372
Depreciation		225	92	0	317	251
		9,105	5,498	530	15,133	14,006

STATEMENT OF CASH FLOWS
(US Dollar '000)

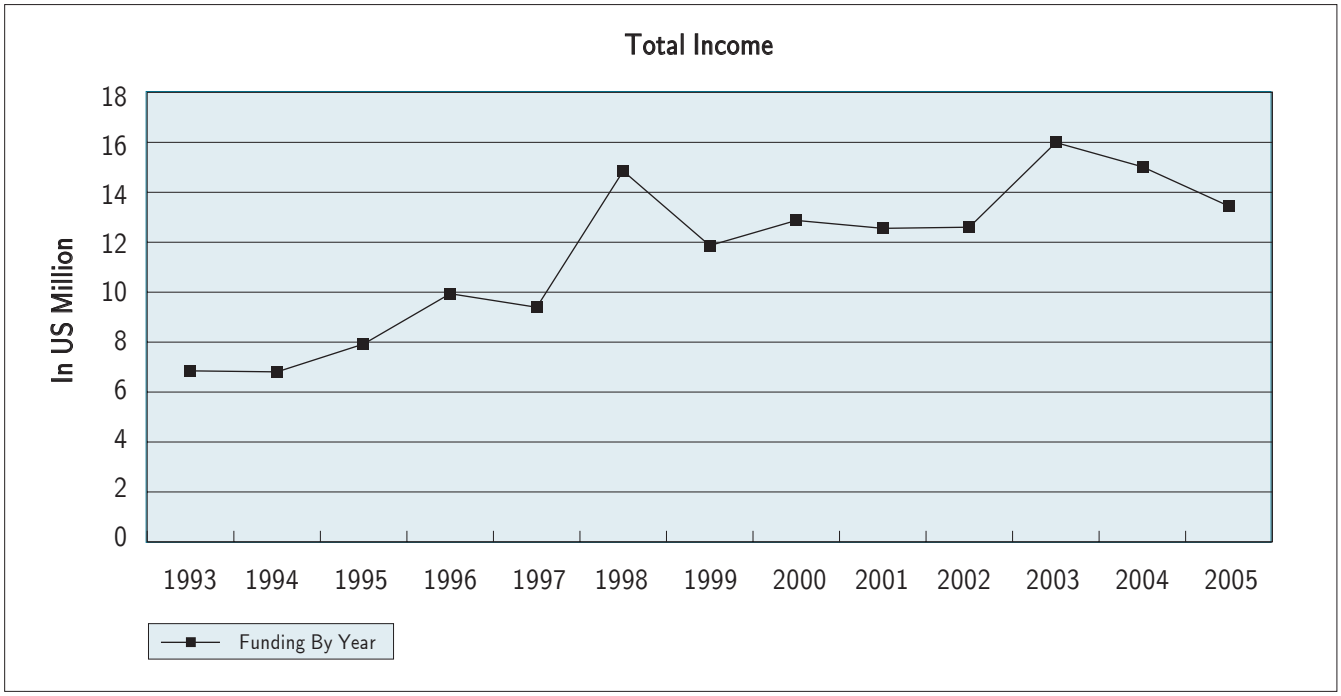
	For the Years Ended December 31 2005	2004
CASH FLOWS FROM OPERATING ACTIVITIES		
Change in net assets	(1,687)	1,019
Adjustments to reconcile change in net assets to net cash (used in) / provided by operating activities		
Depreciation	317	251
Loss / (Gain) on disposal of property and equipment	1	(2)
Decrease / (Increase) in assets		
Accounts receivable	119	1,865
Other current assets	316	(258)
(Decrease) / Increase in liabilities		
Accounts payable	(6)	(755)
Accruals and provisions	(126)	292
Net cash (used in) / provided by operating activities	(1,066)	2,412
CASH FLOWS FROM INVESTING ACTIVITIES		
Acquisition of property and equipment	(604)	(224)
Proceeds from disposal of property and equipment	0	3
Net cash used in investing activities	(604)	(221)
NET (DECREASE) / INCREASE IN CASH AND CASH EQUIVALENTS	(1,670)	2,191
CASH AND CASH EQUIVALENTS		
Beginning of the year	14,223	12,032
End of the year	12,553	14,223

Funding by Year, 1993-2005

('In US 000)	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Funding by year	6.84	6.80	7.92	9.94	9.39	14.86	11.87	12.87	12.56	12.60	16.00	15.03	13.45

Consist of	(restated)												
Grant	6,840.00	6,595.00	7,776.00	9,574.00	9,047.00	14,543.00	11,606.00	12,379.00	12,125.00	12,492.00	14,632.00	14,146.00	13,300.00
Other income		205.00	141.00	361.00	343.00	312.00	259.00	495.00	431.00	110.00	1,365.00	879.00	146.00
	6,840.00	6,800.00	7,917.00	9,935.00	9,390.00	14,855.00	11,865.00	12,874.00	12,556.00	12,602.00	15,997.00	15,025.00	13,446.00

Grant												
Unrestricted	3,285.00	4,293.00	5,793.00	5,630.00	6,772.00	6,139.00	7,014.00	6,346.00	6,046.00	6,625.00	6,476.00	7,272.00
Restricted	3,310.00	3,483.00	3,781.00	3,417.00	7,771.00	5,467.00	5,365.00	5,779.00	6,446.00	8,007.00	7,670.00	6,028.00
	6,595.00	7,776.00	9,574.00	9,047.00	14,543.00	11,606.00	12,379.00	12,125.00	12,492.00	14,632.00	14,146.00	13,300.00



Funding by CGIAR Members (2005)

Unrestricted Support	US$ millions
Europe	
Netherlands	1.3
Norway	0.8
Sweden	0.3
Denmark	0.3
Germany	0.5
United Kingdom (DFID)	0.8
Belgium	0.0
North America	
Canada	0.5
United States	0.8
Pacific Rim	
Australia	0.3
New Zealand (NZAID)	0.2
Japan	0.0
Developing countries	
Egypt, Arab Republic	0.3
International and Regional Organizations	
World Bank	1.0
Others, Multi-donor	0.2
Total for unrestricted support	**7.3**

Restricted Support	US$ millions
Europe	
United Kingdom	2.1
Germany	0.3
Commission of the European Community	0.9
North America	
United States	0.6
Pacific Rim	
Australia	0.4
New Zealand (NZAID)	0.1
International and Regional Organizations	
ADB	0.3
Challenge Program & Comprehensive Assessment	0.6
IFAD	0.1
Ford Foundation	0.1
Others - CGIAR members	0.2
Total for restricted support by CGIAR members	**5.7**

Funding by CGIAR non-members (2005)

	US$ millions
Others - non-CGIAR members	0.3
Total for restricted support by non-CGIAR members	**0.3**
Total for restricted support	**6.0**
Total for funding in 2005	**13.3**

Donors for 2005

Asian Development Bank

Australia (Australian Center for International Agricultural Research; Australian Institute of Marine Sciences)

Canadian International Development Agency

Consultative Group on International Agricultural Research (Challenge Program on Water and Food; System-Wide Initiative on Water Management)

Danish Royal Ministry of Foreign Affairs

Egyptian Ministry of Agriculture and Land Reclamation

European Commission

FishBase Information and Research Group, Inc

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France (Pacific Fund)

Germany (Deutsche Gesellschaft für Technische Zusammenarbeit GmbH; Federal Ministry for Economic Development Cooperation)

Global Environment Facility

Indian Council of Agricultural Research

International Fund for Agricultural Development

International Fund for Agricultural Research

Israel Ministry of Agriculture and Rural Development

Japan (Japan International Cooperation Agency; Ministry of Environment)

MacArthur Foundation

Malaysian Agricultural Research and Development Institute

Mekong River Commission

Netherlands (Ministry of Foreign Affairs; North-South Interdisciplinary Research and Education Fund of Wageningen University and Research Center)

New Caledonia Provinces

New Zealand Agency for International Development

Norwegian Royal Ministry of Foreign Affairs

Organization of Petroleum Exporting Countries Fund for International Development

Oxfam

Philippine Department of Agriculture

Species 2000

Swedish International Development Cooperation Agency

United Kingdom Department for International Development

United Nations (Food and Agriculture Organization; U.N. Environment Program; U.N. Development Program, South-South Cooperation)

United States of America (National Oceanic and Atmospheric Administration; U.S. Agency for International Development)

World Bank

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Australian Mekong Resource Centre
Commonwealth Scientific and Industrial Research Organization
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Greenward Consulting
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Queensland Department of Primary Industries
Queensland University of Technology
University of Sydney
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Association for Community Development
Association for Rural Service and Human Inducement
Banchte Shekha
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Bangladesh Agriculture University
Bangladesh Centre for Advanced Studies
Bangladesh Environmental Lawyers Association
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Bangladesh Rural Advancement Committee (BRAC)
Barendra Advancement Integrated Committee
Bikalpa Unnayan Karmasuchi
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Center for Alleviation of Rural Poverty
Center for Integrated Rural Progress
Center for Natural Resources Studies, DOF
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LUSTRE
Manabik Unnayan Kendra
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Project Peeth
PROSHIKA
Rural Agricultural Social Development Organization
Rural Reconstruction Centre
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Shristy Samaz Kallayan Mohila Sangstha
Shushilan
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Social Association for Rural Advancement
Society for Development Committee
Sunamganj Jonokallan Sangsta
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Department of Fisheries
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Ministry of Agriculture, Forestry and Fisheries
Ministry of Environment
Ministry of Tourism
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National Park and Wild Life Centuaries
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Tonle Sap Biosphere Reserve Secretariat

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L'Organisation pour l'Environnement et le Developpement Durable
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Caribbean Community Fisheries Resources Assessment and Management Program

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Lake Chad Basin Commission (LCBC)

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Chinese Academy of Sciences
Environmental Protection Administration
Freshwater Fisheries Research Center
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Lake Nasser Development Authority
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Fisheries Division
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Finnish Environment Institute

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University of Paul Sabatier
University of Paris

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Hohenheim University
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Water Research Institute

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Hungary
Fish Culture Research Institute

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Icelandic International Development Agency (ICEIDA)

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Central Inland Fisheries Research Institute
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Central Marine Fisheries Research Institute
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National Bureau of Fish Genetic Resources
National Center for Agricultural Economics and Policy Research
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Indonesia
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Bogor Agricultural University
Central Planning Agency – BAPPENAS
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Center for Agricultural Socio-Economic Research
Center for Socio Economic Studies in Agriculture
Center for Soil and Agroclimate Research
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Directorate of Fisheries Resource Management
Directorate General for Capture Fisheries
Directorate General of Aquaculture
Directorate General of Fisheries
District and Provincial Government
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Indonesian Fisheries Socioeconomics Research Network
Indonesian Institute of Mangrove Research
Indonesian Institute of Science – Research Center for Oceanography
Indonesian Network on Coastal Management
Indonesian Seagrass Committee
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Ministry of Marine Affairs and Fisheries
National Development Planning Agency
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Projek Pesisir Lampung (PKSPL – IPM)
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Research Institute for Marine Fisheries
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Tehran University

Israel
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Kiribati
Ministry of Fisheries and Marine Resources Development

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University of York

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U.S. Peace Corps
U.S. Sea Grant College Program

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University of Virgin Islands

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Institute of Fisheries Economics and Planning
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Research Institute for Aquaculture No. 3
Research Institute for Marine Products
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Sub National Institute of Agriculture Planning and Projection
University of Agroforestry
Vietnam Agricultural Science Institute
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Ministry of Agriculture, Food and Fisheries

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Arab Organization for Agricultural Development
Asian Development Bank
Asian Institute of Technology
Delegation Française pour la Communauté du Pacifique
Inland Valley Consortium
Institute of Research for Agricultural Development (IRAD)
International Network on Genetics in Aquaculture (INGA)
Lake Victoria Fisheries Organization
Mekong River Commission (MRC)
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New Partnership for Africa's Development (NEPAD)
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Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)
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Queensland Department of Primary Industries and Fisheries
Regional Organization for the Conservation of the Environment of the Red Sea and the Gulf of Aden
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Secretariat of the Pacific Regional Environment Program (SPREP)
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Southeast Asian Fisheries Development Center (SEAFDEC)
Southeast Asian Regional Center for Graduate Study and Research in Agriculture
Southern Africa Development Community
Technical Advisory Services for Fisheries Products in Asia and the Pacific Region (INFOFISH)
WWF South Pacific Program
WWF Wallacea Bioregion Program

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Agricultural Research for Developing Countries (CIRAD)
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Center for International Forestry Research (CIFOR)
Coral Reef Alliance (CORAL)
Coral Reef Degradation in the Indian Ocean (CORDIO)
Crawford Fund
Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ)
Economic, Social and Cultural Council (ECOSOCC)
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- Admin. Asst./Messenger
Asma Rahman
- Receptionist
Mohammed Anwar Hossain
- Driver
Mohammed Nazrul Islam
- Driver
Mohammed Jahangir Alam
- Driver

Natural Resources Management
Mohammed Golam Mostafa
- Fisheries Resources Scientist
Mohammed Khalilur Rahman
- Research Assistant I
Susmita Choudhury
- Research Assistant I

Policy, Economics and Social Sciences
Ruh Afza Ruhi
- Gender Specialist
Mohammed Ferdous Alam
- Research Coordinator
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Golam Faruque
- Research Associate I
Abdullah-Al Mamun
- Research Associate I
Khondker Murshed-E-Jahan
- Research Associate I
M.H.M Mostafar Rahman
- Research Associate I
Arif Hossain
- Research Assistant I
Khondker M Shameem Kamal
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- Research Assistant I
Mohammed Jahirul Hoque
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Mohammed Shakil Ahmed Khan
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Saiful Islam
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Mohammed Abubaker Siddique
- Research Assistant I
Mahadi Hasan
- Research Assistant I
Mohammed Ferdous Ali
- Research Assistant I
Mohammed Shamim Parvez
- Research Assistant I
Mohammed, Nesaruddin -
Research Assistant I
Kazi Mazbauddin Ahmed
- Field Coordinator/Researcher
Mohammed Akram Hossain
-Field Coordinator/Researcher
Mohammed Nurunnabi
- Field Assistant
Mohammed Abu Taleb Mollah
- Field Assistant
Mohammed Kamrul Islam
- Field Assistant
Mohammed Mirjahan Ali
- Field Assistant
Mozaffar Ahmed Khan
- NGO Coordinator

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Blake D.M. Ratner
- Portfolio Director
Yumiko Kura
- Portfolio Coordinator
Samonn Mith
- Portfolio Associate
Eric Baran
- Research Scientist
San Choeu
- Finance and Admin. Manager
Ratana Noun
- Finance and Admin. Officer
Thida Keat
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Simon Heck
- Portfolio Director
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- Senior Scientist/NRM
Ann Elizabeth Gordon
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- Senior Aquaculture Scientist
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Salah Eldin Mesalhy Aly
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Mohamed Al-Sayed Ahmed
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Nabil Ahmed Ibrahim
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- Library and Info. Supervisor
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- Security Supervisor
Fatehy M. Waheed Salem
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Mohamed Mahmoud Hassan
- Security Driver
Ahmed Abdou Ahmed
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Rezk Fathey Mohamed
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Abdel Hay Hassan El-Sobky
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Seliem Eliwah
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Mahmoud Abdou Mousa
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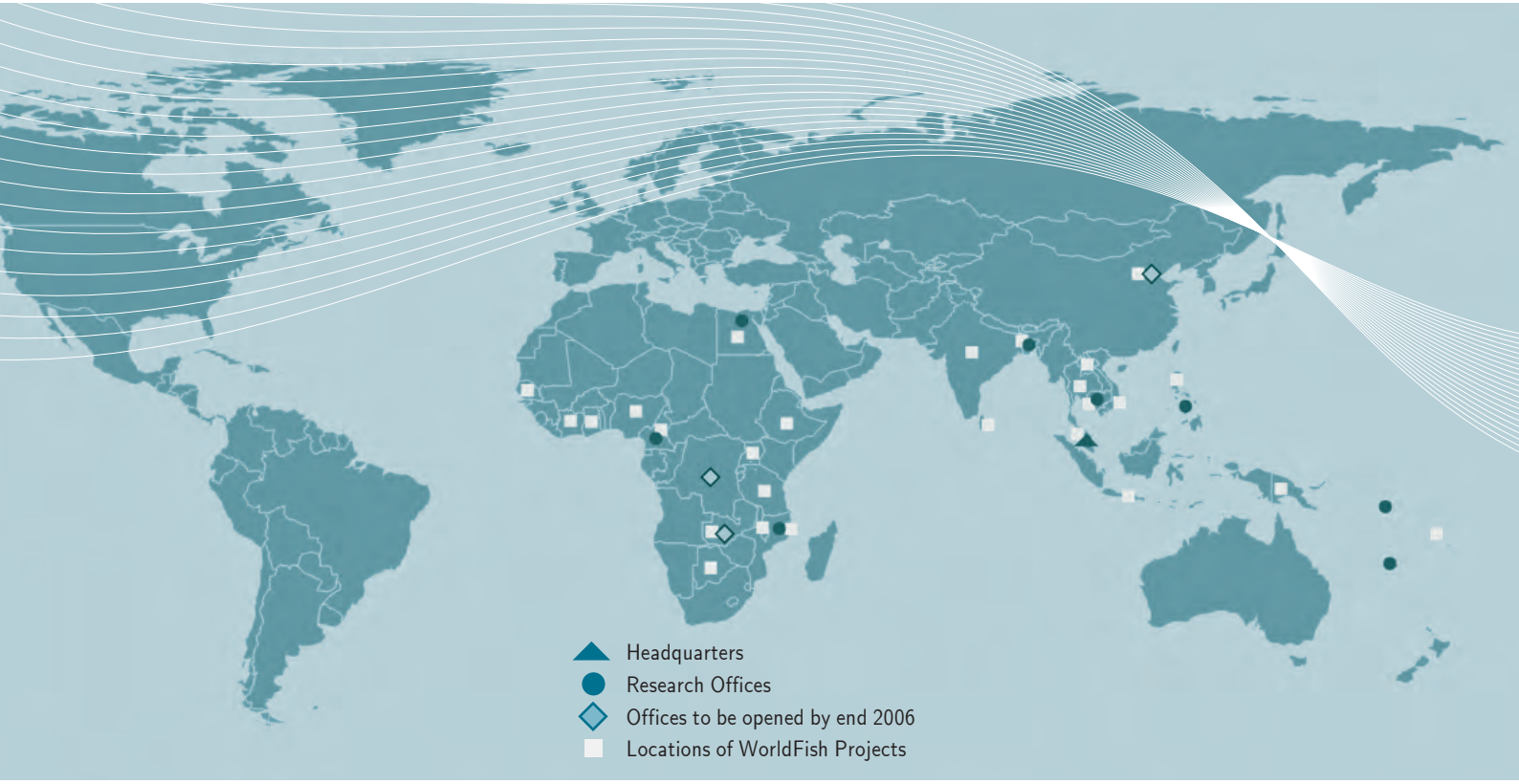

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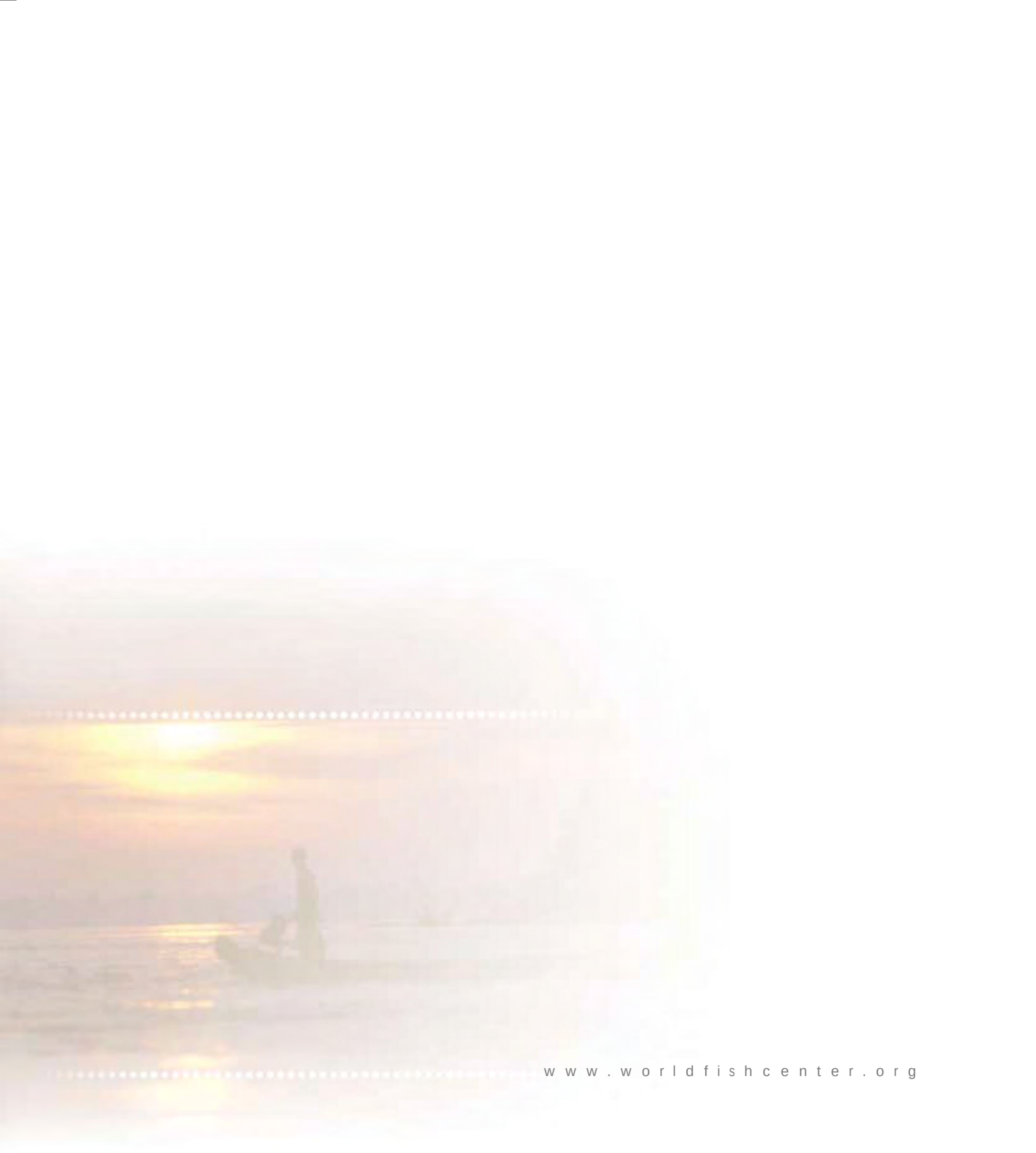

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