A Guide on
SUSTAINABLE FISHERIES MANAGEMENT

2010

USAID-URI Sustainable Coastal Communities and Ecosystems Program (SUCCESS)

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Coastal Resources Center
University of Rhode Island

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Cover Photo: A small-scale fisheries landing site in Bagamoyo District of Tanzania.

Photo Credit: Kathy Castro

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ABOUT THIS GUIDE

GOAL

This Guide provides basic information on how to design programs to reform the capture (also referred to as "wild" fisheries) and aquaculture sectors to ensure sound and effective development that strives for environmental sustainability, economic profitability and social responsibility. Experience has shown that well-designed programs directed at reform of capture fisheries management can contribute to larger development goals. This includes improved governance and rule of law, population and family planning, food security, and sound economic growth.

This Guide attempts to answer:

- Why is reform that focuses on sustainability and responsibility essential?
- What does a manager need to know in order to design, implement, manage, and evaluate capture fisheries programs?
- How do you design activities that will ensure that sustainable development goals are addressed using environmentally responsible good practices?
- What are the recognized best practices for sustainable fisheries?

AUDIENCES

This Guide is intended for a broad audience including Development planners, fisheries managers and multiple stakeholders within the fisheries sector.

CONTENT

This Guide addresses capture fisheries. Much of the capture fisheries discussion focuses on coastal and marine fisheries. However, the approaches and principles presented apply as well to freshwater and inland fisheries found in most of the world's lakes, rivers, and seasonal water bodies. The Guide focuses on nearshore marine and inland fisheries as this segment of the industry tends to employ more people and comprise a larger percentage of the catch—in terms of value and production—in most developing countries. While the emphasis in this Guide is on small-scale fisheries operations, in many cases it is impossible to address problems of the small-scale sector without including the large-scale commercial sector. The Guide's introductory section also emphasizes the important linkages between capture fisheries and other sectors and development initiatives such as biodiversity conservation, economic growth, food security and public health, as well as governance reform that supports participatory democracy and conflict mitigation

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AN OVERVIEW OF FISHERIES

"Fishing" is the capture and removal of fish and other animals–such as clams, oysters, crabs, lobsters, and squid–from the natural environment. It can be considered a form of hunting of wild animals from aquatic environments. Sustained harvests from capture, often referred to as "wild", fisheries depend upon healthy and productive ecological systems to provide these "ecosystem goods." Healthy ecosystems also provide other "ecosystem services" as well—e.g., protecting coasts from storms and providing other products of economic importance globally. Fisheries depend on harvests of natural populations, and as such there are limits on the yields that can be sustainably produced. Yields vary from place to place due to the natural productivity of the aquatic systems. Yields may also vary seasonally and annually as natural conditions change. Over the past decades, wild fisheries have provided an increasing supply of food. At the same time, increases in the global population—especially along coasts—and improvements in harvest technology have also increased humans' capability to exceed the maximum sustained yields from these systems. As most fisheries resources are "open access"—i.e., where anyone can invest and capitalize on their exploitation—overfishing and its associated impacts is an increasing global concern.

In most countries, fisheries production from wild harvests has leveled off or decreased. The reasons include overfishing, poor management, the open access nature of the resources, loss of critical habitats, removal of immature animals, and the use of destructive fishing techniques such as bomb fishing. Ecosystem integrity and productivity has also been compromised by removal of key species in the food chain, pollution from poor land use practices, and the poor quality and quantity of water flowing into wetlands.

In essence, fisheries governance has not kept pace with fishing technologies, nor the increasing numbers of fishers attracted to these "open resources" and "common goods." A key message of this Guide, however, is that it is possible to reverse the decline of individual fisheries. There are an increasing number of examples where local fisheries are being managed wisely and sustainably. These examples show it is possible to improve fisheries productivity, ecosystem health, and ensure more sustainable and profitable livelihoods for the millions of people dependent on fishing. The key is having sound governance structures, proper economic incentives, secure tenure, and access rights. Another message of this Guide is that global and local food security depends upon reversing the decline in fisheries productivity.

THE NEED FOR REFORM

In most developing countries, greater investments are needed to reform fisheries governance, create the enabling conditions, and build the capacity for nations to reduce fishing effort to more sustainable levels. The reasons are several. First is the growing world food crisis, and the fact that fisheries provides much of the global population with a critically important source of high quality animal protein food. Another reason is that capture fisheries continue to provide livelihoods for local populations, and make key contributions to national economies. Ensuring that the fisheries can continue to make these important contributions, however, depends on making major reforms to the sector.

For all the reasons above and more, reform must guide fisheries along a path of sustainability by creating enabling environments and offering incentives that reward good practices. In addition to providing food, jobs, income, and trade as mentioned above, reform in these sectors can also help preserve cultural values over the long term, reduce humanitarian crises, and help nations emerge from conflict and poverty. Better management can also help avoid the continuing collapse of the world's aquatic and marine ecosystems and associated loss of biodiversity in these environments. More, however, remains to be done in reforming capture fisheries sector.

Fishing in marine, coastal, and freshwater ecosystems is the largest extractive use of wildlife in the world. Fisheries products are also the world's most widely traded foods, with commerce dominated by the developing countries (total value of world capture fisheries production in 2004 was US$85 billion). Fisheries are also globally important sources of much-needed high quality animal protein—the primary protein source for one billion people worldwide, and an important part of the diet of many more.

In small-scale fisheries, fishing is a household livelihood where men, women, and even children play roles in cpaturing, processing, and marketing the product.

In spite of fisheries' important role in the national and local economies of many developing countries, the sector is often poorly planned and regulated, inadequately funded, and neglected by all levels of government. Globally, fisheries are frequently overfished and overexploited as a result of weak governance, poor management, perverse subsidies, corruption, and unrestricted access. In addition, destructive fishing practices can rapidly degrade marine ecosystems and contribute to the loss of critical habitats. The declining state of fisheries resources will have disproportionately heavy consequences for developing countries and their poorest members. A recent World Bank study indicates that the fisheries sector is losing an estimated US$50 billion annually in lost revenues due to poor management and from illegal, unreported, and unregulated (IUU) fishing.

Capture fisheries include two sub-sectors: large- and small-scale fisheries. Large-scale industrial fisheries are fleets that can fish both nearshore and into the high seas. Meanwhile, the overwhelming majority of fishers in developing countries are small-scale, often using vessels that are unmotorized and that mainly target nearshore waters. However, both large-scale and small-scale fisheries can overlap in the species

targeted and areas fished, so use conflicts are also common. Both sub-sectors can contribute to overfishing problems.

Issues within the fisheries sector that need urgent attention include concerns of: excess capacity, weak governance, continued poverty within coastal communities, lack of alternative livelihoods, and the impacts of globalization on fisheries trade. Failure to adjust strategies to this new development paradigm has significant social consequences. These include the loss of economic opportunity and food resources for millions of people living in fishing communities, and the loss of national revenues. For instance, Sub-Sahara Africa loses over US$1 billion annually in economic rents from unfair access agreements. This is a region that could significantly increase its food security through better capture fisheries. Failure to reform fisheries will continue the decline of associated ecosystem productivity, biodiversity, and resilience in the face of climate change. These problems will only worsen without concerted efforts by all stakeholders concerned. This includes fishers, their families, the private sector, and governments.

There is a growing suite of proven strategies to address the need for reform and to generate tangible social and economic benefits, and increase biodiversity as well as a growing number of examples where these strategies have been successfully used to establish sustainable fisheries. These include the use of co-management, community-based management, rights-based approaches, and applying proper economic incentives such as secure tenure and property rights to address the governance of common property resources, including fisheries.

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CONTRIBUTIONS TO OTHER SECTORS

Investments in capture fisheries not only benefit that sector, but also directly contribute to the objectives of other development objectives.

BIODIVERSITY

Capture fisheries has been documented as the source of many of the greatest threats to marine and freshwater biodiversity and ecosystems. These include overfishing, destructive fishing, excessive bycatch, and use of non-selective gears. Unsound fishing can contribute to loss of ecosystem health, loss of critical key species or trophic groups from the ecosystem, and loss of ecosystem integrity. This, in turn, can reduce species' resilience to adverse impacts caused by climate change. Promoting more sustainable fishing can directly reduce threats to an ecosystem's biodiversity, while improving fisheries productivity. Fisheries management tools–such as fisheries reserves or no-take areas–can also help conserve and protect aquatic biodiversity. Also making an impact is the increasing emphasis on mitigation of bycatch and on reducing the mortality of protected marine species (sea turtles, seabirds, marine mammals, etc.).

ECONOMIC GROWTH, ENTERPRISE DEVELOPMENT, AND PUBLIC-PRIVATE PARTNERSHIPS

Fisheries and aquaculture offer excellent economic growth opportunities—providing jobs and income for millions of coastal households and international trade at national levels.

One strategy is to take a value chain approach to fisheries—identifying ways to add value at all points in the process from harvest to market, to generate greater revenues for the producer and others along the production chain. A useful place to start with value chains is to conduct a value chain assessment—to identify what are the economic growth and enterprise development opportunities. As part of this process it is always important to consider gender dimensions, especially since women play important roles in the marketing and processing sectors and the opportunities for women-led enterprise development are plentiful.

The fisheries sector is engaging in important public-private sector partnerships to promote improved management and sustainability. For example, seafood buyers–both importers and exporters–are increasingly concerned with maintaining a stable supply of seafood products to the food processing industries and restaurant chains upon which their business survival depends. This has lead to numerous public-private partnerships to promote certification schemes for both farm-raised aquaculture products as well as wild-caught seafood.

GENDER AND MARGINALIZED GROUPS

Those development programs that fully incorporate women and marginalized groups into program design and implementation are more effective and successful. Men, women, and children all play a role in maintaining healthy fisheries and aquaculture enterprises. For this reason, it is important that both genders be considered and consulted within the fisheries and aquaculture planning, policy, and decision-making processes leading to reform. This starts with breaking down what, until recently, have been some long-held misperceptions about men, women, and even children's roles in these sectors.

One long held misperception is that livelihoods in fishing and aquaculture are male-only occupations, and women are involved largely in post-harvest activities only. Recent research, however, estimates that at least 50 million women in developing countries–often with children at their side–work in the fishing and aquaculture industries, performing a wide range of activities from harvest to post-harvest.

The reasons for many of the misperceptions include, but are not limited to:

- A lack of gender-disaggregated data collection and/or analysis
- Barriers to women's participation, access to resources (land, credit), and voice in decision-making
- A tendency for women and children's labor in this sector to be considered as part of their "family" responsibilities vs. as a livelihood
- Women and children's activities in fisheries and aquaculture tend to be less organized and visible

Women are key actors in reef gleaning activities, which is a wild harvest activity typically neglected by fishery managers.

POPULATION, HEALTH AND HIV/AIDS

Population and health considerations and HIV/AIDS interventions have been successfully integrated into fisheries management activities, often under the purview of Population-Health-Environment (PHE) programs. PHE programs address the complex connections between humans, their health, and their environment. The main goal is to improve access to health services–most often family planning and reproductive health care services–while helping communities to manage their environment in ways that protect biodiversity, create sustainable livelihoods, and improve human health. In the fisheries context, it is common to see the merging of HIV/AIDS prevention strategies with coastal and marine conservation initiatives, and the integration of family planning and human reproductive health with conservation.

HIV/AIDS

A growing body of evidence suggests that AIDS-affected households are less likely to use natural resources sustainably. In this context, the HIV/AIDS pandemic can have direct and indirect impacts on the sustainable use of fisheries resources and on conservation efforts in general. AIDS can result in a loss of traditional ecological knowledge, loss of labor and human capacity in resource management agencies, and a diversion of national funds away from conservation agencies to meet rising HIV/AIDS-related costs.

Fisheries and HIV/AIDS are linked in other ways as well. Fishing communities and fishers such as in Thailand and those surrounding Lake Victoria in Africa tend to have higher infection rates than the general population. Fishers often must temporarily migrate or travel away from their families and communities for days or months at a time. Often this leads them to engage in risky sexual behaviors that first infect them and then others. Once infected, fishers then spread the disease back to their own families and communities. Another related gender dimension is the prevalence of women fish mongers being forced to exchange sex for the right to purchase or sell fish. Also, because fishing communities are often located far from health services, gaining access to preventative measures such as condoms and counseling or to facilities for testing and treatment (i.e., anti-retrovirals) is limited and difficult.

Recognizing these linkages, some resource management and conservation programs are starting to integrate HIV/AIDS prevention strategies as a way to mitigate the impact of the disease. These programs provide behavior change communications strategies on both environmental themes as well as HIV/AIDS. Other strategies implemented in fishing communities or those surrounding conservation areas include promoting gender equity, establishing microenterprises around selling condoms, establishing voluntary counseling and testing centers as a means of preventing infection, and establishing explicit HIV/AIDS workplace policies within conservation agencies. Another strategy is to provide HIV/AIDS-vulnerable households with livelihoods that are less labor intensive. Introducing labor saving technologies is another strategy—e.g., introducing fuel efficient stoves or providing access to alternative energy sources helps reduce the amount of wood needed for cooking and thus the time needed to collect wood.

Population Growth and Reproductive Health

In many areas, population growth due to high fertility or in-migration is increasing the need for food, thus the pressure on fish stocks. This increasing pressure results in fishing efforts outstripping the ability of fisheries ecosystems to provide a sustainable food supply. To these growing populations, open access fisheries are often viewed as a food and income generating social safety net of last resort. In addition, these populations live in some of the most remote areas, where access to basic family planning information and services is limited, and perhaps even nonexistent. Even if fishing communities wanted to plan smaller and healthier families, they often lack the information and tools to do so.

Incorporating population and reproductive health approaches into fisheries management can simultaneously improve human and ecosystem health. Family planning is considered a long-term strategic intervention to reduce fishing efforts and to address long-term food security issues. Integrating family planning, and other health interventions into fisheries management has been accomplished through Population-Health-Environment (PHE) programs. These programs hold the philosophy that integrating family planning, basic health, and natural resource management creates greater synergies than do single or dual sector-only programs. Smaller family sizes contribute to better management and conservation of natural resources and ease population pressures on local resources. Health services are often greatly needed in remote coastal areas, and are cited in the top three priorities by communities along with education and transportation infrastructure. Family planning is a highly sought-after health service, especially by women who desire to space or limit the number of children they have and yet have no means of doing so. Integrating basic health services with fisheries management addresses a community's basic needs and can reduce morbidity and mortality–which, in turn, can increase community support for fisheries interventions. The Integrated Population and Coastal Resource Management (IPOPCORM) program in the Philippines has demonstrated that by combining family planning and fisheries management in the same program, one can achieve more effective impacts than achieved with separate programs.

A key to successful fisheries management is ensuring that resource management strategies are implemented hand-in-hand with family planning education and service delivery strategies. This is particularly true in areas where population growth is high and access to family planning information and services is limited. In this way, communities and fishing households have a heightened awareness of the linkages between the two interventions. They learn to understand how high population growth rates impact the environment and the current and future generations who depend on that environment for food, income, and overall quality of life.

GLOBAL CLIMATE CHANGE

The impacts of global climate change on fisheries are starting to be observed and are likely to increase over time. Changes in water temperature and current patterns will affect species' migration patterns and ranges. Increasing sea level rise will drown intertidal habitats and force their retreat landward. Undeveloped buffer zones will be needed to plan for such intertidal habitat retreat, and ensure such critical nursery grounds for coastal fisheries can be maintained. Protecting mangrove forests, coral reefs, and coastal wetlands has multiple benefits for fisheries production. These ecosystems provide coastal protection and storm mitigation, and can serve as buffers as sea levels rise.

Similar to agriculture, fisheries production will be affected by rises in water temperatures. Oxygen content decreases as water temperature increases, which could impact growth and productivity. Less dissolved oxygen could increase the occurrence of coastal "dead zones," where large areas of coastal water bodies located off river mouths and in estuaries becomes anoxic, unable to support much sea life. Meanwhile, rising CO_2 levels will impact ocean systems. The challenge is in knowing more precisely what these changes will be and their impacts on these ecosystems. This uncertainty on the specific affects of climate change on fisheries reinforces the need for the management of these systems to be increasingly resilient and able to adapt as changes do become known.

Rising sea surface temperatures will make coral reefs increasingly susceptible to mass bleaching events, having long-term impacts on reef fisheries. Changing sea surface temperature may also result in changing currents and productivity of fisheries systems–a situation that may or may not be beneficial. Increasing drought, flooding, and changes in freshwater flows in river systems is likely to affect estuarine systems that provide critical habitat for many commercially important fisheries. Rising sea level will increase the risk and vulnerability of coastal infrastructure and communities, while increased storms will place coastal ports and other fisheries infrastructure and coastal communities at increased risk. In some areas of the world, low-lying small islands (e.g., the Maldives and Marshall Islands) may become completely inundated requiring mass relocation of people and communities. In low-lying estuary systems such as Bangladesh and the Mekong Delta, millions of people may need to be relocated as low-lying areas become permanently flooded.

As both the human systems and the natural ecosystems upon which they depend become increasingly vulnerable, they need to become increasingly resilient and capable of adapting to changes that will occur. In capture fisheries, systems that are decentralized and use a co-management approach are more capable of adapting to changing conditions.

DISASTER MITIGATION AND RESPONSE

Natural disasters and human-induced conflict can have major impacts on fisheries. Building community resilience through hazard mitigation and disaster planning is an essential strategy to mitigate the impacts of disasters on the fishing communities. In areas with significant capture fisheries, programs that improve management and governance of the fisheries will aid in faster recovery.

When natural disasters do hit, coastal areas are particularly vulnerable to typhoons, cyclones, and tsunamis, while inland fisheries are especially affected by drought situations. Rebuilding affected fisheries and businesses can include the repair of port and landing facilities, or the provision of new fishing inputs such as boats and fishing gears. Often neglected, but of equal importance, is the rebuilding as well of post-harvest infrastructure for the processing and handling of a highly perishable product. Such

infrastructure includes ice facilities, transport vehicles, and repaired roads and bridges to transfer product to market.

In addition to coordinating any post-disaster efforts with donors and local government, it is important to consider several factors when providing new fishing inputs to communities. In most cases, nearshore and inland fisheries are already being overfished and there is already a critical need to reduce fishing effort. When natural disasters occur, the destruction of large numbers of fishing craft actually provides an opportunity to avoid rebuilding the sector back to its previously unsustainable levels. One approach is to provide fishers with alternatives to boats and gear, institute sector reform that closes fishing access, and create opportunities for fishers to leave the sector. A challenge will be that not all fishers will be willing to change occupations, even at a time of great hardship and emotional stress. Therefore, creating incentives that increase voluntary exit from fishing are the most sensitive way to promote less fishing immediately following a disaster.

In spite of the cautions mentioned above, fisheries livelihood activities can play an important role in rapid recovery after a disaster. Most individuals who work in these occupations want to return to work quickly. If boats and gear can be provided quickly, fishers can help put high quality animal protein back into the local diet and economy and start generating income again. But again—in situations where the fishery has already been overfished—making too many boat donations is unwise as it simply continues subsidies that encourage more fishing effort, which in turn makes the fishery even more unsustainable.

Poor resource management practices can actually contribute to conflicts. For instance, as fish catches in East Africa have dwindled, groups of fishers have been forced to change their patterns of migration and increase the distances they must migrate in order to catch the fish they need for food and income. This often creates conflicts with local fishers in areas where they have migrated, who may view these migratory fishers as intruders usurping their local resources. Conflict situations, in turn, often result in the breakdown of critical food distribution channels, including those for high protein food fish

Indian Ocean Tsunami, December 2004

An estimated 2.5 million people that depend on fisheries and aquaculture as a livelihood activity were affected in the December 2004 Indian Ocean tsunami. The most costly toll was in human lives, with an estimated 60,000 fatalities in the fishing and aquaculture sector along with countless thousands injured. Over 100,000 fishing vessels were lost, destroyed, or damaged along with supporting gears and engines. Direct losses for the fisheries and aquaculture sector have been estimated at approximately US$ 420 million. Many fishing families also lost their houses and their contents, as they are located in close proximity to the shoreline. There was also considerable damage to supporting infrastructure, including fish landing sites, piers, harbors, and coastal roads that served as a main conduit for post-harvest distribution. Coastal aquaculture infrastructure was also heavily impacted with countless fish and shrimp ponds inundated and hatcheries destroyed. The magnitude of these losses was driven in part by the fact that communities involved in fishing and coastal aquaculture need to locate in inherently hazardous and risk-prone areas along the coast that are vulnerable to tsunamis, cyclones, floods, erosion, and sea level rise. However, with respect to the fisheries sector, most areas impacted by the tsunami were considered overfished before the disaster struck–too many fishers and boats chasing too few fish. In the rush to rebuild the fisheries sector, poor donor and country coordination resulted in many more boats and gear being donated to fishing communities than existed originally. In the long term, this only exacerbated the overfishing problem, including creating a situation of even lower income earning potential for each fisher. In many ways, this was a missed opportunity, whereby fishing effort could have been permanently reduced by encouraging fishers to shift into alternative occupations and providing them the means to do this.

FOOD SECURITY

Fish as a food product is an important source of protein in the diet of 1.5 billion people around the globe. In some countries, fish supplies more than half of the animal protein in the diet. Fish contains high levels of omega-3 fatty acids, vitamin A and calcium, and other important components of a healthy diet. As world population grows, demand for food and sources of protein will increase. Increasing demand has several effects on fisheries and aquaculture. For capture fisheries, increasing demand will drive prices higher and place additional pressures on this wild natural resource. If efforts to control exploitation are inadequate, biological overfishing occurs and the amount of sustainable harvest that can be achieved will diminish. Therefore, food security and sustainable supplies of fish from wild fisheries can only be maintained if the capture fisheries are well managed. As such, food security and effective management of wild fisheries go hand-in-hand, especially in countries where fish is a main source of protein in the local diet.

Fish as a source of protein is not just important to coastal countries or countries with large lake and freshwater systems–where most of the world's fish supply is landed. In many places inland populations are equally dependent on fish food for protein in their diet. For instance, in West Africa a significant amount of marine fish is processed through smoking and drying, and is transported as far inland as the sub-Saharan land-locked countries of Mali and Niger.

An emerging controversy in fisheries and aquaculture is the use of fish meal as a protein source in feeds to grow high trophic species such as salmon, grouper, and tuna. While food conversion ratios in aquaculture are some of the highest in agriculture, increasing demand for fish meal places increasing

pressure on wild fish stocks. In addition, fish that could be used directly for human consumption by poor populations are instead used for fish feeds to produce a high value crop for wealthy people. A fishery that has this potential is the anchovy fishery in Peru, which provides one of the largest sources of fish meal. Although at present there is limited demand for direct human consumption of anchovies, this demand is increasing. In addition, the high cost of fish meal is also driving a trend towards substitution, with soybean as a new source of protein in the feed. Grains are also used for feeds in aquaculture, directly competing at times with use as food for people. As food demands increase over the next several decades, this debate of fish for direct consumption versus fish for feeds will continue.

DEMOCRACY AND GOVERNANCE

Poor governance of fisheries resources is one of the leading causes of overfishing in capture fisheries and is one of the leading causes of significant environmental impacts from poorly planned aquaculture development. Governance has many dimensions, including the institutional and regulatory frameworks for fisheries management. Improved governance of fisheries as a key reform issue includes strengthening the rule of law (including fisheries enforcement) and improving civil society engagement (co-management approaches).

In capture fisheries, a leading contributor to poor governance is low stakeholder participation in the sector's management. This is linked, in part, to conventional centralized systems of governance. Governance, however, is about more than just the role of government. A reflection of this is the increasing trend in fisheries towards decentralized and co-management approaches where stakeholder groups including men and women, processers, wholesalers, and suppliers can all have a greater role in decision-making. Increasingly, it is fishers and their associations who are making the voluntary move to adopting codes of conduct for responsible and sustainable fisheries.

An emerging international issue related to poor governance is the problem of illegal, unreported, and unregulated (IUU) fishing. IUU is an issue on both the high seas and the nearshore waters, where most small-scale fisheries operate. Illegal fishing practices work against effective management, as in the case of the widely banned practices of bomb fishing and the use of cyanide, which damages important fish habitats. Also, poor reporting of fish landings confounds efforts to assess the status of fish stocks and apply catch limits. Unregulated fishing inevitably leads to overfishing of important fish stocks.

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PRINCIPLES FOR SUSTAINABLE FISHERIES PROGRAMS

The following principles and best practices should be considered and, as appropriate, incorporated into the design of fisheries programs:

- **Programs should assist a fishery to move from open access to managed access and secure tenure**. Capture fisheries are unique due to the nature of common property resources and the "tragedy of the commons" phenomenon. Fisheries reform requires a transition from uncontrolled open access to forms of limited entry, user rights, or catch shares. Activities should strive to secure access rights to fisheries with less reliance on external enforcement and more reliance on compliance, community co-management, and self-management strategies.

- **Programs should promote comprehensive governance reform**. Programs should help governments re-define their role in sector reform and management by moving from "command and control" to an "enabling" role. This will create sustainability through incentives for the private sector to invest in fisheries management and achieve a durable stake in the long-term protection of the resource.

- **Programs should engage the private sector and apply value chain approaches**. Programs should promote marketing of sustainably sourced, socially responsible, and high quality seafood products – either wild caught or farmed product. Through partnerships with private industry, governments, and civil society, the goal is to turn individuals involved in these sectors into business persons and stewards of the resources, and help them connect with the marketplace to achieve greater benefits. It is essential to move away from maximizing catch or production to maximizing value, while promoting trade and marketplace reform measures that favor certified, value-added products. It is necessary to harness the power of the entire value chain–producers, processors, wholesalers, and retailers–to achieve sustainable management and rational allocation of fisheries and aquaculture resources.

- **Programs should promote social responsibility and equity as key objectives**. Programs must protect subsistence needs and promote fair treatment of labor, including but not limited to, fair prices, prohibition of child labor, and safe working conditions. All phases of the management and decision-making process should be inclusive, involving both harvest and post-harvest segments of the industry.

- **Programs should ensure equitable and broad participation**. Poor stakeholder participation in management planning, decisionmaking, implementation, and enforcement are some of the greatest constraints to improved governance. Additionally, many sectors of society such as women, youth, disabled, and the poor have limited access to the resources that would enable them to participate in fisheries or aquaculture.

- **Programs should adopt codes of conduct and best management practices (BMPs)**. In both fisheries and aquaculture, codes of conduct and BMPs play a role in sustainable development and management. Codes of conduct are broad guidelines or statements for conducting an activity in socioeconomic and environmentally compatible ways. The BMP approach relies largely, but not exclusively, on voluntary adoption of practices that optimize production, minimize impacts, increase benefits, and reduce risks of all types. This often is expressed as a national or industry policy. Quite often, industry associations and government can work on establishing a code of conduct for responsible fisheries as a step preceding BMPs.

- **Programs should commit to sector reform as a long-term process**. Rapid results in short timeframes of five years or less are unlikely. To yield significant results, the focus should be on instituting reform measures today that improve the enabling environment and will set the stage for concrete and sustained results in the medium to long term.

- **Programs should be adaptive.** While the initial design of program activities should be sound, conservation needs are complex and constantly evolving. Programs should be structured in such a way that they monitor their progress, generate timely information for management, and allow for adaptive management as needed.

- **Programs should utilize science-based management.** Science should be the basis for a management program. Programs should aim to build local scientific capacity that strengthens local management decision-making.

- **Programs should foster sustainability.** Programs should (1) focus on how achievements will be sustainable beyond the end of the activity's lifetime, and (2) seek to identify continued financing for ongoing activities. For programs that include resource extraction activities, managers should: examine the likelihood that extractive activities will be ecologically, socially, and economically sustainable; how overharvesting will be controlled; and how extractive use will contribute directly to biodiversity conservation.

- **Programs should strengthen in-country capacity**. Strengthening in-country capacity to increase the sustainability of interventions is key at both the individual and institutional levels. Institutional strengthening may be needed for both government and nongovernmental organizations.

- **Programs should be results oriented.** Programs should clearly articulate their underlying assumptions, rationale, and methods for achieving planned results. They should also describe how program impacts will be measured and monitored.

- **Programs should foster learning.** Analysis of program results and dissemination of lessons learned should be part of a program's activities, particularly larger-scales programs and programs at multiple sites.

- **Programs should complement other conservation and development activities.** In particular, Programs should also consider potential international obligations of the host governments, as some coastal fisheries such as small-scale tuna fishing are linked to international management organizations, e.g., the regional fisheries management organizations (RFMOs).

II. CAPTURE FISHERIES

An Overview of Capture Fisheries

Management Approaches

Fisheries Planning

Fishermen in southern Thailand returning to port in their longtail boats laden with an evening's catch. Fishing often takes place at night and can entail long hours of hard, laborious work.

AN OVERVIEW OF CAPTURE FISHERIES

INTRODUCTION

Capture fishing is the largest use of wildlife in the world. It is a critical source of protein and livelihood, employing over 50 million fishers and representing more than 20 percent of the animal protein in the diet of 2.6 billion people. In developing countries, where the vast majority of fishing communities and fishers are located, fishing is uniquely important to livelihoods, food security, and poverty alleviation.

Seventy-seven percent of world fisheries production is from developing countries.

Net fisheries exports from developing countries in 2002 was worth U.S. $17.4 billion.

For 2.6 billion people, fish represents more than 20 percent of the animal protein in their diet.

Fifty million men and women are directly employed in small-scale fisheries.

Ninety-six percent of fishers worldwide are small-scale and provide 50 percent of global catch, and most reside in developing countries.

Source: FAO, 2006

This Guide focuses on nearshore fisheries, which are conducted in shallow coastal and nearshore marine waters such as estuaries and coral reefs, as well as in freshwater bodies, such as lakes and rivers (Table 1). Most nearshore activities require little capital investment. These use relatively small fishing vessels and traditional gear and may use motors. These are a major source of food for local consumption and livelihood for coastal households. Ninety-six percent of fishers worldwide are nearshore and most are in developing countries. It is estimated that some 50 million men and women are directly employed in small-scale fisheries. Fishing involves all community members: men, women, elderly, and the youth. However, inadequate sex-disaggregated data—at the national, regional, and global levels—means there is little recognition of the contributions of women to the fisheries and aquaculture sectors.

Table 1. Large-Scale and Small-Scale Fisheries Compared

Key Features	Large-Scale Fisheries	Small-Scale Fisheries
Direct employment in fishing	500,000 people	50,000,000 people
Fishery-related occupations	-	150,000,000 people
Fishing household dependents	-	250,000,000 people
Capital cost per fishing job	US $30,000 - 300,000	US $20 - 300
Annual catch for food	15-40 million tons	20-30 million tons
Annual fish by-catch	5-20 million tons	< 1 million tons
Annual fuel oil consumption	14-19 million tons	1-2.5 million tons
Catch per metric ton of oil used	2-5 metric tons	10-20 tons

Source: Berkes et al. 2001

Fishermen are sometimes fisher women

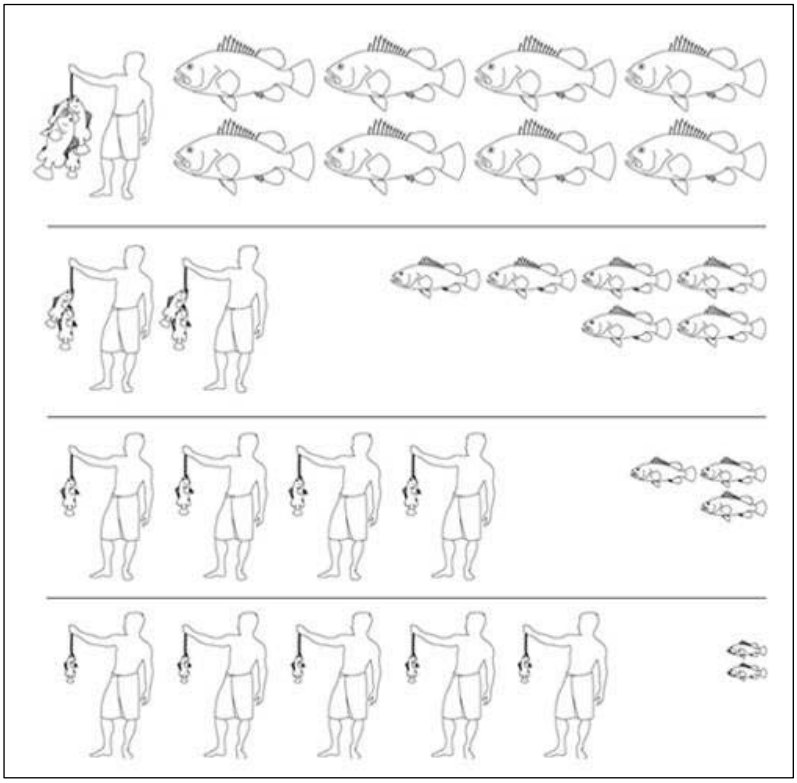
Fisheries play an important role in the national and local economies of many transformational and fragile states. In spite of this, the fisheries sector—as compared to other sectors of the world food economy—has been poorly planned and regulated. It has also been inadequately funded and neglected by all levels of government. Overfishing occurs around the globe. The reasons are numerous. Factors include traditional systems of open access, the difficulty of monitoring landings and effort, the co-existence of multiple species that are caught with the target species, changing environmental conditions, and a general lack of governance and effective enforcement.

Fish stocks have traditionally been regarded as an inexhaustible resource and as a social safety net. Most often, fishing in developing countries is open access with little or no controls, i.e., individuals enter and exit the trade at will. Fishing often serves not only as a food source, but as a last resort for income for the poor. This fact has contributed greatly to the overexploitation of nearshore fisheries resources and harm to marine ecosystems. The poor economic health of fisheries is caused by too many boats and fishers (overcapacity of fishing fleets). Improved harvest technologies, increases in marine pollution, and habitat degradation are other contributing factors.

The problems facing world fisheries are daunting, but not without solutions. Fish is a limited renewable resource. When managed correctly, it can make stable contributions to food security, livelihoods, and revenues. Reforming the governance and the management of this critical natural resource is also essential to maintaining stable and long-term economic development and conservation of biodiversity. In some cases, it even may be essential to overall peace and security. This Guide illustrates examples of innovative approaches that have led to long-term solutions for sustainable fishing. This includes conserving critical fish habitat, reducing destructive fishing techniques, encouraging co-management approaches, and the use of market-based approaches.

Increased numbers of fishers over time leads to too many fishers chasing fewer and fewer fish in the sea. Typical signs of overfishing are declining catches per fishers and decreasing sizes of fish caught.

The Overfishing Problem



If fish sizes become too small, they cannot reproduce—resulting in recruitment overfishing and the danger of fish stock collapse.

SOME BASIC CONCEPTS

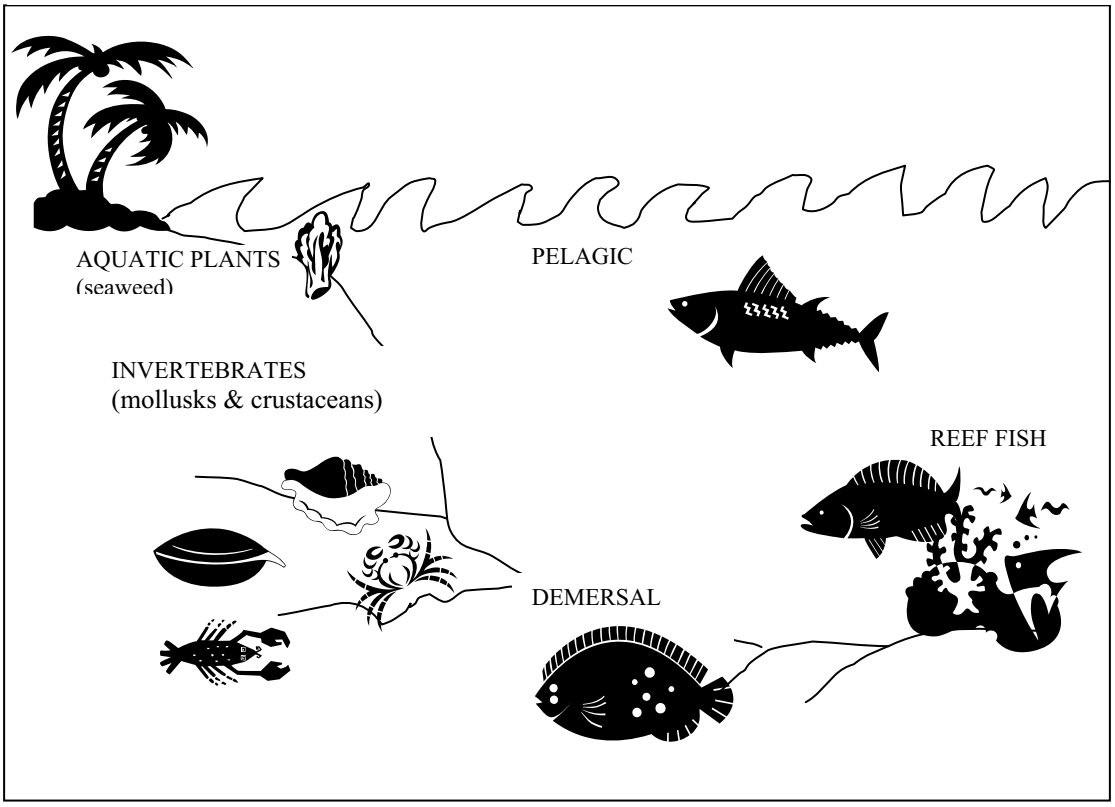
Major Fisheries Types

There is no one-size-fits-all description of fisheries. Fisheries can be classified by what is caught, where it is caught, the scale of operation, type of gear used, and the ultimate destination of the product.

The Fish

There are many animal and plant species harvested in nearshore fisheries. This includes bottom dwelling species (benthic or demersal) and pelagic (swimming) species. Another major group is marine algae and plants—e.g., nori, dulce, Irish moss, and kelp. Seaweeds can provide food for humans, or can be used as an ingredient in cosmetics, as fertilizer, and for the extraction of industrial gums and chemicals. Of total world fish harvest, marine fishes make up the bulk (82 percent), and freshwater and diadromous fishes constitute a much smaller percentage (1.6 percent). The remaining 16 plus percent is comprised of invertebrates such as mollusks (e.g., clams, oysters, mussels, squid and octopus, and scallops) and crustaceans (e.g., crabs, lobsters, and shrimp). Understanding basic biology, ecology, and population dynamics for these harvested species is critical to the harvest strategy.

Fisheries Catch Classification



Fishing Scale

Capture fisheries can be classified as industrial, small-scale, artisanal and subsistence, and commercial or recreational. However, there is often confusion and overlap between these terms. The box at the right offers common definitions that may be useful in explaining the differences in the classifications of fisheries.

Large-scale industrial or commercial fisheries use relatively capital-intensive fishing technologies, with harvesting and processing equipment owned by commercial entrepreneurs and operated by salaried crews.

Small-scale or artisanal fisheries are a more traditional, labor-intensive form of fishing performed by men, women, and children. Small-scale fisheries are sometimes mechanized; however they usually involve fishing from small boats or from shore, gleaning, or use of traditional gear such as hand-lines, small nets, traps, spears, and hand collection methods.

For poorer fisher families, including a high percentage of female-headed households, the catch is mainly eaten by the family. This is referred to as subsistence fisheries.

The use of the word "relatively" in defining large-scale vs. other scales of fisheries helps distinguish between the different levels. Using this approach assumes that all are from the same region with homogeneous socioeconomic characteristics. Boats that fall into the lower end of the defined spectrums are usually considered to engaged in small-scale or artisanal. Those that fall into the intermediate range may be called modern artisanal or semi-industrial, and boats above that range are considered industrial. In general, artisanal fishing in developing countries is considered to be labor intensive forms of fishing performed by men, women, and children from fishing households.

In general, fishers are categorized as subsistence fishers if they bring their catch home as food for their families—with the assumption that fish is critical in the diet. Fishers are considered recreational if they fish for leisure and sport.

Fishing Location

Freshwater Fisheries

Inland fisheries (river, small water bodies, and lake-based) provide a major source of food and employment for millions of individuals, especially in the developing world. Most inland fisheries make protein available in areas that might otherwise suffer from nutritional deficiencies. In some countries, freshwater fishing employs a larger portion of the population than does marine. Although freshwater fisheries is not the focus of this Guide, it should be considered in countries where its importance is high.

Nearshore fisheries is often conducted from small open unmotorized vessels using simple gear.

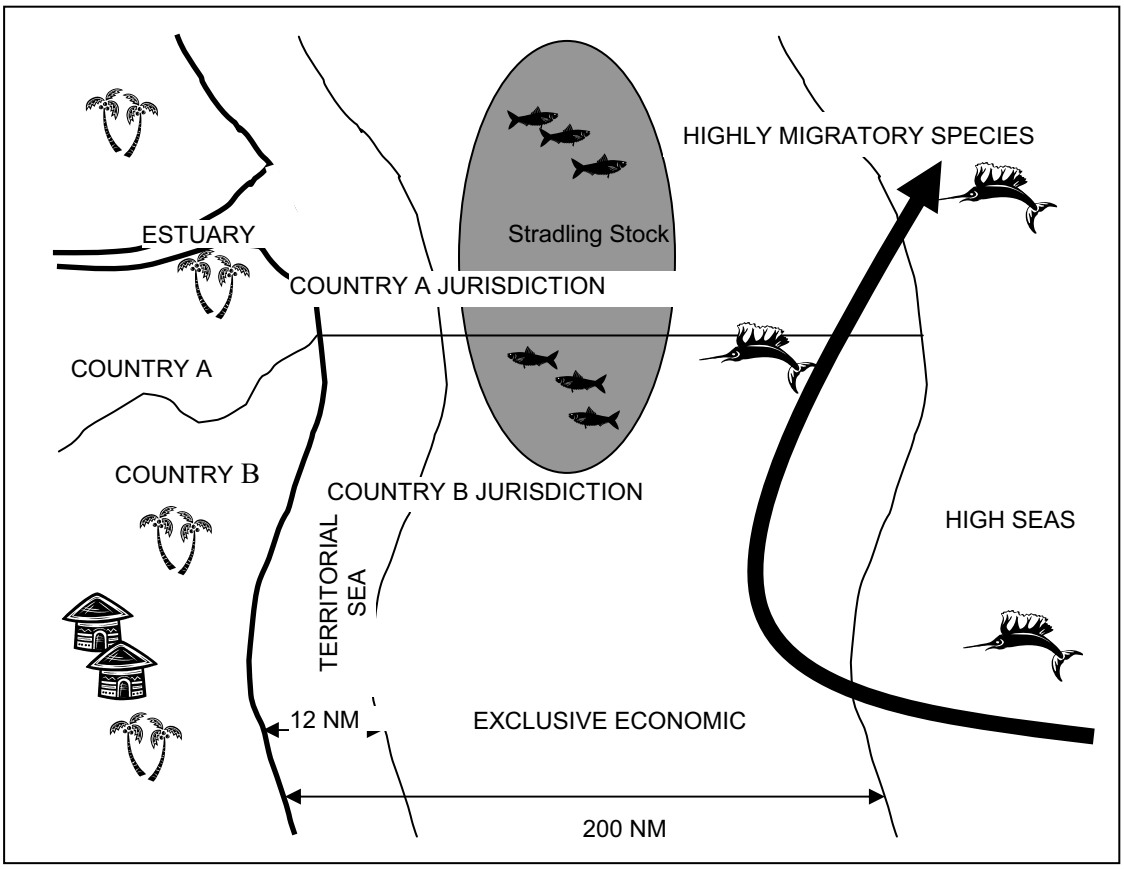
Marine Fisheries: Nearshore to High Seas

Most marine artisanal fishing occurs in the nearshore environment—i.e., the area that encompasses the estuaries, lagoons, bays, reefs, and sounds. Most of this area is under country jurisdiction, out to the 12-mile territorial sea limit. These areas usually receive high nutrients and are extremely productive, with fluctuating salinities, temperatures, and oxygen characteristics. They are important nursery areas for many species.

As the distance increases from the shoreline, the fisheries may become more industrialized. This means larger boats, larger crews, and different harvesting, processing, and holding technology. However, often there is overlap in areas and species harvested between the small- and large-scale fisheries. This overlap can lead to conflict and overfishing. Although a country may have legal jurisdiction to the 200 mile limit (EEZ), there is often no mechanism for enforcement. Also, often there are no national fleets in place to harvest these resources in any case. As such, many countries will rent or lease permits (access agreements) to other countries to allow these countries to enter their EEZ and harvest the resources for a fee.

Many migratory fish cross country jurisdictions. Shared stocks are common. If a species travels between adjacent countries, they are referred to as "straddling stocks." Management of these species requires international agreement.

Fisheries Jurisdictions



Fishing Gear

Most fishing in the nearshore environment is simple and requires low technology such as simple traps, pots, weirs, and hand-lines. Nets did not appear until 8500 BC. When first developed, net material was often stiff and easily broken. As fish trade became important in the Middle Ages, larger nets were utilized by distant water fleets (whaling, salted cod, and herring). The trend to move from shallow water to deep sea developed in conjunction with heavier gear and increased manpower. When mechanization appeared at the turn of the 20th century, new gears such as the beam trawl, otter boards, purse seines, and mid-water trawls became standard equipment. This new gear helped to catch the quantity of fish needed to meet the increased demand for food. Synthetic materials such as monofilament were created in the 1950s. These

materials greatly increased the efficiency of fishing gears. In contrast, more recently, gears are intentionally being made to be less efficient. The purpose is to help reduce catch levels and to increase selectivity. Gear modifications include large escape openings, turtle and fish excluder devices (TEDs and FEDs), biodegradable panels, large mesh and rope trawls, square mesh windows, and other bycatch reduction devices (BRDs).

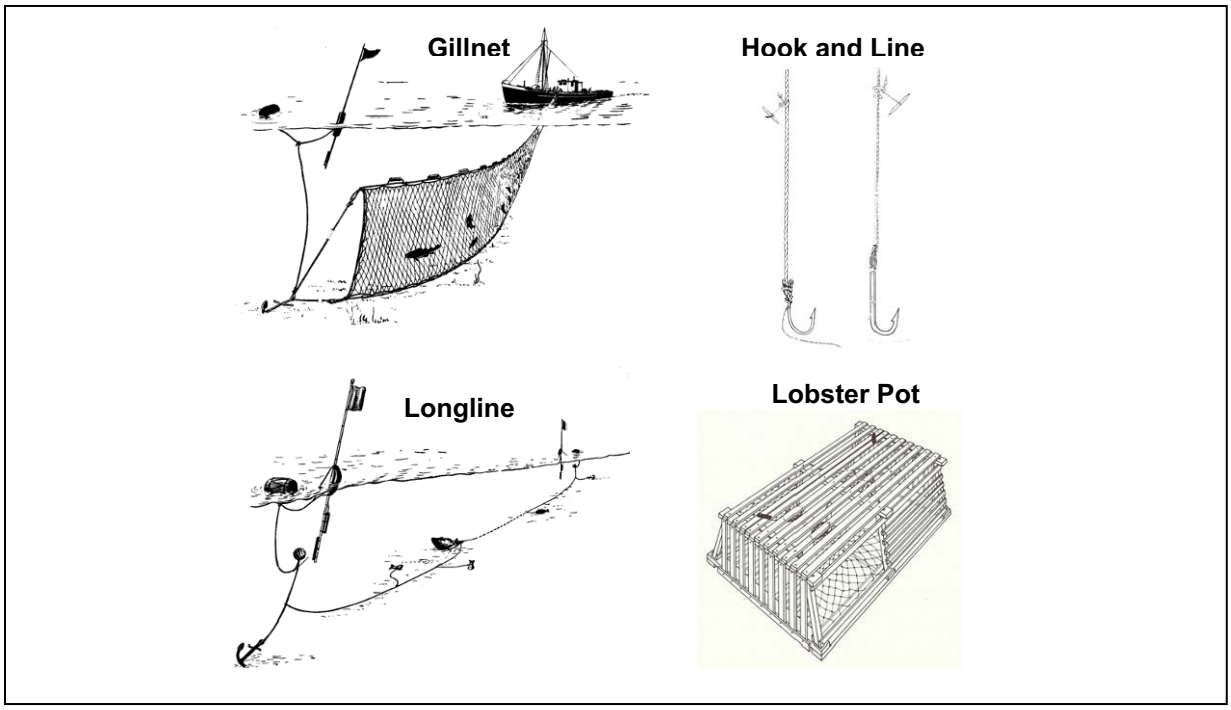
Today, gear types are broken into two categories (passive and active). Passive gear requires the fish to come voluntarily to the gear. Active gear pursues the fish. Examples of different gear types include:

Passive: gillnets, trammel nets, hook and line, hand-lining, trolling, long-lining, pots, and traps

Active: spears and harpoons, trawls (beam, bottom, mid-water) and dredges (hydraulic, scallop, clam), seine nets (purse, beach, and other)

Other: Fish Aggregating Devices (FADs)

Gear Types



Fisheries Science and Management

The overall goal of fisheries science and management is to maximize the production of the fishery while maintaining a healthy population of fish and habitat for a long-term sustainable future. There are many unknowns that can affect reaching this goal. These range from changes in the environment, to changes in the number of fishers, multiple landing areas, insufficient fisheries data, and many other factors. Fisheries science is statistical in nature and based on modeling. This means there are always uncertainties and variances associated with the sampling and monitoring designs and with the model outputs.

The potential contribution of a resource to society is determined by the size and productivity of the resource that is harvested. Fisheries resources are renewable and produce surplus biomass that can be harvested without harm to the species. The harvesting of fish changes an "undisturbed ecosystem" and its species characteristics. In theory, the goal is to harvest fish when the growth rate produces the greatest gain in weight balanced against the mortality rate as fish age and start to die from natural causes. When such data is not available, there are many other simple indicators of species and fisheries health.

KEY THREATS AND MANAGEMENT ISSUES

Most fisheries in developing countries are poorly managed or not managed at all. In most cases, this includes unrestricted access and overfishing. Poor management has detrimental ecological, environmental, economic, and social consequences. This is particularly true for nearshore fisheries, which are considered overfished and over-capitalized, and which often use destructive fishing methods. Combined, these issues reduce the overall ability of the ecosystem to sustainably produce an important high quality food source for the world. These same issues also present significant threats to aquatic biodiversity. Reforming capture fisheries to be economically and environmentally sustainable and socially responsible requires addressing the following issues.

Open access and the resulting tragedy of the commons has been a universal feature of fisheries. The historical view of an inexhaustible fish supply became the blueprint for open access. Open access offers no incentives for long-term conservation practices. This has led to overcapitalization, excess effort, degraded habitat, and depleted resources worldwide. This ethic is slowly changing. New approaches to management involve secure access privileges, community-designated fishing areas, zoning, national access agreements, licenses and permits, and other forms of use rights or tenure.

> The declining state of fisheries resources—a state readily acknowledged today—will have disproportionately serious consequences for developing countries and their poorest communities and citizens.

Weak governance, and the implications of such for changing open access policies, is widely acknowledged as one of the largest and most common problems within the sector. Factors characterizing weak governance in fisheries include: corruption, inadequate resources available for management (physical, human, and financial), poor enforcement, illegal fishing, unclear traceability of point of origin, lack of stakeholder participation in decision-making, lack of clear vision, and user conflicts. The inclusion of fishers in management can strengthen governance infrastructure by creating responsible, economic incentives for conservation, and reducing the need for extramural enforcement. A stronger, corruption-free institutional framework will allow for capture of economic rent and reinvestment in management.

Overfishing and overcapacity are a consequence of a short-term view of fisheries in an open access structure. When incentives to conserve are introduced, a longer-term strategy can be put into place. This can move fisheries from subsistence level harvest to a more profitable economic activity that generates increased value per pound of fish harvested. This will help to encourage the use of less harmful gear types, reduce fishing effort, benefit ecosystem health, and preserve valuable habitats and ecosystem relationships.

Loss of ecosystem productivity and resilience are two of the consequences of poor governance and overfishing activities. The coastal marine and freshwater environments are some of the most stressed ecosystems worldwide. They are being weakened by increased human populations and subsequent coastal alterations, loss of critical spawning habitat, changes in water flow, and runoff that includes suspended solids, pesticides, herbicides, and other chemical and biological waste products. Destructive fishing

practices such as bomb fishing and cyanide, or the use of fine mesh nets can also cause long-term ecological damage and reduce the productive potential of estuarine and marine ecosystems. The use of bottom trawls and dredges on sensitive bottom types can also affect biodiversity and essential habitat. These problems will be exacerbated by the effects of global climate change, including sea level rise, increased sea surface temperatures, and increased ocean acidification.

Recent assessments show a dramatic decimation of key target species of fish worldwide.

Globalization of trade is another factor affecting fisheries as changes occur quickly and reverberate throughout the system. Small-scale fishers often harvest numerous products that enter the global food market. Many of these are high-price, high-demand products and are thus attractive as income-generating opportunities for small-scale fishers. However, when there is high demand but a weak management framework, these high-valued species can be quickly depleted. To minimize this, the global trade community can impose required international food safety standards such as hazard analysis critical control point (HACCP) certification. These food safety standards enhance the value of the product and decrease post-harvest losses. However, HACCP can make it more difficult for countries that use traditional post-harvest and processing methods to export their fish.

Loss of economic rents in marine capture fisheries is a consequence of open access, weak governance, and degraded ecosystems. Marine fisheries reform can recapture a substantial portion of the economic losses by reducing effort and strengthening tenure systems. This is a long-term process requiring political will and a shared vision developed collaboratively with stakeholders.

Maritime security is threatened by illegal fishing. To meet the national security challenges faced by many developing countries, maritime and coastal security requires a holistic approach. This includes border surveillance; national, local and community fisheries management; and enforcement.

Labor, health, and safety considerations should be part of any fisheries reform. Fishing often takes fishers away from home for long periods. This frequently leads to behaviors that increase public health risks such as HIV/AIDS infection. Women fish mongers, often forced to barter sex for sales, are also vulnerable to HIV/AIDS infection. Women play a significant role in post-harvest marketing and processing, and in some cases even in the harvesting process itself. The role of women is often overlooked in fisheries reform. Yet, economic development is only sustainable if it includes respect for worker rights and human rights. Too often in fisheries, these rights are violated—especially in regards to child labor and working conditions. Fair trade certifications may help alleviate poor working conditions. Education about and treatment of HIV/AIDS should also be considered as part of an integrated approach to fisheries reform.

Child Labor in Fisheries

In Senegal, children under the age of 15 represent approximately 29 percent of fishery labor. They are forced to work in physically demanding and harsh working conditions at an average age of less than 11 years. In Mwanza, Tanzania, bordering Lake Victoria, boys and girls labor seven to eight hours a day in the fishing and processing sectors. On Lake Volta, over 1,200 boys serve as ”slave masters” onboard fishing vessels. In Thailand, illegal female migrant workers from Burma comprise a significant portion of the cheap labor employed in processing plants.

(Samudra Report, 2006)

Inadequate support services is a problem in the fisheries sector. Training, extension, financial services, skilled human resources, and market infrastructure lay the foundation for a long-term conservation vision. Where support services are provided, attention must be given to making them accessible to both men and women. Providing this

support requires considerable investment, planning, and effort to integrate activities. Scientific and logistical support to fisheries institutions is also critical for developing sound management policies. Fisheries will be sustainable only when there is adequate provision—to both men and women—of the various categories of support services outlined above.

Increasing world populations are escalating the demand for food and seafood products. This puts upward pressure on seafood prices and can result in increased fishing pressure and overfishing. In addition, many countries show increased migration to coastal areas where unemployment and underemployment may already be high. In open-access fisheries, and where management systems are inadequate to hold down fishing effort, these demographic trends exacerbate the threats to sustainable fishing. Programs that integrate population-health-environment initiatives, including family planning, can help address the long-term threat of population growth. Even in the short term, more carefully planned families and spacing of children can help households become more economically secure. This, in turn, makes them more willing and able to engage in sustainable harvest practices. Programs that integrate family planning and fisheries management, such as the Integrated Population and Coastal Resource Management (IPOPCORM) in the Philippines, have been found to be more effective then single-sector approaches.

Bycatch and its subsequent discard threaten many species. Bycatch is a byproduct of fishing. This includes the catch of non-target species, undersized fish, marine mammals, and endangered species. A primary concern is the capture of threatened or endangered species, especially seabirds or turtles, during the fishing process. Incidental capture occurs in all types of fishing—longlines, gillnets, traps, trawl gear, and even single hook and line operations. Trade restrictions and world pressure have been strong motivators for changes in this area. Some countries have enacted regulations that require fishers to use turtle and fish excluder devices (TEDs and FEDs). They have also restricted fishing to certain times and in certain areas and have adopted a variety of gear modifications—including floating line, acoustic pingers, streamers, and hook styles—to reduce the impacts of fishing.

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MANAGEMENT APPROACHES

Key Question

- What information is needed to design and implement a fisheries management program?

Limits must be set on how much yield or harvest can be extracted on an annual basis as determined by fishery management objectives. There should also be an evaluation of how these limits can be set within the governance structure, and an assessment on existing capacity for enforcement and the development of stewardship.

There are many tools available for the fishery manager to consider. This includes time and area closures, use rights, no-take reserves, input and output controls, or a combination of these measures. For a given fisheries area to be managed, all stakeholders must agree to the limits set for the fishing effort, and the tools they will apply to ensure that sustainable limits are not exceeded. The decision to use one or several of these tools will be a function of the environment, the type of fishery, the ability to enforce regulations, and the perceived benefit to the stakeholders. Once a menu of tools is selected, it is necessary to put monitoring, control, and surveillance (MCS) programs in place to ensure compliance.

Fisheries management in the past largely focused on measures that controlled the size and number of vessels, fishing technology, and gear. These are referred to as “input” controls. More recently, fisheries management is focusing on letting fishers themselves make those kinds of technology decisions. Instead, it is placing restrictions on the allowable harvest—i.e., where and when fishing is permitted as well as the amount and size of fish that can be taken. These are referred to as “output” controls.

Another, more recent evolution in fisheries management—aimed at eliminating the open access problem—is to allocate limited rights to fish in a particular fishery or marine area. This is referred to as a “rights-based approach” to fisheries management. There is some overlap between use rights and both input and output controls. Some input and output management measures give entitlement to access a fishery. Below, these three management approaches and specific measures are described, as well as voluntary and market-based management approaches (codes of conduct, best management practices, eco-labeling, and certification). None of these approaches are mutually exclusive and are often combined in an overall fishery management system.

HOW DO WE MANAGE ACCESS?

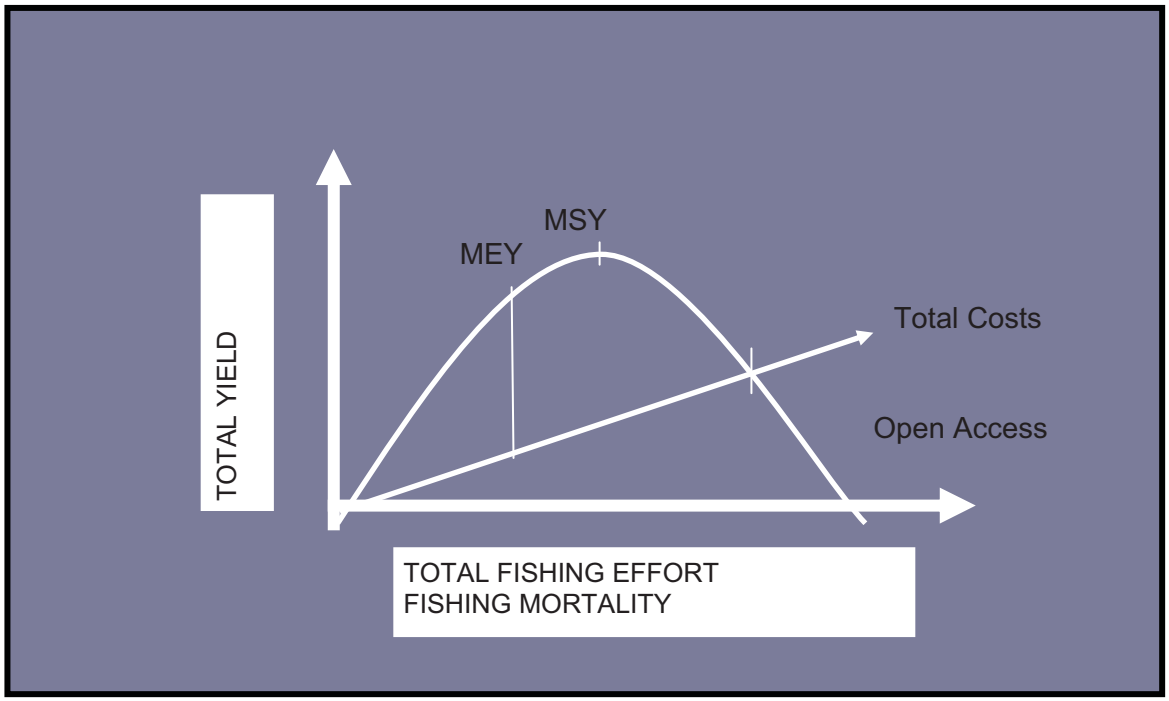
Key Questions

- What is the difference between open access and managed access fisheries?
- Why is this important for fisheries programming?
- What else needs to be in place before managed access will work?

Fisheries reform includes the need to move from "open access" towards a "managed access" regime. When a fishery is "open access," the first interim step, however, is to move towards secured access. Secured access places a limit on the number of participants who have rights and responsibilities in harvesting and managing the resource.

The figure below illustrates the typical catch curve that results with increased fishing efforts. When fisheries first begin, effort is low and catches are low—although the catch per unit of effort (CPUE), catch per unit of gear or catch per fishers, may be high. As new fishers enter the fishery, catch rises–both total and per unit of effort. The point is reached, however, where in spite of increased fishing effort, there is no rise in catch and CPUE decreases. Maximum sustainable yield (MSY) is defined as the point at which the greatest yield can be taken continuously—under existing environmental conditions. This also is often referred to as the maximum biological yield.

Fisheries Catch-Effort Relationship



Where the cost of fishing is low, such as in small-scale fisheries, the number of fishers and boats in the open access system will be high. This over-exploitation drives the total sustainable yield below the MSY. In some cases, it may lead to a complete exhaustion of the fishery. The open access equilibrium point

occurs when the total yield equals the total costs. Total costs include the opportunity costs of capital and labor plus all economic profits. Without effort controls, more people may be employed in fishing, but individual yields and wages will be low. This unmanaged equilibrium point is where most small-scale fisheries are today. This is the current challenge for fisheries management.

The catch/effort relationship is useful for understanding how a stock might respond to effort. It illustrates that increased effort does not always result in more fish. In an unmanaged, open access system, the level of fishing effort will exceed the point of MSY when the reproduction and growth processes are not sufficient to replace the quantity of biomass lost to natural mortality and over-harvesting. Where the objective is to maximize production of fish for food, MSY is frequently the target reference point. The MSY is easily calculated just with catch and effort data. However, since it is a *maximum* point, it is almost impossible to know if the fishery is below, at, or past this point until it has been exceeded. Once exceeded, it is difficult to stop entry into the fishery, or reduce the size of the fishing fleet and the level of fishing effort that would allow it to return to this MSY equilibrium point.

If the objective is to maximize economic profits, the fishing effort should be maintained at the point of maximum economic yield (MEY). This is the point where the difference between total yield and total costs is the greatest. It occurs at lower total effort levels than MSY. If benefits from non-extractive activities such as tourism and sport fishing are the desired goal, the management objective may be to maintain optimal fish assemblages where fishing effort is close to or at zero, and yields are also minimized or maintained near zero.

To increase yields in cases where a fishery is beyond the point of MSY, fishers must reduce effort. However, most nearshore fisheries are overfished and overcapitalized. The needed reductions in fishing effort would likely have difficult consequences for the marginal population that is dependent on the fisheries for food and livelihood. The challenges to reduce excess capacity in small-scale fisheries are compounded by factors such as growing populations and sluggish economies. Policies that aim to reduce the number of fishers without also creating diversified, non-fishery employment opportunities face difficulties. However, alternative livelihoods alone will not reduce effort or prevent overfishing. What is required is two-pronged approach. It is essential to both: 1) provide incentives for those who are currently fishing to leave the activity, and 2) take action to limit new entry into the fishery. If the fishery remains open access, the equilibrium point will never achieve optimum biological or economic yields. Programs that invest in alternative livelihoods without requiring a reduction in the total number of licenses/fishers will not result in reduced fishing pressure.

Many individuals enjoy the occupation of fishing. They view it as a chosen way of life, and are unwilling or reluctant to leave it. While a full exit from the fishery may be the ultimate goal, a gradual approach may be necessary. This includes encouraging fishing households to try additional or supplemental income and food-producing activities that make them less economically dependent on fishing alone. Reducing, but not eliminating, fishing as a livelihood helps preserve the cultural heritage of fishing and reduces the socioeconomic dislocations that would come with a full exit—if a full exit were necessary in the future.

What is needed is an integrated approach that considers resource management along with economic and community development. Solutions to a healthier, more sustainable fishery often depend on changes not just within, but outside the fishery sector. This requires understanding how men and women adapt, the incentives that drive decisions and behaviors of the resource user, and the sources of vulnerability to stresses and shocks. It requires addressing more holistically the social, economic, and environmental reforms that affect individuals, households, and communities.

Effort reduction is the critical first step in fisheries management and sustainability. There are several ways to accomplish this. One is to shift from full- to part-time fishing, or to use other forms of input controls

and catch quotas. These are described in more detail in subsequent sections of this Guide. These shifts may be biologically or economically healthy for the fishery, but almost always result in social costs to fishing communities and families. Such costs generally need to be addressed and mitigated as part of an overall fisheries reform package. Capture fisheries reform programs must be very clear on their objectives. Assuming a key objective is to reduce the fishing effort, the program design must include strategies and processes to garner stakeholder and political support for the proposed changes. It must also consider ways to ameliorate the impacts on fishing communities—where fishers are often unwilling or unable to leave fishing as an occupation.

There are creative and innovative approaches to the challenge of open access nearshore fisheries and over-exploitation. This includes co-management, ecosystem-based management, inclusive, and participatory processes, as well as promotion of sustainable diversified livelihoods.

CO-MANAGEMENT

Key Questions

- What types of co-management approaches are used in fisheries management?
- How does co-management differ from decentralization?

There is increased recognition that fisheries can be more efficiently managed when fishers are involved in the process. As fisheries become self-regulated, issues of enforcement and compliance—often major factors in management failure—typically diminish. Co-management is a partnership arrangement where fishers and government share responsibility and authority for managing the fishery. It has many variations ranging from fishers playing a minor role to being included as major decision-makers—often supporting the science, enforcement, and management of the fishery. Community-based management is one form of co-management and is carried out at small-scales by village communities. Traditional management is a form of community-based or co-management. It integrates local cultural or traditional practices, and often follows informal rules or community norms that fall outside of legal or conventional management regimes.

Co-management is different from, but related to, decentralization in fisheries. Decentralization can take several forms, from de-concentrated to delegated authorities. Usually decentralization refers to shifting of responsibilities from central government to lower levels of government—e.g., municipalities in the Philippines or districts and provinces in Indonesia. Administrative decentralization may or may not include delegation of responsibilities for fisheries management or clearly defined maritime jurisdictions of fisheries authority. The Philippines is a good example of decentralized fisheries management. In the Philippines, municipalities control all fishing within 15 km of the shoreline. Central government retains control beyond 15 km, to the limits of the exclusive economic zone (EEZ). While central government controls licensing for commercial fishing vessels, these vessels cannot fish in municipal waters without municipal licenses as well. In Indonesia, the districts manage the marine resources from the shoreline to four nautical miles. Provinces manage from four to 12 nautical miles, and the central government retains responsibility from 12 nautical miles to the limits of the EEZ. Decentralized administrative authorities can decide on the degree of co-management within their area of jurisdiction. Decentralization and co-management are often implemented hand-in-hand.

ECOSYSTEM-BASED MANAGEMENT

Key Questions

- What is an ecosystem-based approach to fisheries management?
- Why is it important for implementing sustainable fisheries programs?

An ecosystem-based management (EBM) approach to fisheries management focuses on conserving the underlying health and resilience of the ecosystem, thus maintaining the system's goods and services and leading to increased productivity. Developing an ecosystem-based approach to fisheries management need not be complicated. It is built around common sense principles (see box below) that include:

- Identifying critical fisheries nurseries, habitats, and linkages between habitats, such as between mangrove forests and coral reefs
- Understanding freshwater inflows into coastal estuaries
- Maintaining the quantity, quality, and timing of such flows that make wetlands some of the most productive ecosystems in the world
- Understanding how human activities impact ecosystem function

The 10 Commandments of Ecosystem-Based Fisheries Management

- Keep a perspective that is holistic, risk averse and adaptive
- Question key assumptions, no matter how basic
- Maintain old growth age structure in fish populations
- Characterize and maintain the natural spatial structure of fish stocks
- Characterize and maintain viable fish habitats
- Characterize and maintain ecosystem resilience
- Identify and maintain critical food web connections
- Account for ecosystem change through time
- Account for evolutionary change caused by fishing
- Implement an approach that is integrated, and inclusive

Source: Hixon et al. (2007)
http://www.csc.noaa.gov/cz/2007/Coastal_Zone_07_Proceedings/PDFs/Tuesday_Abstracts/0000.Hixon.pdf

EBM can be viewed as a long-term, incremental process that over time builds increasing levels of integration and larger scales of management. Existing sectoral-based fisheries management can move on a path towards ecosystem-based management in any number of ways. For example, it can incorporate initiatives targeted at marine habitat protection, especially habitats such as coral reefs and mangroves that are important in various life stages of the most economically important fisheries. EBM can acknowledge the important role of herbivores in coral reef ecosystems and the role of top predators, such as groupers and sharks, in maintaining ecosystem resilience and integrity. It can incorporate efforts to address land-based sources of marine pollution, or it can help in assessing and planning for the impacts of global climate change.

EBM approaches to fisheries often recommend the application of the precautionary approach. In certain situations, such as when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. When there is scientific uncertainty on the potential impacts or consequences of a fishery project, it is essential to conduct an evaluation and risk assessment before moving ahead. Monitoring and risk assessment should continue throughout the project as well.

EBM does not necessarily require a high degree of scientific understanding of the marine ecosystem and fisheries components. However, it does require a basic understanding of the potential linkages and the political will to make sound decisions. While EBM should encourage the use of best available science in decision-making, fisheries are often managed in information-poor contexts. Ideally, science is needed for good governance, e.g., adequate assessments of fish stocks. Unfortunately, the resources to obtain such knowledge will always be limited. Management decision-making should also incorporate traditional and local knowledge provided by stakeholders. In some cases, local knowledge may be the *only* source of information on complex stocks and on ecosystems. Regardless, in most cases there is usually sufficient knowledge about how similar types of ecosystems function to guide management actions in a precautionary manner.

USE RIGHTS

Key Questions

- What are use rights in fisheries?
- What types of use rights are applicable in developing country contexts?

Under a rights-based system, those individuals or groups entitled to access the fishery are said to have use rights. Rights in a fishery define the particular actions a fisher is allowed to take and the claim the fisher has to a benefit stream. These rights/benefits are usually protected by the government. Rights provide fishers with an incentive to behave in a way that helps ensure long-term sustainability and greater stewardship of the fisheries resource.

Use rights systems fall into two categories. Access rights allow entry into the fishery and harvesting. Harvest rights provide the right to a specific amount of effort on a specific species. Licensing and total allowable catch rules, as described below, are forms of use rights. Territorial use rights in fisheries (TURFS) are often important in rural isolated locations and where tribal or traditional use practices are still respected within the local culture. Often, such traditional use rights can be codified or endorsed within "modern" management policies and laws.

Use rights can be controversial. This is especially so when a part of the fishing community is excluded from fishing. Once use rights are allocated, the next question is, "Should they be transferable?" Can they be bought and sold or handed down within families or communities? Can women as well as men buy or inherit these rights? Can rights be transferred permanently or borrowed for short times? There are major consequences to the decisions made regarding this management issue. This includes the economic efficiency of the fishery, the social cohesion of the community, and the concentration of rights to a few.

Use rights or catch shares (or sector management) can be extremely useful in managing a fishery, as they confer a clear economic "asset" to the user/owner. This can create positive incentives for enhanced stewardship, self-compliance, and reinvestment into management.

A type of use rights that is popular with economists is individual transferable quotas (ITQs). ITQs allocate annual fishing quotas to individual fishers. These can be bought and sold among fishers or conservation groups. However, in the context of small-scale fisheries, ITQs or overall total allowable catch (TAC) quotas are seen as unworkable. They require careful monitoring of individual catches and a system that can easily shut down fishing as soon as a quota is reached. Given the highly dispersed nature of most small-scale fisheries and data-poor systems, quotas are generally not feasible. New ideas to address these problems include allocating collective quotas or sector quotas. In these cases, a fishers' association may own the rights to a certain transferable quota and decide collectively how it will be allocated amongst its members. When considering ITQs as an alternative, it is necessary designate the maximum allowable percentage of the total quota that any one firm or individual can own. This is necessary to avoid too much consolidation in the industry and situations of monopoly. In some

Examples of Use Rights

Access Rights
- Territorial Use Rights in Fisheries (TURFS)
- Limited entry

Harvest Rights
- Input/effort rights (time, location, gear)
- Output rights (annual quotas, trip limits)

cases, there should also be processing quotas for processing plants and harvest quotas for fishers.

There are management approaches that tap into the rights of owners, managers, and users. Marine conservation agreements (MCAs), for example, can be entered into with governments, local communities, and fishing cooperatives. MCAs help in restricting and managing activities, and in restoring areas. MCAs work within the existing forms of governance to improve fisheries.

Elements and Variables of Marine Conservation Agreements

Mechanisms		Parties		Benefits	
Formal	**Informal**	**Grantor**	**Grantee**	**Incentive**	**Protection**
• Purchase and sale • Lease • Easement • License • Permit • Concession • Contract	• Verbal • Handshake	• Private individuals • Private companies • Local government • State • Federal	• NGOs • Communities • Ecotourism • Other for profits	• Direct payments • Social services • Infrastructure • Jobs • Culture • Pride	• Ownership • Access • Harvest • Management
• Duration defined or undefined		• Lead Implementer		• Behavior changes • Laws/regulations • Private MPAs • Community MPAs • State, Federal MPAs	

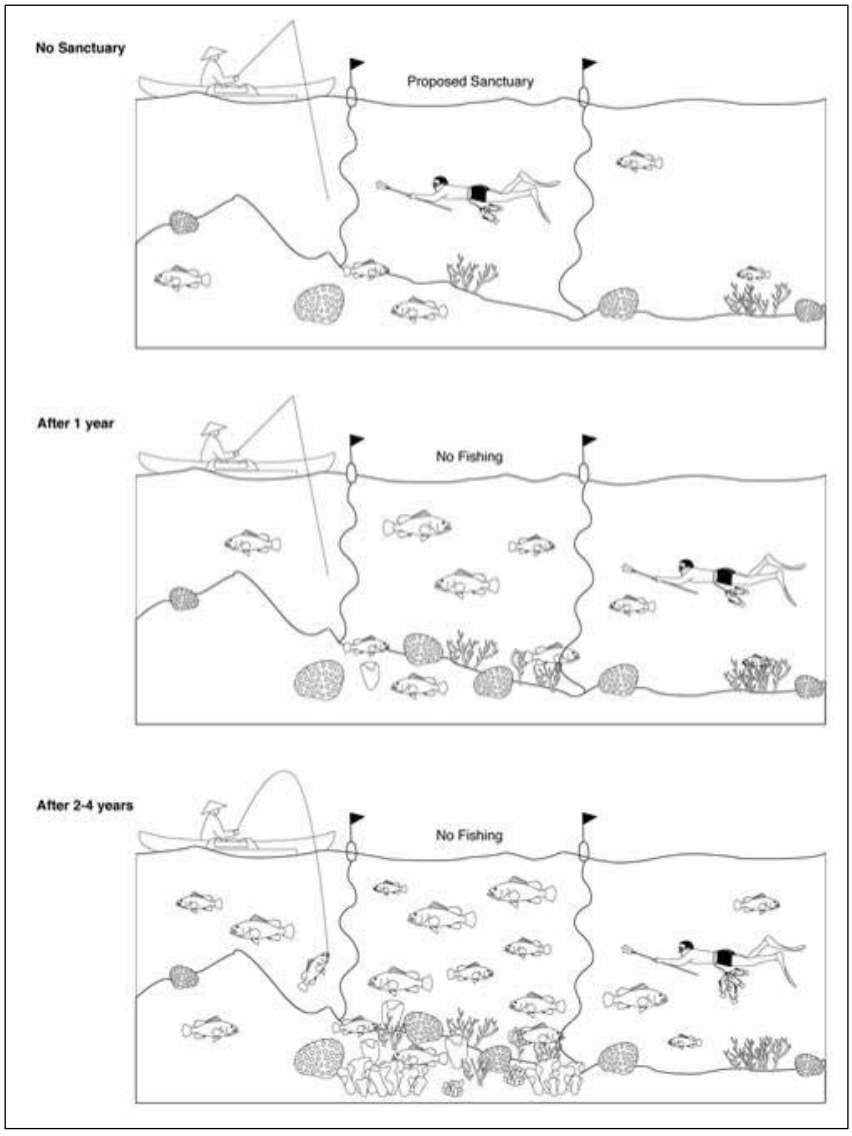
Source: www.leaseown.org

OUTPUT CONTROLS

Key Questions

- What types of fisheries regulations are considered as output controls?
- What are the advantages and disadvantages to output control regulations?
- Can they work in developing country contexts?

Output controls are direct limits on the number or size of fish harvested regardless of the inputs used. They include such measures as a limit on harvest, total allowable catch, discards, and minimum and/or maximum allowable size.



Size limits. Size limits vary by the species harvested. For example, sizing would be measured as carapace length for lobsters or crabs, head to fork length on finfish, or shell width for bivalves such as clams. Size limits can be a maximum or minimum size. A minimum is used to allow the population to reach reproductive age and spawn at least once before being harvested. Minimum size for a species is set relative to the average individual size at spawning maturity. A maximum size allows a certain portion of the population to grow very large and thus realize greater spawning potential (e.g., one 10 kg red snapper can produce many more eggs than ten 1 kg red snappers). More reproductive output from large breeders means more potential for recruitment into the fishable stock.

Prohibitions. Certain species can be banned from harvest altogether. This can include endangered or threatened species such as sea turtles, marine mammals, hard coral, and certain types of groupers, etc. Prohibitions can be placed on species that are not on the Convention on International Trade in

Endangered Species (CITES) list (See Chapter V), but whose spawning stock sizes are so small as to threaten commercial extinction.

Total allowable catch (TACs) or harvest limits. Total allowable catch (TAC) can be a soft or hard TAC. A soft TAC is used as a reference point to assess how close actual landings are to desired levels. Soft TACS may be modified as necessary. A hard TAC is a limit and cannot be exceeded. It restricts the harvest to a safe proportion of the exploitable stock of fish. A hard TAC is usually less than the actual maximum yield that can be extracted by the fishery based on biological considerations or effort levels. This figure needs annual updating since all stocks experience variations in their recruitment and mortality parameters. The fishery must continue to be managed so as not to exceed the hard TAC.

Co-management requires government to relinquish some decision-making authority to fishermen and requires a williness of government agents to communicate with fishermen in situations where fishermen are comfortable in honestly and clearly articulating their concerns.

There are challenges to the TAC approach. If issued for an entire fishery, the TAC can lead to a "race to fish"—with each vessel trying to catch the most fish over the shortest period. Also, if there are many landing sites, it may be impossible to gather all the landings data before TACs are exceeded. In small-scale tropical countries where it is impossible to monitor all landing sites, this form of management may be inoperable unless there exists a community-based management authority. Although TACs used this way are more difficult to monitor, it allows fishers to choose the most advantageous times to fish. For example, they may elect to fish when prices are high and/or when it is likely they can reduce by-catch and discards. TACs are also associated with the individual transferable fishing quota (ITQ) or sector quotas previously mentioned.

INPUT CONTROLS

Key Questions

- How do input control regulations differ from output controls?
- What are the various types of input controls?
- What are the limitations of using input controls?
- How can they be used in combination with output controls?

Input controls are regulations directed at controlling the fishing power and total effort used to harvest fish. They can be in the form of limits to the number and size of fishing vessels; to the amount of time allowed to fish; and to the types, numbers or characteristics of gear used.

Gear Restrictions. Gear restrictions can range from requiring minimum mesh sizes to avoid catching juvenile fish, to outright prohibitions on certain gear types. For instance, dynamite or blast fishing, the use of poisons such as sodium cyanide, or electro-fishing should be banned outright.

Licensing. There are numerous ways to manage fisheries effort or catch. It is the way these management efforts are imposed that will determine which objective(s)—social, economic, or biological—are successfully met. Licensing provides the most basic form of effort control. Unfortunately, in some cases licensing requires little more than filling out forms and paying a nominal fee. Licensing can also create what is known as "latent" effort—i.e., where the license is purchased but not active. Matching licenses to a minimum level of landings is one way to eliminate latent effort. Licenses need to limit vessel capacity to prevent upgrading to more efficient vessels at a later date. This is especially important if licenses are transferable. This is especially important if licenses are transferable – that is, they can be bought or sold or transferred from father to son as an inheritance. A licensing scheme of some form will be necessary to manage effort at sustained levels and particularly if long-termuser rights are to be granted, a license confers certain use rights. If short-term limited licenses are issued, it becomes difficult to institute long-term solutions and to address sustainability issues.

Frequently, more licenses are issued than the fishery can sustain. This leads to overcapacity in the fleet. When this happens, governments must reduce licenses in some equitable fashion. Even then, reducing the number of licenses may not reduce effort unless there are also restrictions on the number and/or size of vessels and gears per licensed vessel. Another option to help reduce effort is designating shorter fishing periods. All these measures are difficult to manage effectively and may even exacerbate the situation by creating a "race to fish" atmosphere, as described under the previous section on TACs.

Area and time closures. Several terms are used to define area closures, regardless if they are permanent or seasonal closures. The most commonly used term is "protected area." Protected areas range from no-take of all species, to restrictions only on selected species, to restrictions on gear types, or seasonal closures such as during spawning season. An important element of the protected area tool is its clearly stated objectives for closure.

Time and area closures are simple and effective in protecting species, provide a tractable approach for stock protection when data are poor or absent, and protect sensitive benthic habitat. One disadvantage is the high transaction cost of interagency negotiation. Others are the difficulty in getting resource users to comply with protected area rules and regulations, and the high costs to enforce them.

Objectives of Area and Time Closures

Fishery Purposes:
- Protect spawning locations or individuals; or protect juveniles
- Protect depleted stocks during a rebuilding period
- Protect genetic reservoirs
- Protect critical habitat
- Restrain excess fleet capacity and optimize the value of the catch

Conservation:
- Protect benthic habitats of high conservation value
- Limit bycatch
- Protect attributes that are critical for maintaining ecosystem

Equity:
- Provide a mechanism for resolving conflict over multiple use areas
- Reserve economically vital marine and coastal resources for traditional users

A critical issue for fisheries management in situations where ecosystems have been heavily overexploited is a rebuilding of standing fish stock biomass. Without a critical spawning stock left in-situ, fisheries populations cannot reproduce and replace themselves. Without a sustained surplus of fish being produced, there is too little for people to harvest for food and income. Also, it is best to retain a certain level of large-sized adults (especially for long-lived species) because on a "per unit weight" basis they are the most likely to produce more eggs and offer reproductive potential.

Area and time closures and size limits are typically the primary management tools when the key objective is to rebuild stock biomass in an overfished system. In most instances, these tools can be combined with other input and output controls.

NO-TAKE RESERVES

Key Questions

- What is the difference between a protected area and a no-take reserve?
- Why are they popular as a fisheries management tools?
- What are the design criteria for establishing individual and networks of no-take reserves?

No-take reserves deserve special mention. Increasingly, they are a tool of choice for biodiversity protection and fisheries conservation and management in developing countries. No-take reserves are also sometimes referred to as locally-managed marine areas sanctuaries, or core areas. They are a specialized form of area closure. No-take reserves can also be controversial, often facing strong opposition from the fishing community. In all cases, it is important to provide education to and engage stakeholders in decision-making on and implementation of no-take reserves.

Women cockle gatherers on Zanzibar have established community-managed no-take reserves inside the Menai Bay Conservation Area to rebuild spawning stock biomass and populations of bivalves in adjacent areas that are important sources of income and food security.

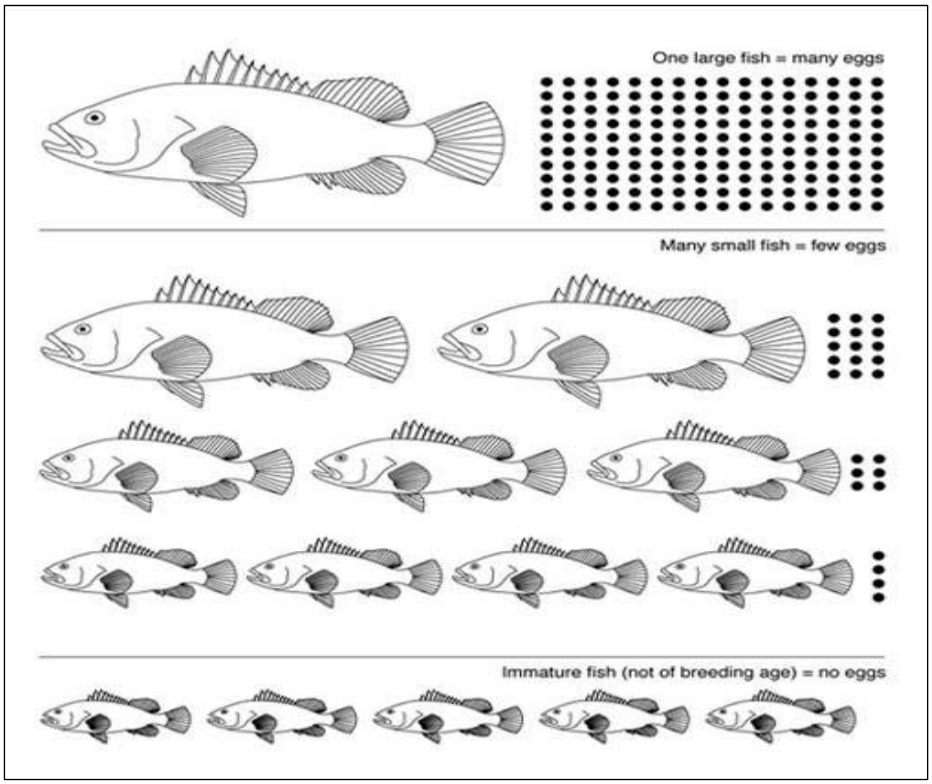
In a no-take reserve, all extractive activities—including fishing—are permanently prohibited. Some no-take areas allow for other non-extractive activities to occur, such as scuba diving or snorkeling. Marine conservationists are increasingly advocating for no-take reserves as they typically provide high biodiversity as well as fisheries benefits. A no-take marine reserve is a form of marine protected area (MPA), and may have a management goal focused primarily on biodiversity conservation or fisheries. It is important to distinguish the purpose of the no-take reserve, as should influence how it is designed.

No-take reserves used for conservation purposes are intended to:

- Protect valuable habitats and preserve biodiversity within the reserve's boundaries
- Generate greater species diversity
- Increase overall biomass, size, and abundance of individuals
- Result in higher levels of reproductive output than areas open to extractive uses (e.g., fishing)
- Protect ecologically resilient areas that can help the larger ecosystem rebound from natural or man-made disasters

No-take reserves influence adjacent areas that are open to fishing. This is important to consider when deciding whether to implement no-take reserves for fisheries management purposes. Two functions of a no-take reserve are of primary importance—adult spillover and larval export. "Spillover" refers to adult fish swimming out of the reserve and becoming available to be caught by fishers. The premise is that as

fish abundance and size increase inside the reserve, crowding and competition for food and space forces some fish to migrate out. It is not unusual to see "fishing the line," whereby fishers stay right on the edge of the reserve. Here, the catch rates are higher and the fish size larger than in areas further away. "Larval export" or "larval recruitment" refers to the export of larvae from the reserve to adjacent areas. The reserve effect, by producing older and larger sized individuals, results in these individuals producing more eggs and larvae per unit of biomass than smaller individuals typically found in fished areas. The reserve then provides for increased seeding of open, adjacent areas as larvae are carried by the currents to downstream areas. As these larvae grow, the result is larger numbers of individuals available for capture.



Why a build-up of big fish in marine reserves helps increase reproduction

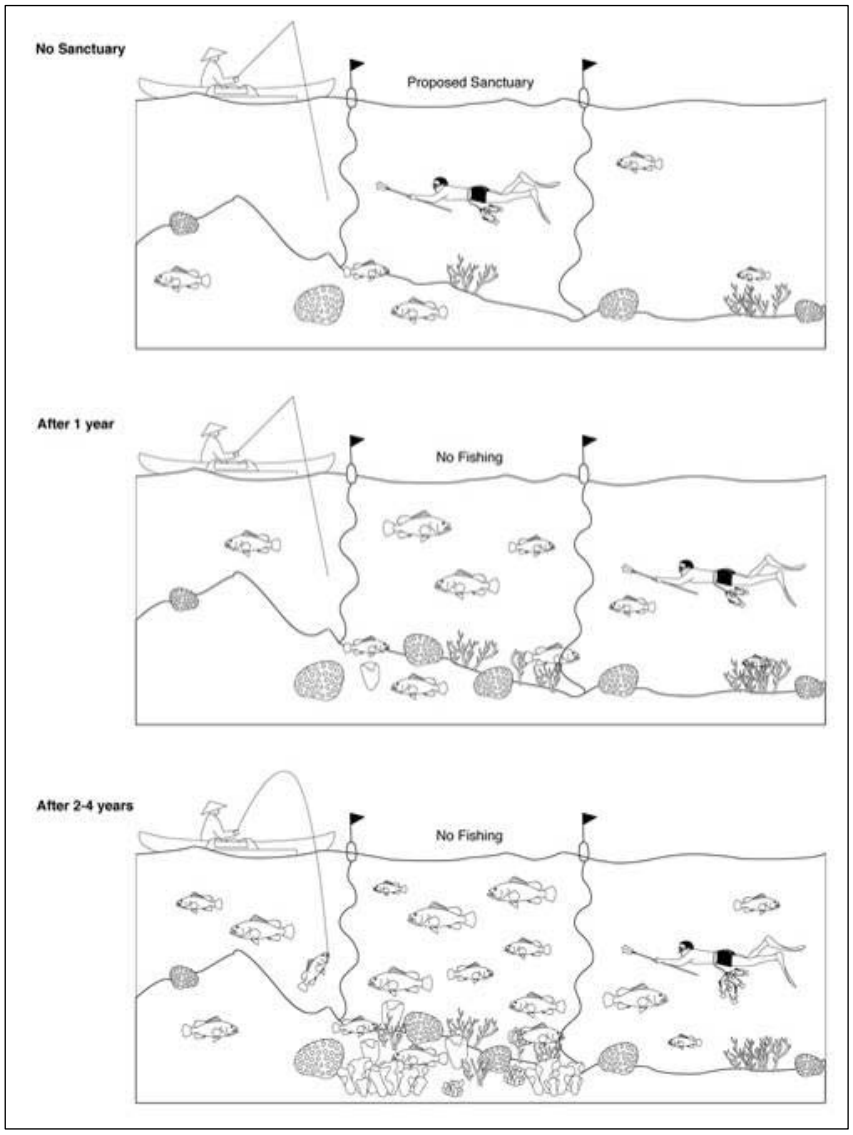
Most conservationists use the rule-of-thumb that approximately 20-30 percent of aquatic habitats should be set aside as reserves if they are to fully achieve conservation and fisheries management objectives. However, most experts stress that, in addition, sites need to be carefully selected and individual reserves should be nested within large-scale networks. Networks of reserves are often part of larger-scale seascape programs. Such programs "nest" reserves designed for the purpose of conservation into larger-scale management systems. These "nested" reserves usually designate some areas primarily for conservation and others for sustained use, especially fisheries.

Many conservationists argue for large-sized reserves to ensure self-replenishment of species within the reserve. Another argument for the larger size is that adults—which have the greatest potential for reproductive output—are less likely to escape from their home ranges and be caught. Where the objective is fisheries management rather than conservation, the preference is often for smaller-sizes reserves. These provide more spillover and edge effect and are more readily accepted as legitimate by fishers.

No-take reserves are a relatively easy tool to implement. They can be a good choice for tropical developing nations, where the institutional capacities to successfully apply alternative management techniques are weak. A critical success factor for reserves is high compliance with no-take rules. Many existing reserves are established by national mandates and are centrally planned, often with little local stakeholder involvement. They are then poorly managed with inadequate resources, weak enforcement, and strained relations with local stakeholder groups. Top-down approaches such as this—i.e., that impose reserves on fishers with little or no consultation—invariably result in poor legitimacy, low compliance,

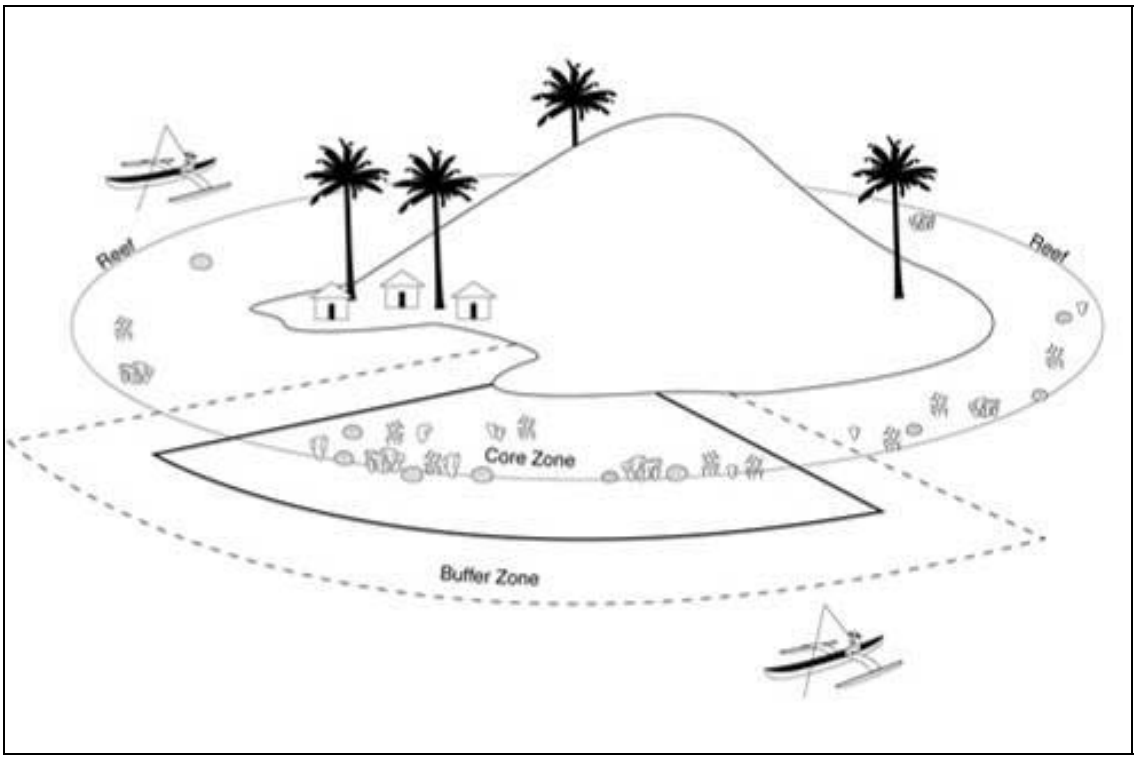
and high levels of poaching. At the other end of the spectrum are reserves that are locally managed—by local governments, private sector groups, nongovernmental organizations, communities, and/or traditional groups. For small-scale traditional or community-based reserves, the factors that make these successful are well known. The major factor is having a high level of local stakeholder involvement in planning and implementation.

Key stakeholders, especially fishers, must perceive tangible benefits if reserves are to be sustainable in the long term. Reserves established for tourism or conservation cannot be assumed to automatically benefit fishers. For this reason, impacts on this particular group must be carefully assessed.



Typical progression of habitat recovery and build up of fish biomass as a result of area closures or permanent no-take reserves.

The local context should drive the shape and size of the reserve and the choice of institutional arrangements for its management (e.g., centralized vs. community-based or traditionally managed). As well, the design of the reserve should be practical and have the greatest probability of success. For example, is a permanent no-take arrangement feasible in the local context? The answers to this and other questions will influence whether ecological considerations need to be compromised in order to accommodate the social, economic, and political considerations necessary to achieve fisheries management outcomes. For example, in the traditionally managed reserves in Eastern Indonesia and Papua New Guinea, the permanent no-take rule is not absolute. Rather, the reserves are opened for short periods (one to two days) during cultural celebrations. This accommodation has lead to high compliance with no-take rules for the rest of the year, resulting in lower overall poaching levels and a higher degree of conservation and fisheries performance.



Typical design for a community-based marine reserve showing core no-take zone and a buffer zone

VOLUNTARY AND INCENTIVE-BASED APPROACHES

Key Questions

- What are voluntary and incentive-based approaches?
- What are BMPs and codes of conduct?
- Can certification and eco-labeling be applied to fisheries management in developing country contexts?

There are two types of voluntary and incentive-based approaches. One is codes of conduct or best management practices. The second is eco-labeling or certification schemes. Regulatory approaches have their limits and may require high implementation costs for monitoring and enforcement. In contrast, voluntary and incentive-based approaches encourage fishers to "do the right thing" through moral suasion, peer pressure, or for economic reasons. Incentive-based and voluntary approaches can be referred to as market-based approaches. Some market-based approaches attempt to address the problem of sustainability from the consumer demand side. Consumer-based approaches promote mass movements to buy only sustainably sourced seafood from retailers or patronize restaurants that serve only sustainable green or eco-labeled seafood.

Codes of Conduct and Best Management Practices. Codes of conduct are broad guidelines or statements for conducting an activity in a socioeconomically and environmentally compatible ways. This often is expressed as a national or industry policy. The best management practices (BMP) approach relies mainly on voluntary adoption of practices that optimizes production, minimizes impacts, increases benefits, and reduces risks of all types. Quite often, industry associations and government can work on establishing a code of conduct for responsible fisheries as a step preceding BMPs. Training and extension at all levels is essential in promoting individuals and industries to implement BMPs and other voluntary forms of compliance.

A turtle excluder device (TED) in a trawl net allowing for the escape of a marine turtle is one form of BMP for trawling in tropical waters.

Eco-labeling and Certification. Some countries have introduced traceability and labeling schemes as an incentive for sustainable fishing practices. An eco-label is a tag placed on a product that certifies it was produced in a sustainable, environmentally friendly way. These tags allow consumers to make informed choices about the purchase of the product. Eco-labels allow consumers to choose seafood products based on specific criteria and to ultimately promote sustainable fishing practices. Fishers benefit from new and more

consistent markets. In some cases, but not always, fishers may also benefit from higher prices associated with eco-labeled fish products.

A Certified Small-scale Fishery

The Baja California spiny lobster fishery made history by becoming the first small-scale community fishery from a developing country to become certified. This fishery had to address both data gaps and political obstacles on their path towards Marine Stewardship Council (MSC) certification. They were successful in large part due to the will and determination of the 10 communities that make up this fishery.

Certification is another voluntary and market-based measure gaining in popularity and related to eco-labeling. Certification encompasses three processes: 1) standard setting; 2) accreditation; and 3) certification. Rigor, neutrality, and transparency must be inherent in these processes for certification to be effective and accepted by the stakeholders. In certification programs, an independent body—e.g., the Marine Stewardship Council (MSC)—sets sustainability standards against which a particular fishery is audited. If a fishery meets the standards, it can be certified and use the MSC label on its products. Certifying bodies work through the private sector's value-added chain of buyers and producers. They charge fees for their certification services and for the use of the eco-label. The incentive is the potential price premium that consumers will pay for the eco-labeled vs. non-labeled products. Currently, however, it is unclear how much of a price premium actually exists. Also, when all producers have the eco-label, the price premium incentive disappears. That said, wholesalers and retailers view certification as part of their corporate responsibility to be good environmental and social stewards. At the same time, they are helping ensure there is a stable and continuing supply of product on which their businesses depend.

For some countries, the costs of complying with certification standards may be excessive. In addition, certification demands data on the resource that often is lacking and costly to collect. As such, small-scale fishers in particular lack the financial or human resources to meet certification demands—even when they are organized into larger producer groups. Even at the country level, many lack the human, institutional, or infrastructural capacity to participate effectively in international trade.

Certification and eco-labeling schemes are generally geared to large-scale commercial and industrial fisheries in developed northern countries, or at very specific high-value species exported from developing countries to developed countries. There is an increasing amount of fish trade moving from developing to developed countries. This creates increased opportunities for using this approach for these types of seafood products. Currently, eco-labeling and certification are not useful for the vast amount of seafood harvested for local consumption in developing countries, where fish is often a basic commodity and accounts for the majority of protein consumed. Further, poverty and the lack of environmental/nutritional awareness will likely make developing country consumers resistant to the higher prices required to justify eco-labeling.

TRADE

Key Questions

- What are trade-based approaches?
- How does the U.S. use trade-based approaches to fisheries management outside the U.S.?

Developing countries often see importation measures aimed at more sustainable fisheries as obstacles to trade. For example, U.S. law (Section 609 PL 101-162) requires that wild caught shrimp imported into the U.S. be certified as caught in a manner that does not result in significant mortalities of marine turtles protected under U.S. law and international treaties. This requires the use of such devices as turtle excluder devices (TEDs) and bycatch reduction devices (BRDs) or other methods that can demonstrate comparable bycatch mitigation results. The State Department certifies countries that meet these standards—currently 40 qualify. Some meet the standards only because they have shown no direct impact on turtles.

Other countries may welcome importation measures as a way to assist in more sustainable resource management and illegal exports. Trade approaches can be used to combat illegal, unregulated, and unreported (IUU) fishing. For example, the U.S. is required to work with listed nations to take corrective action to address IUU fishing. The absence of steps to address problems of IUU fishing and bycatch of protected species may lead to prohibitions on the importation of certain fisheries products to the U.S.

ACCESS AGREEMENTS

Distant water fleets (DWFs) fish outside their national waters and must enter into agreements with individual countries to fish inside of the EEZ. These agreements generally involve access to the fisheries resources in return for a financial contribution or in-kind benefits. Access agreements can be an important source of revenue for developing countries and provide additional fishing opportunities for the DWFs. However, they also can have detrimental effects on the stocks and local fisheries. In some cases, access agreements have been negotiated without adequate knowledge of the state of the fish stocks or knowledge of fair price. Many developing states lack the capacity to manage their fisheries including monitoring and enforcement. The access agreements may inhibit host countries from developing their own capacity to generate economic benefits—e.g., development of a local fleet or drawing economic rent from the foreign fleets. Agreements may also create conflict between the foreign vessels and the local fishers as they compete for resources and a market share. A country's dependency on this income may create a reluctance to limit fishing opportunities even when stocks are overexploited.

When developing countries have effective governance and management in place, access agreements can provide the following benefits:

- Providing access only for surplus stocks
- Providing effective enforcement through MCS
- Developing port and processing infrastructure to capture a greater portion of the potential value-added from the agreement
- Providing reliable stock assessment data

SUBSIDIES

A fisheries subsidy is a government intervention (or lack of) that affects the fishing industry and has an economic value. Subsidies affect the profitability of the fishing industry. They can include interventions such as offering fuel tax rebates, providing landing site facilities, issuing investment grants, and instituting no-access fees. Subsidies may also impact trade regulations and exchange rates. Global fishing subsidies are estimated at US$30 to $40 billion annually.

While not all subsidies are harmful, many do increase fishing effort and capacity. In some cases, fleets might not be profitable without subsidies. Fisheries subsidies may distort competition. Under certain conditions, a subsidy can benefit developing countries struggling to develop their local fisheries, especially in the international trade market. However, there continues to be great debate about criteria for subsidies and evaluation of their impacts.

RESEARCH AND EXTENSION SERVICES

Extension is the process of promoting the transfer of information and technology, and providing support for its implementation and improvement. Extension is an institutionalized means of supporting fisheries by providing new information and methods, and linking fishers and managers with researchers. This is usually performed by extension agents based at universities or government agencies. In the case of the U.S. Land Grant or Sea Grant agencies, individuals may play both a research role and an extension role. Extension agents may also assist with non-technical topics such as institution building, management techniques, marketing, or financing. Some countries have little or no extension capacity. This must be strengthened if fisheries are to develop and provide benefits.

Fisheries require extensive research support—especially regarding stock assessment, gear technology, and management techniques. Research and extension support are critical in helping to move fisheries towards environmental and social sustainability. Generally, a single operational practice can affect production, environmental impacts, and profitability. Hence, efforts to improve practices of all types through research, extension, and education have multiple benefits. In most cases, the research role will fall to university and government scientists. For over 20 years, USAID has also played a key role in guiding and sponsoring fisheries research through its Collaborative Research Support Program (CRSP), the World Fish Center, and other organizations. USAID support to fisheries has included the development of partnerships between U.S. and foreign universities to deliver training programs, fund graduate students, and link extension and research.

SOURCES FOR MORE INFORMATION

Management / Managed Access

A Fishery Manager's Guidebook. 2009. http://blackwellpublishing.com/book.asp?ref=9781405170857&site=1

The knowledge base for fisheries management in developing countries-alternative approaches and methods. Report to Nansen Programme. Bergen, Norway. Institute for Fisheries Management and Coastal Community Development. http://www.ifm.dk/reports/67.pdf

Understanding Fisheries Management. 2005. http://nsgl.gso.uri.edu/masgc/masgch00001.pdf

Pew Marine Conservation Fellows' Action Statement for Fisheries Conservation. http://www.tucs.org.au/~cnevill/marinePewFellowsStatement2005.pdf

Co-Management

Fishery Co-Management: A Practical Handbook. http://www.idrc.ca/en/ev-92339-201-1-DO_TOPIC.html

Devolution and Fisheries Co-Management. http://www.capri.cgiar.org/pdf/pomeroy.pdf

Fisheries Co-Management fact Sheet K. http://www.seagrant.uconn.edu/COMGMT.PDF

Fisheries Co-Management Collaborative Research Project. http://www.co-management.org/

The Fisheries Co-Management Experience: Accomplishments, Challenges and Prospects. http://www.amazon.com/Fisheries-Co-management-Experience-Accomplishments-Challenges/dp/1402014279

Use Rights

Rights based fisheries management. http://www.seagrant.uconn.edu/RightsBased.pdf

Who gets the fish? Proceedings of the New England Workshops on Rights-Based Fisheries Management Approaches. http://seagrant.gso.uri.edu/bookstore/rights_fish_workshop.pdf

The Use of Rights-Based Measures in Fisheries Management. WWF Position Paper. 2007. http://ec.europa.eu/fisheries/cfp/governance/consultations/contributions260207/wwf_en.pdf

Territorial use rights in marine fisheries: definitions and conditions. http://www.fao.org/docrep/003/T0507E/T0507E00.htm#toc

The Practitioners Toolkit for Marine Conservation Agreements. www.mcatoolkits.org

Ecosystem-based Fisheries Management

Ecosystem-based fisheries management. http://www.nmfs.noaa.gov/sfa/EPAPrpt.pdf and http://www.seagrant.uconn.edu/ecosystem.pdf

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Ten commandments for ecosystem-based fisheries scientists. M. Elizabeth Clarke, Steven A. Murawski, and Stephen Ralston. 2007. http://www.csc.noaa.gov/cz/2007/Coastal_Zone_07 Proceedings/PDFs/Tuesday_Abstracts/0000.Hixon.pdf

Advancing Ecosystem based management – A decision support toolkit for marine managers. www.marineebm.org

Marine Protected Areas and Marine Reserves

Marine Protected Areas as a Tool for Fisheries Management (MPAs). http://www.fao.org/fishery/mpas/en

The science of marine reserves. http://www.piscoweb.org/outreach/pubs/reserves

When can marine reserves improve fisheries management? Ray Hilborn et al. http://www.esm.ucsb.edu/academics/courses/595PB/Readings/Hilborn_et_al_2004.pdf

Sustainable Livelihoods Approach

The sustainable livelihoods approach. http://www.fao.org/fishery/topic/14837

FAO Code of Conduct for Responsible Fisheries. http://www.fao.org/fishery/ccrf/2/en

Strategy for Market-Intervention Tools to Conserve Marine Fisheries. http://www.packard.org/assets/files/conservation percent20and percent20science/marine_fisheries_strategy_041007_Web_site.pdf

Marine Stewardship Council. http://ecolabelling.org/ecolabel/msc/

Technical consultation on international guidelines for the eco-labeling of fish and fishery products from marine capture fisheries. ftp://ftp.fao.org/docrep/fao/007/y5889t/y5889t00.pdf

Trade-Based Approaches

Shrimp embargo legislation for marine turtle conservation, http://www.nmfs.noaa.gov/pr/species/turtles/shrimp.htm

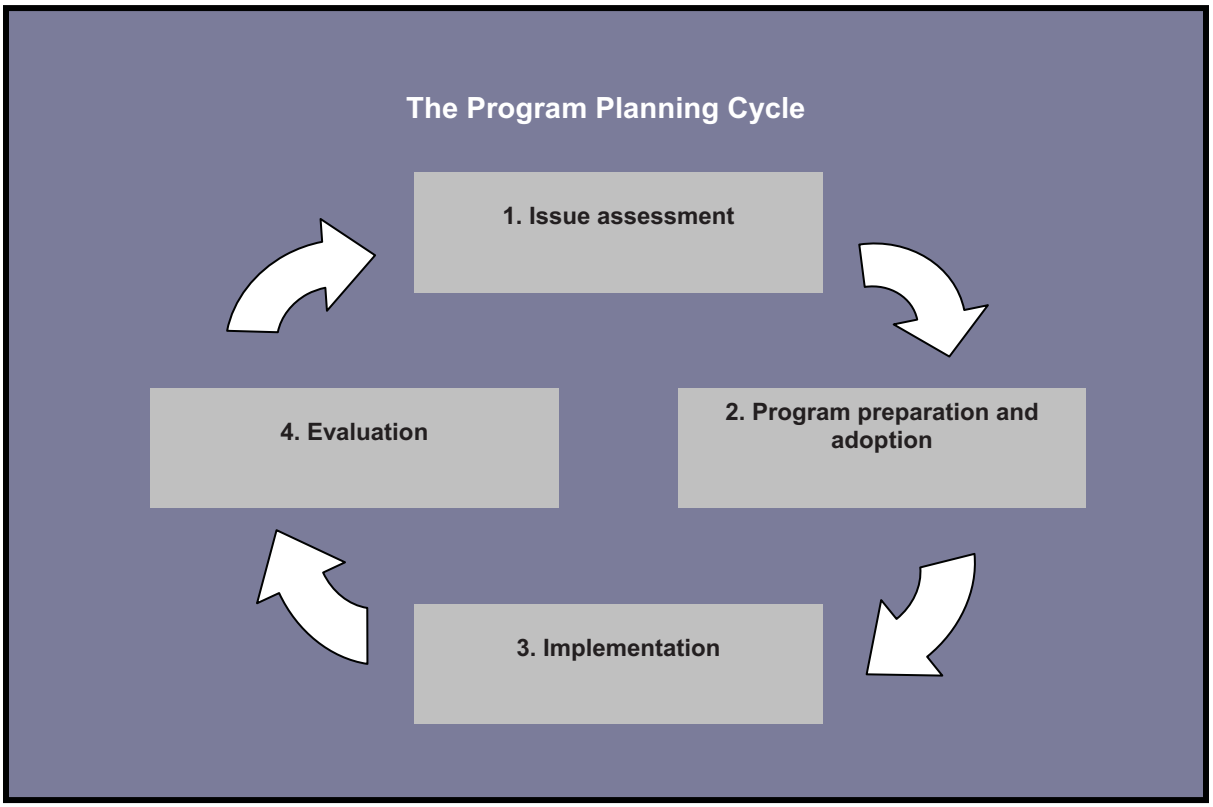
Sea turtle conservation and shrimp imports, http://www.state.gov/r/pa/prs/ps/2005/45611.htm

Fisheries Subsidies: A critical issue for trade and sustainable development at the World Trade Organization. An Introductory Guide. May 2008. http://www.unep.ch/etb/areas/pdf/UNEP-ETB percent20Brochure percent20on percent20Fisheries percent20Subsidies_May2008.pdf

Promotion of Sustainable and Equitable Fisheries Access Agreements in the Western Indian Ocean. www.panda.org

FISHERIES PROGRAM PLANNING

Fisheries planning is not unlike planning in other sectors, and follows several basic steps as shown in the figure below. These include: issue assessment (Step 1); plan or program preparation and adoption, (Step 2); implementation (Step 3); and evaluation (Step 4). Planning and implementation are not necessarily linear, but cyclical and iterative. It is a strategic process of setting priorities and articulating specific goals, identifying important fishery and aquaculture issues, selecting appropriate activities that address key issues, and developing systems to monitor impacts. This section of the Guide is structured around the steps of the planning cycle as they apply to capture fisheries.



CONSIDERATION OF SCALE

Key Questions

- What are the different scales of fisheries operations?
- What are the geographic scale considerations for fisheries management?
- How can fisheries management be scaled up?

One of the first considerations in program planning is "scale." Scale can be viewed in several ways:

- Size scale, i.e., small-scale versus large-scale fishing
- Geographic scale, i.e., fishery of communities or municipalities, or stock
- Implementation scale, i.e., small pilot demonstration, sector reform using social networks, seascapes, or working with large marine ecosystems or regions

This Guide emphasizes nearshore fisheries operations. In many cases, however, it is impossible to deal with the small-scale sector without also considering the commercial large-scale or industrial sector. The same is true geographically, especially when management authorities operate at different levels (village, state, international). Scale can mean targeting one fisher, a cooperative, one or several villages, middlemen, markets, etc. Often middlemen aggregate the products of many small-scale fisheries for export, thus changing the scale of the original sector.

Nearshore Fisheries and Trawler Conflicts in Tanzania

Small-scale fishers in the District of Bagamoyo complain about reduced catches due in part to excessive bycatch from shrimp trawlers fishing near shore. There is also concern about the incidental capture of threatened marine turtles from trawl gear. The Tanzania Coastal Management Partnership is working with commercial and small-scale fishers, conservation groups and government agencies to devise strategies for testing smart gear designs that can reduce trawl by-catch of finfish species targeted by the small-scale fishing sector and at the same time address incidental mortalities of marine turtles. Other options under discussion include rethinking times and locations where trawlers can operate to try to maintain separation between the nearshore small-scale fishery and the trawl fishery, but in a manner that can maintain the economic efficiency of the trawling sector. The Department of Fisheries recently instituted a moratorium on shrimp fishing until a new management approach is developed.

Fish stocks do not respect local, national, or administrative boundaries, so management systems may need to be designed that rationalize management across many jurisdictions. This is increasingly the case even within a nation, where decentralized authority for management may be delegated to a village, municipalities, or districts. Yet another consideration of scale is the operational level at which management functions. This involves temporal, spatial, political, and economic issues. Fishery scientists often look at scale, based only on biological or ecological criteria of a unit stock. Meanwhile, resource users and other stakeholders will be concerned with the social implications as well.

Scale can also be viewed as replicating best practices that may have been piloted initially in a small geographic setting, i.e., scaling-up a pilot program in scope, or targeting a sector for reform (such as the

SCALE approach). Some practitioners recommend a third approach. This is to comprehensively address large marine ecosystems or regional fisheries issues. This, however, can be cumbersome and costly. It can also require a high level of institutional capacity that is often lacking, and require decades or more to see tangible results. Other conservation practitioners are choosing to work with "seascapes" and designing a network of marine protected areas to minimize risk from overfishing.

A fishery stock is defined as a portion of a fish population that may share biological characteristics and/or fishery characteristics. Usually it is defined by geographical boundaries for simplicity in stock assessment.

Alternatively, there are models for diffusion of innovation that enable smaller projects to achieve behavior change quickly and to more rapidly scale-up good practices. The Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fishing provides many such opportunities for behavior change. In some cases, however, a larger-scale effort may be necessary—one that can help link these smaller innovative initiatives. Outreach and education and the transfer of information, technology, and alternative ideas can play a key role in fostering behavior change and can help programs achieve their long-term goals.

To decide what scale to use for implementation, one must:

- Clarify program goals
- Assess funding levels
- Identify the extent of the fishing grounds and critical fish habitats
- Identify a cohesive or natural set of communities with a governance unit—e.g., identify how the fishing groups are socially connected

STAKEHOLDER PARTICIPATION

Key Questions

- What are the key stakeholders for fisheries program planning?
- Why is stakeholder engagement important?

Changes in human and institutional behavior occur slowly and only when shown to be desirable. For instance, conserving fish stocks will only be effective if a large majority agrees to restrict harvesting and understands the long-term vision of creating a healthy environment. If this is mandated without understanding and buy-in, there are certain to be heavy enforcement costs and widespread illegal activities. The best incentive is to change the paradigm of "you are the problem" to "you are part of the solution." Participants-in-change start to accept responsibility for the design, implementation, and assessment of interventions and become tied to the outcomes. Even if the intervention runs into problems, an adaptive approach allows for adjustments and improvements mid-stream.

There are many techniques for ensuring an inclusive and participatory approach—e.g., stakeholder mapping, open space formats, participatory rural appraisal, vulnerability and capacity analysis, and others. It is important to recognize that fishers are not a homogenous group. They may differ simply by nature of the fishing gear and techniques they use. For example, the gear used by gillnetters may put them in conflict with handliners, while industrial and commercial interests may conflict with small-scale fishing interests. In addition, fisheries stakeholders include not only fishers, but also those involved in the marketing and processing of fish. More often, the capture sector is dominated by men and the marketing and processing sector by women. Therefore, mainstreaming gender equity issues and gender inclusivity in participatory and decision-making processes is also essential. All interests need a voice in decision-making. Getting those voices heard, however, may require adapting how, when, and where the planning, decision-making, and implementation processes occur. Differences in men and women's lives, family responsibilities, and schedules means they often cannot lend their voice at the same time and place.

Stakeholder participation and buy-in are critical

There are no regulations written that cannot be circumvented by ingenious fishers if they do not believe in them. When communities and fishers are included as partners in the planning, design and implementation of the regulation, then they will be active participants in legislation, enforcement, and self-compliance.

ISSUE IDENTIFICATION AND ASSESSMENT

Key Questions

- What information is needed to design and implement a fisheries management program?

Local Context

It is essential to understand the local context for fisheries reform and sustainable development before commencing programming activities. This process includes defining:

- Current status and trends of the fisheries resources
- Governance structure and management rules in place
- Types of fisheries involved
- Local and export markets
- Lifestyles and aspirations of the fishing community
- Diversity of livelihoods
- Other demands on the marine environment—e.g., tourism, natural gas, and oil

Key issues, and the strategies to address them, will differ across communities, regions, or countries. Hence, the design of the program must be tailored to those different priorities and contexts. Some issues can be addressed quickly. Others require more time. In either case, the issues must be considered within the broader framework of overall fisheries planning. This is necessary to minimize or avoid unexpected consequences resulting from program decisions.

A fishery system can be examined from many angles. What is the cultural context? At what scale does fishing take place? How important is fisheries for food and income? What are the different roles of men and women in the industry? What are the policies and legal and institutional frameworks that govern it? What are the individual and institutional capacities and willingness to manage the fisheries? Answering these questions and others is essential to understanding the present situation—a prerequisite to defining what is needed to lead to a more sustainable fishery. Additional considerations include:

- State of physical infrastructure, technological capabilities, institutions, and /or human productivity in the system
- Effectiveness of systems in place to collect, analyze, and disseminate data on fisheries to support fisheries management and development activities
- Effectiveness of the fisheries management system(s) and measures in place to sustain the fishery
- Inherent vulnerability of the species to fishing pressure
- Impact on marine habitats and ecosystems, including bycatch of endangered species

Stock Assessment

Most countries have poor data on their fisheries. However, this does not have to deter fisheries projects from moving forward. It becomes even more important to understand the fisheries governance arrangements, how to involve all stakeholders in the stock assessment program, how to provide assessment of value to the community or nation, and how to determine loss of economic rent.

A critical part of the assessment phase is in understanding the status of the fish stocks to be managed. This is essentially a biological assessment—similar to a threats assessment in biodiversity planning. A first step in selecting the best approach to managing a fish stock is to collect as much information as possible. A stock assessment is designed to give managers and decision-makers detailed information about the past and current status of a fish stock. Is the fishery overfished? If "yes," to what extent? How big is the stock? Is it growing or shrinking? A stock assessment also provides information about how the stock might respond to specific future management actions.

A fishery stock is defined as a portion of a fish population that may share biological characteristics and/or fishery characteristics. Usually it is defined by geographical boundaries for simplicity in stock assessment.

A complete stock assessment contains a vast array of information on both the fish population and the fishery itself. A fish population is defined as a group of individual fish of a single interbreeding species located in a given area. This area could be as large as the Atlantic Ocean or as small as a single river. A fish stock is defined not only by biology, but also by management concerns—e.g., jurisdictional boundaries or harvesting location.

To produce a stock assessment, a fishery scientist applies appropriate biological and mathematical models to the available data, examines the uncertainty in the models' outputs, and tests the sensitivity of the outputs to changes in the underlying assumptions. There are several ways in which this is done. These include bio-economic models, index models (e.g., catch per unit effort/CPUE), yield per recruit models, spawning stock biomass models, and virtual population and cohort analysis. Each approach has its strengths and weaknesses, and depends on the type of fishery being managed and the availability of existing information. Many stock assessment models are geared to single species fisheries. However, tropical developing country fisheries are mainly multi-species, where dozens if not hundreds of fish species may be harvested for sale and consumption. This complicates stock assessment.

A stock assessment will provide information about past, current, and future stock conditions. This information is compared to the accepted management reference points. It can help in analyzing how likely each management option is to achieve its stated objectives. A stock assessment should also quantify the risk—i.e., the probability that the option will *not* achieve the goal. A careful and complete stock assessment should provide the manager with the information necessary to select the best options for managing the fishery successfully into the future.

Performing a stock assessment may entail building the scientific capacity of the institutions in the country that will be responsible for providing this information. In many developing countries, the data and the capacity necessary to carry out stock assessments may be weak or non-existent. This is especially true when attempting to address fisheries issues on a local scale in rural and isolated settings. In such cases, the best way to proceed is to gain qualitative information on the status and trends of stocks by asking local fishers a series of questions. These include:

- Has the number of fishers and/or boats increased in the past five to 10 years?
- Has the catch per fishers declined?
- Has the size of the fish decreased?
- Have vessels recently been motorized?
- Has the size of vessels and gears changed?
- Have new and more efficient gears been introduced recently?
- Are there fewer targeted species, such as groupers or large pelagics, being caught?
- Are an increased numbers of species lower down the food chain being caught instead?

If the answers to most of these questions are "yes," the fishery is likely overfished or headed in that direction. More proactive management and more restrictions on fishing effort are needed. However, because anecdotal information is limited in use and reliability, efforts should be made to strengthen the scientific capacity of the institutions and governance structures. There are many ways to gather data for stock assessments—drawing on port samplers, fisheries-independent data (research surveys), and fisheries dependent data (i.e., observers, logbooks and electronic logbooks).

Stock assessments are linked to what are often called reference points. Reference points explain, in broad terms, the management objective of the fishery. They are designated as targets (target reference points (TRP)) or as limits (limit reference points (LRP)). Targets are indicators of a desired stock status, such as biomass levels or fishing mortality rates. Fishing effort that achieves two-thirds of maximum sustainable yield (MSY) are target reference points. Fishing effort at MSY can also be considered an LRP. An LRP may correspond to a minimum condition (e.g., dangerously low spawning biomass) or a maximum condition (e.g., a high rate of decline in stock size or a high mortality rate).

Socioeconomic Assessments

Stock assessments focus on understanding the biological component of the fishery system. However, it is equally important to understand the human dimensions of fish harvesting, handling, processing and marketing. Socioeconomic assessments can provide baselines on the social and economic conditions of fishing communities—information that can be used later to assess performance in meeting certain social or economic goals of fisheries management. Socioeconomic assessments can also provide insights into how proposed regulations may impact fishing communities. They can also be used to tailor management interventions to better suit local conditions.

There are a number of ways to collect socioeconomic information—by engaging in rapid participatory appraisals, using existing information from a national census or published fisheries statistics, by conducting detailed household and individual surveys, or through a combination of these and other techniques. Information should be collected at the same scale at which management interventions are proposed—i.e., at scales ranging from the village level, to that of an entire bay, or for the nation as a whole.

Basic information that should be collected in socioeconomic assessments includes:

- Basic physical geography of the coast marine system
- Settlement patterns and population trends, including long-term and seasonal migration
- Occupational patterns of fishing villages and numbers of full and part-time fishers
- Indicators of economic or material wealth of fishing households—i.e., income, household structure and contents or other physical indicators of wealth
- Locations of landing sites, and other fishing infrastructure (e.g., ice or processing plants, markets)
- Types of fishing gear, vessels, and crew used
- Disagregated data on who is doing the fishing (men, women and/or children)
- "Lay" systems for how shares of fish catch and profits are distributed among crew and vessel/gear/engine owners
- Types of fish caught, handling and processing methods, marketing channels within the value chain
- Social groups—existence and functionality of fishermen organizations and management groups and other existing community organizations
- Traditional or customary management practices in addition to those contained in conventional regulations and laws

- Perceptions of fisheries stakeholders concerning issues and problems within the fishing sector and the community, including trends in conditions of the fish stocks, legitimacy of regulations, degree of compliance with rules, and the prevalence of use of illegal and destructive fishing practices

The above information must be assessed in terms of its gender dimensions and the role that various stakeholder and gender groups play in the entire fisheries system. Assembling this information in a consistent manner will provide project managers with valuable insights on the economic objectives for sustainable fisheries management.

Value Chain Analysis

Fisheries management is about more than just catching fish in a sustainable way. It is also about the handling, processing, distribution, marketing, and sale of fish. Value chain analysis is a method for analyzing the series of activities that add value to fish products. This analysis also helps identify value-added opportunities or challenges in the industry. One key challenge is finding ways to ensure that the increased value to fishers serves as an incentive to increase the sustainable management and reform of fisheries, rather than as an "incentive" to catch more fish.

In conducting a value chain analysis of small-scale fisheries, the following questions are relevant:

- Where are the fish sold, who sells them, and what is the distribution system?
- Who are the buyers—retail and wholesale?
- Are there opportunities to improve cooperation among buyers and sellers and to transport the fish to larger markets where prices are more competitive?
- What can be done to improve quality control?
- Are the fish processed?
- Are there opportunities for improved processing, marketing, and packaging?

Value chain analysis is particularly important when eco-labeling or certification schemes are being considered.

PLANNING AND PROGRAM DESIGN

Key Questions

- What activities can USAID programs support in order to achieve fisheries management goals?
- How can this fisheries program contribute to other goals of the Mission such as governance, conflict reduction, biodiversity, food security or maritime security?
- What are the key goals of the program?

The results of initial assessments of the current context, resource trends, and enabling environment of the nearshore capture fisheries sector provide the basis for defining a strategic plan of action. This includes the selection of specific fisheries management issues, management goals and objectives, and activities.

Identify Priorities and Select a Course of Action

An assessment will likely identify numerous fisheries issues—often more than can reasonably be acted upon based on resource availability or institutional and technical capacity. Therefore, a fisheries development and management program must be strategic. The first step is to clearly identify the priority issues upon which to focus efforts and resources. These priorities determine the choice of implementation actions.

Program priorities must be selected using an inclusive and on-going process that involves fishers, fishing groups, other major stakeholder groups, and decision-makers. Encouraging broad collaboration and cooperation of these different individuals and groups, including both men and women, ensures salience. It also promotes public and political support for fisheries reform and effective implementation in the short- and long-term. Best practices for effective program design include:

- Identify and involve governmental agencies and other formal institutions—e.g., universities and user groups—that have an interest in the condition and use of the marine ecosystems being considered
- Solicit the views of major stakeholder groups as well as the views of other groups and, to the extent possible, the general public (e.g., through focus groups and surveys)
- Identify potential leaders and the stakeholder groups that will be involved in the implementation of fisheries reform measures
- Ensure that the scope and complexity of the fisheries issues selected as priorities for management are appropriate to the capacity of the institutions involved

There are four general categories of activities that USAID projects would be likely to implement to achieve fisheries management goals. One, several, or all of these may be part of the project design.

Policy reform. Strengthening the enabling environment is a key objective of policy reform. Policies and laws at any governmental level, but especially at the national scale, may need adjustment to allow for changes in an approach at the operational level and to enable more rapid progress. Needed reforms typically include changes in laws or policies that provide greater decentralization of authority for management to local government units or regional management bodies. This also allows for varying degrees of co-management approaches, whereby fishers and other stakeholders have a greater role and responsibility in planning and management.

Planning and implementing site-based fisheries management plans. Fisheries management is typically implemented through management plans for specific sub-national administrative regions such as a municipality, district or province; for specific fisheries ecosystems such as an entire bay or coral reef system; or for a major single species fishery such as crabs, lobster or tuna. In most cases, a program would be involved in developing or reforming management strategies at the operational level for one or several site-based locations. Local-level site-based management initiatives can also run parallel to efforts being made on broader national level or fishery sector reforms. In such cases, site-based initiatives should be viewed as pilots (adaptive and innovative experiments) that can inform national policy and serve as demonstrations for widespread replication and scaling-up.

The FISH Project

The Fisheries Improved for Sustainable Harvest (FISH) Project is a seven-year effort of USAID and the Philippines Bureau of Fisheries and Aquatic Resources. The goal of the project is to increase fish stocks in four target areas that have been depleted in the past due to rampant overfishing, habitat loss, and use of destructive and illegal fishing practices. The project uses an integrated ecosystem-based approach that combines national policy and capacity building initiatives with the development of informed and engaged stakeholders for management. It links environmental governance with economic growth and food security through three primary implementation mechanisms: growth to enhance production (e.g., no-take zones), control to allocate access, and maintenance to build stakeholder capacity.

One can accomplish a great deal by taking a structured, common sense approach to fisheries management plans, especially for small-scale fisheries. Plans may be geographically defined by administrative boundaries such as a municipality, district, or province. Additionally, they may be based on ecosystem units or units of stocks, or upon the scale of a specific fishery. Plans can be scaled from small (e.g., a coral reef system or island) to very large. Large-scale plans are especially appropriate for dealing with pelagic and highly migratory species such as tuna. Often, the geographic management unit that is selected is a compromise between ecological, legal, and administrative characteristics and the practicalities of and capabilities for implementation. The larger the scale of a management plan, the more complex and difficult the planning and management becomes, and the greater the need for strong institutional capacity to implement the plan. On the other hand, a small pilot site may not be large enough to deal with outside influences that are acting on the system.

Capacity building and training. Capacity building and training activities are essential for engaging stakeholders in a participatory process and sustaining the project. These activities should be targeted at government agencies, fishers, and other stakeholder groups. They must target women as well as men—as research shows women are the least likely to receive this much-needed support. It is also essential to strengthen the technical capacities of fisheries scientists to conduct stock assessments. Fisheries personnel, including those from universities or governments, may still be focused on the old paradigms of fisheries development. In these, programs emphasized increasing fishing effort through technology and gear improvements, and on subsidies for larger vessels or motorization campaigns—rather than on sustainable use. In such cases, there may be a need for specialized training in the full repertoire of fisheries management. This includes training in new concepts of co-management, rights-based approaches, catch shares, and ecosystem-based management.

Capacity building can also be viewed as more than just human resource development. It should consider the institutional development needs of fisheries management agencies and authorities. This includes strengthening their internal operating procedures and management systems. Fisheries management authority is increasingly decentralized, and in any one country there may be numerous local fisheries management committees. These and other factors point to the need for capacity building at not only the

national level but at multiple local levels. Capacity building should focus on areas that include resource economics, development of access agreements, and reinvestment of revenues into management.

Reducing bycatch or habitat destruction. As part of an ecosystem-based approach, it is necessary to consider interactions with non-target species and the protection of important habitats. This habitat may be essential in various life stages of individual target species that make up the fishery—e.g., an important feeding, spawning, or nursery area. In addition, certain technological innovations and fishing gears may have undesirable impacts on bycatch of species that are not necessarily the targeted fishery. For example, this might include marine turtles that are caught in trawl or gill nets, seabirds caught by tuna long lines, or undersized fishes caught at different life stages by other gear, such as juvenile fish caught in trawls. These issues can be addressed by using certain regulatory measures or more selective gear.

Gear Innovations that Reduce Bycatch

Technological fix	How it works	Fishery
Turtle excluder devices	A large metal grid in the neck of a trawl net that physically excludes turtles from the base of trawl nets while allowing shrimp to be caught effectively	Trawl
Tori (bird scaring) lines	Keeps seabirds from baited hooks	Pelagic longline
Weighted lines	Sinks hooks out of reach of seabirds	"
Side-setting devices	Reduces the scavenging area by half	"
Line-setting devices	Places baited hooks immediately underwater	"
Circle hooks	Reduces frequency of deeply ingested hooks and limits gut perforation	"
Pingers	Acoustic devices that alert marine mammals to the presence of gillnets to prevent entanglement	Gillnet
Medina panels	Fine-mesh net aprons that reduce the probability of dolphin entanglement during net retrieval	Purse seines

Set Management Goals and Objectives

Lasting impacts are achieved only when issues are addressed directly, goals and objectives are clearly defined, and activities are designed to produce impacts that are measurable and monitored. Activities should link directly to management objectives.

Fisheries management goals often fall into five broad categories: biological, ecological, economic, social, and governance. Examples include:

- Maintain target species at or above a threshold level of spawning stock biomass or standing stock to ensure continued productivity
- Minimize the impacts of fishing on the physical environment and on non-target species
- Maximize the economic incomes of the participating fishers
- Maximize employment opportunities for men, women, and other marginalized groups
- Secure access and tenure rights to improve governance, reduce conflicts, or increase maritime security

Objectives define how to achieve fisheries management goals and guide the selection of specific management measures. Objectives should be specific, measurable, achievable, realistic, and timely (SMART). They should be established through a participatory process that involves well-informed key stakeholders. A transparent process based on the best science available, coupled with a realistic assessment of the potential tradeoffs associated with different sets of priorities, has the greatest potential for producing goals and activities that have broad stakeholder support. Each project should clearly list their goals and objectives with measurable outcomes and success criteria. Activities should clearly show the connection between the objective(s) and outcome(s).

Fisheries management objectives are key to the selection of an appropriate reference point. Most reference points are biological and become more complex when additional data on the species is available. The simplest reference points are those obtained through catch or catch and effort monitoring. If average individual growth, mortality, and gear vulnerabilities are known, then a yield per recruit model can be used with its corresponding conservative target reference point (TRP).

Maximizing biological yield should not be the only objective of management. It is also important to include economic and social objectives as well. Fishing effort set at maximum economic yield (MEY) is a TRP frequently used to maximize economics of a fishery. MEY is responsive to changes in the economic environment and affects the value of fish or the cost of fishing. Subsidies or external economic considerations (e.g., fuel prices) will affect the location of the economic reference point. TRP management requires active monitoring and readjustment of management measures.

IMPLEMENTATION

Key Questions

- What are typical implementation challenges in small-scale fisheries development?
- What can USAID do in response to these challenges?

Many fisheries management efforts fail or encounter major barriers when making the transition from assessment and planning to implementation. Areas that require attention in order to avoid problems in program implementation are discussed below.

Managing in the Context of Data Poor Fisheries

For small-scale fisheries, information on catch rates and effort is typically quite poor. In some cases, this is a factor of weak capacity of the management agencies. However, it also simply reflects the nature of small-scale fisheries. The lack of highly centralized landing centers means there is often little information available to managers regarding the resource or fishing extraction rates. In part, this is due to the highly dispersed nature of small-scale fisheries—there may be hundreds of fish landing sites and thousands of small-scale fishers within the country.

In these data poor situations, it is useful to: 1) use simple statistics to manage the fishery, 2) rely on fishers' knowledge, and 3) combine management approaches that are simple to implement and require less intensive information gathering for decision-making. Whenever possible, it is best to also disaggregate the data by gender. Cooperative and collaborative fisheries planning and research is beginning to capitalize on the knowledge and skills of experienced fishers and incorporate it into program design and management processes. In the data poor systems that characterize most developing country contexts, traditional and local knowledge is an underutilized asset for fisheries managers. That said, it is often the only information available for making management decisions.

An extension agent in Nicaragua prepares to undertake participatory monitoring with women cockle gatherers to evaluate the effectiveness of the no-take zones established by the community.

Fisheries are unusual in the realm of economic activities because there is no way to know with certainty the number of fish available for harvest in a given year. Nor is it possible to know with certainty the effects of consumer and market demands on the resource. Given these uncertainties, the management framework can minimize risk by using the "precautionary approach." The "precautionary approach" promotes erring on the side of caution when faced with uncertainty. It calls upon managers to act in a more cautious or conservative manner

relative to the level of uncertainty, adequacy, or reliability of the best available information. The precautionary approach also says that the absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures. In implementing the precautionary approach, managers should also take into account:

- Uncertainties relating to the size and productivity of the stocks
- Reference points
- Stock condition in relation to such reference points
- Levels and distribution of fishing mortality
- Impact of fishing activities, including discards, on non-target and associated or dependent species
- Environmental and socioeconomic conditions

Adaptive management is another concept that is crucial for successful fisheries management—especially in data poor contexts. The adaptive management approach sets out explicit management hypotheses and then tests them through actions. A lack of information is *not* considered a reason for inaction. As actions are implemented, they generate information to use in judging whether those actions are having their intended effect, and to assess if the management "hypothesis" is or is not accurate. If an action did not have the intended effect, managers must decide whether the problem is due to poor implementation of the action, or whether the hypothesis must be reformulated and new actions identified. Adaptive management requires that decisions be made quickly and actions adjusted accordingly, often before the next fishing season begins. Adaptive management is especially suited for decentralized management contexts and data poor situations, but can be applied at any scale of operation.

Strengthening the Enabling Environment and Governance

Governance is defined as the sum of the many ways through which individuals and institutions, public and private, manage their common affairs. The basic governance challenge in fisheries management is to establish and maintain institutions that put forth the norms and rules to guide decisions and a formal framework for decision-making.

The policies, laws, and regulations of governments and other organizations provide the framework and context in which people make decisions and take actions that affect fisheries. This mix of laws, policies, and regulations is often referred to as the "enabling environment" under which governance is carried out. It also includes the political will and the capacity of management institutions to carry out their mandates.

How can we strengthen governance?

- Strengthen institutional and human resource capacity
- Develop funding mechanisms to support change
- Promote co-management (fishers education and institution building)
- Create incentive-based programs (i.e., rights-based approaches)
- Employ new strategies using integrative programs, (e.g., ecosystem-based management)
- Promote public/private sector partnerships

Since more than 90 percent of the global fish catch is taken in zones under national jurisdiction, a strong enabling environment at the national level is essential for effective governance to occur at the operational scale. Weak governance is one of the main problems with capture fisheries—as characterized by corruption, conflicts of interest, inadequate resources (physical, human, and financial) available for management, poor enforcement, illegal fishing, lack of stakeholder participation in decision-making, lack of clear vision, and user conflicts. It is weak governance that has led to failures in controlling industrial

fleets and in successfully empowering small-scale fishers. It has also lead to failures to establish a coherent system of regulations that limit entry, reduce capacity, establish appropriate fisheries management reference points, enforce gear regulations, define spatial and time restrictions, and redirect subsidies away from production.

Monitoring and Control

A fundamental part of management involves monitoring, control, and surveillance actions (MCS). While monitoring gathers information on the fishery, surveillance uses this information to ensure compliance with regulations. The MCS system chosen will be specific to the structure of the fishery—i.e., it will depend on who pays for the MCS; what allowances there are for flexibility in the stocks and the fishery; how the system's performance will be assessed; and the defined roles of resource users. Strategic considerations for shaping the MCS strategy include:

- Type of fishery: industrial or small-scale, multi-user, gear types, single and multi species
- Type of management measure: use rights, input, output, and technical controls
- Legal framework: fisheries acts, regulations, rules, and regulations
- Human resources: qualified personnel to administer and implement the system
- Time dimension: before fishing, during fishing, landing, and post-landings
- Financial requirements: cost effectiveness, who pays, donor support, low cost options, regional and bilateral strategies

Some actions will make facilitation of an MCS plan easier, more efficient, and more cost effective. This includes registration/licensing of fishers, use of a vessel marking system, a ban on the transfer of catch between vessels at sea, a limit to the number of landing sites, and a possible zoning of fishing areas.

The fishing sector itself has recently become a more viable partner in research and monitoring activities. The use of private fishing vessel time and fishers' expertise has greatly expanded the geographical scope of work and allowed for incorporation of local knowledge into management models. In some countries, fishers have gone as far as to take over the monitoring activities completely from government or to conduct activities that complement this monitoring. In rare cases, fishers' organizations even fund research—allowing them to serve as principal players in setting priorities and defining issues. New technologies such as cell phones, remote sensing, and vessel tracking systems have made at-sea monitoring more timely, accessible, and affordable.

Maintaining an Inclusive and Participatory Process

Successful fisheries management requires active stakeholder involvement in forming and implementing management measures. Yet, the lead agency responsible for fisheries management may not have stakeholder involvement as a priority, or it may lack the skills needed to carry out good inclusive processes. Further, fisheries management is time consuming, with its requirements for assessment, stakeholder dialogue, consensus building, and monitoring, control, and surveillance. Even simple measures need to be widely accepted by fishers and stakeholders; since enforcement through command and control actions is costly and, alone, is not effective. Stakeholder involvement is hard to sustain—waxing and waning based on the issues themselves and multiple other external factors. Keeping stakeholders involved and engaged over a longer time period can be challenging. Too often, stakeholder participation ends at the completion of the planning process. This is a mistake. Stakeholder participation needs to be sustained during all phases including implementation, monitoring, and evaluation.

What can be done to maintain fishers and other stakeholder involvement?

- Before designing the program, ensure support of the primary stakeholders in the fishery
- Build in participatory management, including a high level of transparency in decision-making and information dissemination
- Promote community involvement and leadership to build a sense of ownership
- Consider constraints on women's ability to participate at the same times and in the same capacity as men
- Conduct small, doable actions that build support for a larger effort
- Educate fishers and the public, and encourage them to be active in the stakeholder process in order to keep sustainable fisheries on the public agenda
- Seek top level government support and leadership to build trust and make participation and negotiations with stakeholders seem worthwhile

In addition to the above, for actions that need formal adoption by multiple entities (e.g., no-take reserves), treat the entire process as a major, serious public policy formulation effort right from the start.

Stakeholder participation can take place in official settings of government offices and meeting halls, but often informal settings are equally important to put all stakeholders at ease with expressing their viewpoints and concerns.

EVALUATION AND ADAPTIVE MANAGEMENT

Key Questions

- What are the characteristics of good indicators for program management?
- What is the value of adaptive management in fisheries program development?

Learning is a key element of adaptive management. Monitoring and evaluation can be useful tools in the learning process—providing feedback about what works and what does not, so that activities can be adjusted as necessary. When designing a project, a key question is "what needs to be monitored?" Once that is determined, it is important to identify indicators directly linked to project goals and objectives.

Good indicators are:

- Useful: the information provided can help inform programming decisions
- Measurable: assesses the appropriate quantitative and/or qualitative changes
- Attributable: the change measured can reasonably be ascribed to the activities
- Realistic: practical, cost-effective, and feasible to collect and record
- Timely: data is collected at reasonable time intervals to effectively show change; and data is available when it is needed
- Reliable: uses standard data collection methodologies, and data is robust and verifiable
- Direct: closely tracks the results it is intended to measure; assumptions are clearly stated

Using adaptive management and making iterative adjustments can sometimes help projects reach their stated goals sooner. However, adaptive management also requires time—enough for its learning-by-doing approach to be effective and to see real behavior change. For example, when fishing efforts for a given fishery are reduced (changed behavior), the result should be measurable changes in the standing stock biomass. For some activities, however, the time frame for realizing change is longer and/or the causal link between the project activities and the result more difficult to state. For example, the impacts of policy reform measures are likely to be harder to attribute to tangible changes in the specific fisheries being managed.

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III. POST-HARVEST ISSUES

Introduction

Product Quality and Sanitation

Marketing and Economic Issues

Use of insulated containers and icing to keep harvested fish products cool for transportation to market maintains product quality and freshness. Unfortunately, ice is often unavailable at many small-scale fish landings around the world.

INTRODUCTION

Key Questions

- What are post-harvest losses?
- Why are post-harvest losses important?

Post-harvest issues for both fisheries and aquaculture sectors are similar, as these products often enter the same marketing and processing channels on their way to the consumer. Once fish products leave a fish pond or fishing boat and enter the market chain, they are seldom distinguished as being farm-raised or wild-caught. For that reason, this section of this Guide applies to both sectors.

Post-harvest losses—physical or economic—are an unacceptable waste of a product. Physical loss results from poor handling, preservation, and discarding. There can also be nutritional loss as a result of poor handling and processing of the product. Economic loss occurs when fish spoil and lose their value or when fish are re-processed, which raises the cost of the finished product. In some cases, the use of fish for animal rather than human consumption is also counted as a loss of a food product.

Post-harvest losses in small-scale fisheries are one of the highest in the food production system. Fish losses due to spoilage are an estimated 10-12 million tons per year—much of this resulting from over-harvesting during times when processing, distribution, and marketing systems are inadequate to handle the excess amounts—including the inability to preserve the product.

SOURCES FOR MORE INFORMATION

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National Research Institute: Post Harvest Fisheries http://www.nri.org/research/postharvestfisheries.htm

PRODUCT QUALITY AND SANITATION

The high water content of fish makes it necessary to be either: 1) consumed soon after harvest, or 2) quickly preserved. Otherwise, fish decomposes, losing its value and presenting health threats. This is a problem even for small-scale producers, since their goal is to obtain not only food, but income. When ice or other preservation methods are not available, the small-scale producer still has food for the family, but has a limited market in which to sell the product and make income.

Key Questions

- What on-board or processing practices are available to help ensure the quality and sanitation of perishable fish and aquaculture products and thus increase their post-harvest value?
- What environmental conditions impact the quality and safety of these fish and aquaculture products?

Maintaining cleanliness and hygiene at processing centers is critical for ensuring a safe and sanitary supply of seafood product.

The first step in ensuring post-harvest value is to provide training in basic sanitation and preservation methods. Next is to provide simple, low-cost preservation equipment and resources such as ice. The ability to maintain food quality for just a few additional days can make the difference between having to quickly sell the entire harvest at a low cost to neighbors or being able to transport it to a larger market and sell it for a higher price. In remote locations, achieving this will be nearly impossible due to the high cost of implementing even the simplest procedures. In such instances, careful consideration must be given to whether non-perishable products, such as seaweed or pearls, are better alternatives to seafood production. Non-aquaculture alternatives for food and income should also be considered (Otwell et. al., 2001).

ON-BOAT HANDLING

On-boat handling is extremely important. Between the time that fish are landed on deck and offloaded, the fisher can take steps to improve its quality and reduce losses. Almost as soon as fish are landed, bacteria can start to deteriorate the flesh, decreasing the quality of the product. This deterioration cannot be stopped, but it can be slowed by temperature control and careful handling, and by preventing contamination. Simple steps include keeping the deck as wet and cool as possible, especially in hot weather. Another on-boat procedure that will help is to quickly sort the catch, concentrating on the smaller fish (these heat up more quickly) and the higher value species. Shorter tows or fewer nets per string can also speed up the sorting process. Reducing the use of gaffs and throwing when handling can

also reduce physical damage to the fish. Gutting and gilling the fish while still on-board and using clean gloves or hands and a sanitized knife help to eliminate a source of bacteria. Using water with a simple bleach solution to clean hands, gloves, and knives will also help.

Another process that will preserve quality is washing the fish in a fresh water or a brine solution and then chilling (ice if possible) them. If fish are stored in totes (with ice, if possible), they should be neatly packed, belly down on the bottom layer and belly up on all the upper layers. All totes should have drainage holes. Severely damaged fish should be separated from other fish. Fish bent in rigor mortis should not be straightened out as this causes separation of the muscle bands in the flesh, which reduces the quality of the fillet.

PROCESSING

Processing facilities are extremely important in the fisheries sector. Even fish that are fresh and clean when delivered to a processing facility can become contaminated if the facility fails to follow best practices. Fish processing skills and facilities are necessary for anything more than the very smallest scale operation(s). Processing facilities offer benefits such as improved product quality and revenues, and additional employment. However, it is often difficult to develop and manage these facilities, particularly in remote locations. Unfortunately, when the product is intended for local consumption only, inspection, enforcement, and compliance may be lax.

Processing facilities are usually financed by the private sector. Meanwhile, it is government agencies, concerned with health and exports, which are responsible for ensuring that processing meets national requirements. Products for export must meet international standards as well. While exporting companies are generally of sufficient size and capability to comply with importing countries' standards, there are notable exceptions. In some cases, the reputation of a country's entire aquaculture industry can be damaged for a long time if even one plant fails to meet standards. Therefore, the responsible government agencies have a stake in enforcing compliance and providing technical assistance.

Drying fish products on ranks is a common form of preservation when cold storage or ice is unavailable to maintain product freshness.

ENVIRONMENTAL CONSIDERATIONS

Sanitation issues that can affect the product are not limited to the confines of the immediate production facility. Rather, fish and aquaculture product sanitation begins with environmental quality. An example is when unhygienic environmental conditions lead to product contamination. This can occur when the growing waters are polluted. In the case of mercury or PCBs (polychlorinated biphenyls), these often bio-accumulate in aquatic organisms, making them unsafe to eat. The growing environment may also become contaminated when solid waste is disposed of improperly, or where potable water in not available to wash

one's hands before handling the fish. For these and other reasons, all aquaculture or fisheries development efforts must address inadequacies in sanitation. The issue of sanitation highlights the need to approach aquaculture development and fisheries management from a broader integrated coastal zone management perspective.

Environmental and social conditions have a direct impact on the product safety of bivalves or shellfish. Whether addressing pre- or post-harvest sanitation issues, it is important to consider shellfish sanitation as part of the planning and management efforts for both cultured as well as for natural harvest areas (National Shellfish Sanitation Program, 1995). Filter-feeding mollusks such as clams and oysters have a pronounced tendency to bio-accumulate toxic substances in their tissues and to harbor pathogens in their digestive tracts. Bivalves, however, are usually exempt from this problem as only the adductor muscle is eaten (e.g., scallops in the U.S.). Gastropods also tend to escape this problem as their digestive tract is not consumed (e.g., snails). Nevertheless, there are health threats associated with bivalves—ranging from toxic compounds derived from harmful algal blooms to pathogens such as *Hepatitis A*, *Salmonella,* and *Vibrio*.

Bivalves are also highly susceptible to post-harvest contamination. Many countries deal with these pre- and post-harvest issues by developing shellfish sanitation plans that cover a wide range of topics. One element of such plans usually focuses on water quality. Monitoring water quality at shellfish growing grounds is important in order to confirm that pathogens or toxic algae are not present. This is especially important in areas where it is common practice to eat the shellfish raw. Another element of shellfish sanitation plans focuses on post-handling good practices. These need to begin as soon as the shellfish are removed from the water and continue until they are presented to the consumer.

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MARKETING AND ECONOMIC ISSUES

It is important for producers to identify the opportunities for and costs of marketing their products before they start actively marketing them. When doing this, there are both logistical and legal issues involved. First, producers must be able to get their products to market in good quality, and then they must be able to negotiate the sales process. Producers often seek to market directly to the end consumer and reap the maximum profit. However, most small-scale producers simply cannot afford the costs associated with direct-to-consumer marketing. There may, however, be ways for farmers to sell some, if not all, of their product direct to the consumer or to increase the selling price (their profit) by considering value-added strategies. For example, even simple steps such as salting fish or selling only the fillets can increase profits. Another strategy is to choose the time of harvests to occur around special events or holidays, when customers may be willing to pay higher prices for the product. Cooperative efforts in marketing are often effective, as access to larger markets often requires a specified minimum volume of product that is made available on a regular basis/schedule. This is something a single producer likely could not promise, but which might be possible for a cooperative of producers. Marketing and its associated issues is an area in which government agencies can provide important support and assistance to producers.

Key Question

- When designing and implementing fisheries and aquaculture development programs, what are the key considerations regarding market access?

CERTIFICATION

Certification schemes are becoming increasing popular in aquaculture and fisheries. These labels are used because a certified sustainable product may bring a price premium and because an increasing number of consumers prefer a "green" product. This is similar to other labeling schemes such as "certified organic" or "fair trade" labels. While the Marine Stewardship Council's (MSC) sustainability label is apparent on certain types of wild caught seafood products sold in supermarkets in developed countries, particularly the U.S. and Europe, aquaculture certification labels are less evident at the consumer level. In part, this is because there are multiple certification schemes depending on the country of origin. Many countries (e.g., Bangladesh and Thailand) have national certification schemes, while others rely on international schemes such as the Aquaculture Certification Council (ACC). In the case of aquaculture,

Location of fisheries around the world certified by the Marine Stewardship Council

certification is important in spite of the non-labeling at the consumer level, as major buyers such as Wal-Mart are requiring sustainable-sourced product from their suppliers. A possible downside to certification is it is likely to exclude small producers unless they receive assistance in the certification procedure. In some cases, processing plants may use new certification standards as an excuse to impose lower pricing on small producers whose only option is to sell their products to the local processing plant.

Product showing the certified label (MSC)

Country of origin labeling is also a means of informing the consumer about the source of an aquaculture or fisheries product. Although not necessarily explicit in this labeling, it may lead consumers to infer traits about food safety, trade issues, and environmental issues. Branding (i.e., using images or phrases to distinguish one product from another in the marketplace) is another way to convey information on quality, health, safety, environmental aspects, and similar information. HACCP labeling is common on most seafood products imported into the U.S. It is expected that efforts towards certification, labeling, and branding will intensify as consumer awareness grows, and if the effectiveness of these approaches are proven in the marketplace.

SOURCES FOR MORE INFORMATION

Bureau of Oceans and International Environmental and Scientific Affairs; Certifications Pursuant to Section 609 of Public Law 101-162. http://www.epa.gov/EPA-GENERAL/2000/May/Day-03/g11025.htm

Globe Fish Marketing reports. http://www.globefish.org/index.php?id=481&easysitestatid=1533326373

Seafood network information center. http://seafood.ucdavis.edu/marketing/marketing.htm

Fish and Seafood Market Research Reports. http://www.marketresearch.com/browse.asp?categoryid=490

Best aquaculture practices certification. http://responsibleseafood.org/

Aquaculture certification council. http://www.aquaculturecertification.org/

Seafood watch. http://www.montereybayaquarium.org/cr/seafoodwatch.aspx

Marine Stewardship Council. http://www.msc.org/

INFOFISH a source of marketing support for fish producers and exporters in the Asia-Pacific. http://www.fishtradenet.com/index.aspx

GLOSSARY

Access agreements are entered when distant water fleets (DWFs) fish outside their national waters and must enter into agreements with individual countries to fish inside of the Exclusive Economic Zone (EEZ). These agreements generally involve access to the fisheries resources in return for a financial contribution or in-kind benefits.

Acquisition involves buying or contracting for goods, services, or results.

Active fishing gear is gear used to pursue the fish—e.g., spears and harpoons, trawls (beam, bottom, mid-water) and dredges (hydraulic, scallop, clam), seine nets (purse, beach, and other).

Adaptive management emphasizes designing, implementing, and monitoring project activities in a way that helps people learn more about complex ecological and social systems, which in turn can help them make better choices and design more effective interventions.

Aquaculture is the culturing or farming of animals or plants in water.

Area and time closures are used in fisheries management to control fishing effort, protect certain essential fish habitat or protect species during critical life stages (e.g. spawning aggregations), regardless if they are permanent or seasonal closures.

Artisanal or small-scale fisheries are a more traditional, labor-intensive form of fishing performed by men, women, and children. The boats are sometimes mechanized; however, they usually involve fishing from small boats or from shore, gleaning, or use of traditional gear such as hand-lines, small nets, traps, spears, and hand collection methods.

Best management practices (BMP) rely mainly on voluntary adoption of practices that optimize production, minimize impacts, increase benefits, and reduce risks of all types.

Biodiversity is the variety and variability of life, including the diversity of genes within species, the diversity of species, the diversity of communities and ecosystems, and the diversity of ecological processes.

Biofilters generally contain materials with a large surface area which hosts bacteria that remove nitrogenous compounds from the used water, therefore improving the water quality to a level where it can be re-used.

Biomass is the measure of the quantity, usually by weight in pounds or metric tons (2,205 pounds=1 metric ton) of a stock at a given time.

Biosafety deals with the risk or hazard of using genetically modified organisms in research; field trials; or agricultural, medical, industrial, or other technologies.

Biosecurity is the ability to exclude pathogens listed by the OIE (World Organization for Animal Health) from farm operations. This is usually done through ensuring that new animals, workers, feed, and other items entering the farm are free of pathogens.

Bivalves (oysters, clams, cockles, scallops) are mollusks with two shells that generally feed themselves by filtering water and extracting algae.

Boom phenomena occurs when a particular type of aquaculture grows rapidly with little control or oversight in a context where technical capacity, governance, and policy may be absent or weak.

Bycatch is a byproduct of fishing. This includes the catch of non-target species, undersized fish, marine mammals, and endangered species.

Bycatch reduction devices (BRDs) are devices to help reduce catch levels and to increase selectivity. Gear modifications include large escape openings, biodegradable panels, large mesh and rope trawls, square mesh windows, and other bycatch reduction devices.

Cage culture is the farming of aquatic organisms in floating pens or other netted enclosures and is most often practiced in reservoirs or lakes, estuaries and bays, although it is now becoming common to use very large cages in off-shore, open-ocean sites.

Capture fisheries is the wild harvest of finfish, mulloscs, shellfish, algae and aquatic plants, or other animals or live organisms from aquatic environments (lakes, rivers, estuaries and oceans)

Catch per unit of effort (CPUE) is the catch of fish, in numbers or in weight, taken by a defined unit of effort.

Certification programs set sustainability standards against which a particular fishery is audited. Certification encompasses three processes: 1) standard setting; 2) accreditation; and 3) certification—e.g., the Marine Stewardship Council (MSC).

Co-management is a partnership arrangement where fishers and government share responsibility and authority for managing the fishery.

Codes of conduct are broad guidelines or statements for conducting an activity in socioeconomically and environmentally compatible ways.

Community-based management is one form of co-management and is carried out at small-scales, usually by village communities.

Consortium Agreement is when three or more public and private entities jointly provide the services and share in all decision-making.

Consumer-based management approaches promote mass movements to buy only sustainably sourced seafood from retailers or patronize restaurants that serve only sustainable green or eco-labeled seafood.

Contractual relationships involve the contracting of a private entity by a public agency to provide goods or services to the public.

Decentralization refers to the shifting of responsibilities from central government to lower levels of government.

Discard is the fish that are caught but not landed because they are unmarketable, or prohibited,.

Eco-labeling is a tag placed on a product that certifies it was produced in a sustainable, environmentally friendly way.

Economic post-harvest losses occur when fish spoil and lose their value or when fish are re-processed, which raises the cost of the finished product.

Ecosystem-based management (EBM) is an integrated approach that focuses on conserving the underlying health and resilience of the ecosystem, thus maintaining the system's goods and services and leading to increased productivity.

Environmental assessment (EA) is an analysis to determine whether a proposed action will have a harmful effect on the environment.

Environmental impact assessment (EIA) is an analysis to determine whether a proposed action will have a harmful impact on the environment, often comparing the impact of this proposed action with that of other alternatives and options.

Eutrophication is a process whereby water bodies receive excess nutrients that stimulate excessive plant growth. This enhanced plant growth, often called an algal bloom, reduces dissolved oxygen in the water when dead plant material decomposes and can cause other organisms to die.

Exclusive Economic Zone is the area of the ocean up to two hundred nautical miles from a country's shore.

Extensive culture refers to the lowest density of organisms kept in a culture system. Generally, extensive culture systems require less feed, no artificial aeration, and may produce minimal effluent loads.

Feed Conversion Ratio (FCR) is defined as the net amount of feed (dry weight) used to produce one pound or kilo of animal product (wet weight).

Fish Aggregating Device (FAD) is a man-made object used to attract ocean-going pelagic fish such as marlin, tuna and mahi-mahi (dolphin fish).

Fish meal is made from fish harvested but not used for human consumption, and used as the protein component of fish feed. It is easily digestible (as compared to vegetable sources such as soy), and supplies an amino acid (constituents of proteins) profile that fish require.

Fisheries management is the integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources, and formulation and implementation—with enforcement as necessary—of regulations or rules that govern fisheries activities in order to ensure the continued productivity of the resources and accomplishment of other fisheries objectives.

Fisheries subsidy is a government intervention (or lack of) that affects the fishing industry and has an economic value and typically reduces costs of operations to the private sector or individual fishing enterprise.

Fishery stock is defined as a portion of a fish population that may share biological characteristics and/or fishery characteristics.

Fishing effort is a predefined unit of total fishing gear in use for a specified period of time.

Fishing mortality is the deaths in a fish stock caused by fishing. It can include discard mortality and landings.

Fishing power is the catch which a certain gear or vessel takes from a given density of fish during a certain time interval. For example, larger vessels with more horsepower have a greater ability to catch fish, thus greater fishing power.

Gastropods (snails) are mollusks and are generally more difficult to culture than their cousins, the bivalves.

Gear restrictions can range from requiring minimum mesh sizes to avoid catching juvenile fish, to outright prohibitions on certain gear types, e.g., dynamite or blast fishing, the use of poisons such as sodium cyanide, or electro-fishing.

Hard total allowable catch (TAC) or harvest limit is a limit on total harvest and cannot be exceeded. This type of TAC restricts the harvest to a safe proportion of the exploitable stock of fish. A hard TAC is usually less than the actual maximum yield that can be extracted by the fishery based on biological considerations or effort levels. This figure needs annual updating.

Highly migratory fish refers to fish species that undertake ocean migrations and also have wide geographic distributions. It usually denotes tuna and tuna-like species, shark, marlin, and swordfish.

Individual transferable quotas (ITQs) allocate annual fishing quotas to individual fishers. These can be bought and sold among fishers or conservation groups.

Input controls are regulations directed at controlling the fishing power and total effort used to harvest fish. They can be in the form of limits to the number and size of fishing vessels; to the amount of time allowed to fish; and to the types, numbers, or characteristics of gear used.

Intensive culture occurs when stocking densities are high enough that higher levels of feeding and fertilization are required, aeration is usually required, and water quality must be carefully controlled and monitored.

Intertidal zone is the coastal area between the highest and lowest tide marks.

Initial environmental examination (IEE) is a brief statement of factual basis for a threshold decision as to whether an EA or an EIS will be required.

Invasive or nuisance species is a species, often introduced inadvertently or deliberately by human activities from another continent or ecosystem, which can crowd out native species and take over habitats, thereby threatening native biodiversity.

Large-scale industrial or commercial fisheries use relatively capital-intensive fishing technologies, with harvesting and processing equipment owned by commercial entrepreneurs and operated by salaried crews.

Limit reference points (LRP) are stock assessment indicators that may correspond to a minimum condition (e.g., dangerously low spawning biomass) or a maximum condition (e.g., a high rate of decline in stock size or a high mortality rate).

Marine ornamental species are fish (mostly aquarium), corals, invertebrates, and plants.

Marine protected area (MPA) is an area of sea especially dedicated to the protection and maintenance of biodiversity and of natural and associated cultural resources, and managed through legal or other effective means. MPAs range from small, locally managed and enforced fisheries or ecological reserves (no-take reserves) to larger national marine parks that are zoned for multiple uses.

Maximum economic yield (MEY) is the point where the difference between total yield and total costs is the greatest. It occurs at lower total effort levels than maximum sustainable yield (MSY).

Maximum sustainable yield (MSY) is the largest average catch or yield that can continuously be taken from a stock under existing environmental conditions. This also is often referred to as the maximum biological yield.

Mollusks are bivalves (oysters, clams, cockles, scallops) and gastropods (snails).

Natural mortality is the deaths in a fish stock caused by predation, pollution, senility, etc. but *not* fishing.

Nearshore environment is the area that encompasses the estuaries, lagoons, bays, reefs, and sounds.

No-take reserves or locally managed marine areas are areas where extractive activities—including fishing—are permanently prohibited. Some no-take areas allow for non-extractive activities to occur, such as SCUBA diving or snorkeling.

Non-extractive activities are activities that include tourism, SCUBA diving and snorkeling.

One-stop permitting process is an application submitted to a single institution, which then facilitates review and approval by other institutions.

Optimum yield is the yield from the fishery that provides the greatest overall benefit to the nation with particular reference to food production and recreational opportunities.

Output controls are direct limits on the number or size of fish harvested regardless of the inputs used.

Partnership Agreement is when public and private entities jointly provide the service and share in all decision-making.

Passive fishing gear requires the fish to come voluntarily to the gear, e.g., gillnets, trammel nets, hook and line, hand-lining, trolling, long-lining, pots, and traps.

Physical post-harvest losses result from poor handling, preservation, and discarding.

Protected area can range from an area where there is no-take of all species, to areas where there are restrictions only on selected species, to restrictions on gear types, or seasonal closures such as during spawning season.

Quota is a portion of the total allowable catch allocated to an operating unit, such as an individual, vessel, or country.

Recirculation systems are generally tanks or raceways where water is recycled by pumping through some sort of biofilter.

Regional Fisheries Management Organizations (RFMOs) are affiliations of states that are responsible for the conservation and management of fisheries on the high seas and fish stocks that migrate through the waters of more than just one state.

Rights-based management system gives use rights to those individuals or groups entitled to access the fishery.

Salmonids are salmon and trout.

SCALE is a framework, a process, and a set of practical tools and techniques that catalyze system-wide change and result in enhanced livelihoods, improved governance, increased civil society participation, and the adoption of best practices.

Secured access fishery places a limit on the number of participants who have rights and responsibilities in harvesting and managing the resource.

Semi-intensive culture refers to moderate stocking rates where artificial feeds, attention to water quality parameters, and careful adjustment and control of feeding and fertilization to maintain water quality are required.

Shrimp and prawns are crustaceans. Shrimp usually refers to marine species while prawn refers to certain larger marine species and freshwater species.

Small-scale or artisanal fisheries are a more traditional, labor-intensive form of fishing performed by men, women, and children. The fishery is sometimes mechanized; however it usually involve fishing from small boats or from shore, gleaning, or use of traditional gear such as hand-lines, small nets, traps, spears, and hand collection methods.

Soft total allowable catch (TAC) or harvest limit is used as a reference point to assess how close actual landings are to desired levels. Soft TACS may be modified as necessary.

Stakeholder is any person, group, or organization with an interest in the use and management of some aspect of biodiversity in a given place, or which affects or is affected by a particular conservation action, ranging from local users, to government agencies, nongovernmental organizations, and the private sector. Stakeholders can include those at the local, national, and international levels.

Stock is a part of a fish population usually with particular life history patterns, migration patterns, spawning grounds, and subject to a distinct fishery.

Straddling stocks are fish stocks that migrate through, or occur in, more than one EEZ (e.g., cod, flounder, and turbot).

Sustainable yield is the number or weight of fish in a stock that can be taken by fishing without reducing the stock biomass from year to year, assuming that environmental conditions remain the same.

Target reference points (TRP) are stock assessment indicators of a desired stock status, such as biomass levels or fishing mortality rates.

Trade-based management approach uses importation measures as a way to assist in more sustainable resource management and illegal exports.

Traditional management is a form of community-based or co-management. It integrates local cultural or traditional practices, and often follows informal rules or community norms that fall outside of legal or conventional management regimes.

Turtle and fish excluder devices (TED and FED) help reduce catch levels and increase selectivity. Gear modifications include large escape openings, biodegradable panels, large mesh and rope trawls, or square mesh windows.

Value chain analysis is a method for analyzing the series of activities that add value to fish products.

Voluntary and incentive-based management approaches include codes of conduct or best management practices, and eco-labeling or certification schemes. These approaches encourage fishers to "do the right thing" through moral suasion, peer pressure, or for economic reasons.