MANAGEMENT OF ARTISANAL FISHERIES: THE ROLE OF MARINE FISHERY RESERVES

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MESSAGE FROM USAID

This Policy Brief is a product of the Environmental and Natural Resources Policy and Training (EPAT) Project funded by the United States Agency for International Development (USAID). It is part of USAID's effort to provide environmental policy information to decisionmakers and practitioners in developing countries. The objective is to encourage the adoption of economic policies to promote sustainable use of natural resources and to enhance environmental quality.

EPAT Policy Briefs are written for development professionals and policymakers in developing countries who are responsible for establishing and implementing policies on the sustainable use of natural resources and for civil servants, project officers, and researchers who are directly involved in the implementation of development activities. This Policy Brief reviews the use of marine reserves to control the decreasing production of artisanal fisheries. These fisheries are near shore, used by small-scale fishers, and employ primarily labor-intensive methods. Marine reserves also protect habitat and preserve marine biological diversity. Since artisanal fishers produce nearly one-third of the world's food fish harvest, policymakers need to know about alternative approaches available to both sustain this catch and protect the marine environment.

The contribution of USAID toward writing, printing, and distributing this document is estimated to be $7,500. The document is being distributed to more than 2,000 policymakers and professionals in developing countries. We will assess its effectiveness by soliciting the views of recipients. An evaluation sheet is enclosed with each mailing of EPAT documents for that purpose.

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MANAGING ARTISANAL FISHERIES WITH MARINE FISHERY RESERVES

The rich and diverse resources of the sea are being exploited up to and beyond sustainable levels in many areas of the world. Among the results are extinction of species, disturbance of delicate ecosystems, collapse of important fisheries, and destruction of pristine undersea environments.

Less dramatic, but of enormous importance, is the decrease in

yields, income, and employment from fisheries.

Sometimes the technical expertise and funding necessary to manage fisheries effectively and protect marine resources is lacking. In other cases, the government does not consider the problem a priority or there is political opposition to regulation. Systems of regulation and management developed for modern commercial fisheries often do not suit the needs of fisheries in developing countries.

Partial closure of artisanal fisheries using marine reserves may be a feasible and effective means of protecting fishery production as well as habitat and biological diversity.

Alternative Regulation for Artisanal Fisheries

Artisanal fisheries account for nearly one-third of the food fish harvested worldwide (see box 1). In Asia, fishers provide two-thirds of the total catch, and in Africa they account for more than 80% of the total (Bailey 1988) (see figure 1).

Box 1.

In much of the developing world, the fisheries sector consists of "artisanal fisheries." These fisheries are near to shore, exploited by small-scale fishers using labor-intensive methods with little or no modern technology. Typically, they are part-time, subsistence, and small-scale commercial fishers who use multiple fishing technologies and target multiple species.

Figure 1.

World Fish Production 1990
Total Production: 82,741,000 metric tons

Asia and Oceana 44%
Latin America 17%
Africa 4%
Rest of the World 35%

Source: FAO 1991

Artisanal Fisheries
Production in Asia and Africa

Asia
Artisanal 67%
Nonartisanal 33%

Africa
Artisanal 83%
Nonartisanal 17%

Source: Bailey 1988

Figures cannot transfer in gopher format.

Of the approximately 15 million people directly employed in the fisheries sector in developing nations, more than 90% are artisanal fishers. Support services such as processing, marketing, boat building, and transportation indirectly employ an equal number of people. Despite the importance of artisanal fisheries in providing food, income, and jobs, governments very rarely regulate them, and the yields of many have dropped dramatically.

As human populations have grown, they have increased pressure on artisanal fisheries. Destructive methods, such as dynamite fishing, have resulted in widespread destruction of fishery habitats. In addition, decentralized traditional systems of fisheries management such as lagoon and sea tenure [note 1], closed seasons, and closed areas have broken down as the areas have become more "developed" (Johannes 1978).

Conventional regulatory methods for large-scale commercial fisheries include licenses, individual or overall harvest quotas, closed seasons, and restrictions on fishing gear and techniques (Cunningham 1983). Artisanal fisheries present several difficulties for these methods.

Because the industry is not centralized, it is difficult and expensive to enforce catch restrictions. Seasonal closures present hardships for fishers who rely on the fishery for subsistence. Managing fishing effort is very complicated because fishers often use a variety of fishing methods within the same fishery.

By design, conventional fisheries management methods are for single-species fisheries in which the same group of fishers target single species. But artisanal fishers use a wide variety of fishing technologies and methods and target diverse species.

Recently, several fisheries biologists (Roberts and Polunin 1991, Bohnsack 1990, Davis 1989) have suggested that sometimes marine reserves, which close part of the fishery, may increase overall fishery harvest. The reserve acts as a stocking area where reproduction and growth are not impeded.

Reserves offer several other advantages including some protection against collapse of the fishery from overfishing (Bohnsack 1990). They also require less information about fishers and the biological state of the fishery than other management methods,

and fishers easily understand reserves.

Administration and enforcement of a reserve policy only requires keeping fishers out of the reserve rather than regulating their activities in all areas. Marine fishery reserves also protect species and habitat in their natural state so that researchers can study them and revenue-generating tourists can enjoy them.

In the past, governments have often viewed fishery regulation and protected areas as conflicting, even mutually exclusive, approaches to marine resource management. Policymakers have viewed reserves as valuable in conserving habitat and biological diversity and providing amenities such as diving and snorkeling sites. However, decisionmakers have also believed that reserves impose the cost (besides administrative costs) of the value of lost harvest.

Decisions on whether to establish a reserve require comparison of these two values. However, appropriately-designed marine reserves may allow governments to protect undersea habitat and biological diversity and simultaneously improve productivity. If this is true, conservation and harvest values may actually be complements rather than substitutes.

Even so, reserves will not solve the problem of overfishing outside the reserve unless governments enforce additional laws. Although reserves may improve fishery production and security, they will not achieve economic efficiency by themselves. However, when such new regulation is not possible, reserves may be a second-best management strategy or a valuable component of a multifaceted management policy.

Managing Reef Fishery Reserves

Marine reserves will be effective only for certain types of fisheries. For instance, reserves may not manage species such as tuna that live mainly in the open ocean and move from one area to another.

Reserves are likely to be more effective for inshore fisheries such as those based on reefs or mangrove swamps. In these areas, fish tend to stay in one location. A reserve can protect them from fishers and act as a natural hatchery to replenish stocks in surrounding areas.

The potential for marine reserves as a fisheries management tool appears to be greatest for reef fisheries. If properly managed, coral reefs could potentially supply 12% of world fish production and more than 20% of production in developing countries (McManus 1988).

However, these reef fisheries are difficult to manage with present methods that limit catch and effort because they are usually artisanal or recreational fisheries with multiple target

species and fishing methods. As a result, reefs and nonreef coral communities within 15 km of shore are generally overfished (McManus 1988).

The eggs and larvae of reef fish float in ocean currents for weeks or even months, spreading them widely (Doherty and Williams 1988). In this way, the protected population can also replenish the stocks of surrounding areas (see figure 2).

Figure 2

The reserve allows an older, larger, and fertile population to grow. It then provides recruits to the surrounding fishery by exporting larvae and adult fish.

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Normally, it is not food or space for adult fish that limit reef fisheries. It is the number of new recruits, young fish that grow to catchable size (Doherty and Williams 1988). Sufficient recruitment is especially unlikely with heavily-fished reefs. A reserve would not only protect a breeding stock but it would also allow an older and larger population to develop.

For many important fish species, larger fish have many, many times the eggs of smaller fish. For instance, one 60-cm red snapper will produce as many eggs as 212 females of 41 cm (Bohnsack 1990). Thus, increases in young fish production may more than compensate for the fishing area given up to the reserve to protect larger and older fish.

Experience with Marine Reserves

To date, governments have mainly used marine reserves to conserve marine habitat and biological diversity rather than to promote fisheries production. Research on reserves has concentrated on their ability to protect life and habitat within the reserves with little investigation of their effects on surrounding areas.

Roberts and Polunin (1993) undertook extensive studies of marine fisheries on the Sinai coast of Egypt and the Caribbean. Comparing the reserves with surrounding fished areas, they found significantly higher densities inside reserves for some species but not for others. Usually, larger predator species, often preferred target species, were significantly more abundant and larger in unfished or lightly-fished areas.

Two studies of reserves in the United States Florida Keys demonstrate the effects of banning recreational spear-fishing in

protected areas. Bohnsack (1982) found higher densities and larger sizes of several species in the Key Largo National Marine Sanctuary than on nearby spearfished reefs.

A survey of Looe Key reef two years after banning spearfishing showed a 93% increase in snappers and a 439% increase in grunts (Clark, Causey, and Bohnsack 1989). They also discovered other species not present before the ban.
Evidence shows that reserves will allow a more abundant, larger, and more fertile population to develop in protected areas on tropical reefs.

However, evidence supporting the theory that the reserve population will supplement the surrounding fishery is much weaker. The only clear support comes from research results done on a small reserve in Central Philippines (Russ 1985, Alcala 1988).

The government closed a 700-meter-wide section of the 50-hectare fringe reef surrounding the Sumilon Island to fishing from 1974 to 1983. The reserve area was approximately 25% of the total reef area. The decrease in overall reef fishery yields, after people began fishing in the reserve area, illustrates the benefits that the reserve had provided

Beginning in 1984, political changes withdrew reserve protection, and fishers began to encroach on the reserve area. Between 1983 and 1985, the reef density of primary target species fell by 45% to 95% (Russ 1985). Catch per unit effort declined by 55% to 33%, depending on the type of gear. Overall yield for the reef dropped from 36.9 t/km2/yr in 1983-1984 to 19.87 t/km2/yr by 1986 (Alcala 1988).

Apo Island, near Sumilon, also provides evidence in support of reserves. With the support and participation of the local community, the government began a marine conservation program including a small reserve and a halt to destructive fishing methods. In 1986, estimated production from the Apo reef was 31.8 t/km2/yr (White 1987). This is far above the 4-6 t/km2/yr expected from a reef under moderately heavy exploitation (Munro 1984).

Although there is "limited" evidence for the benefits of reserves to fisheries, there is "no" evidence to the contrary. Research clearly shows that reserves are effective in protecting fish populations within their boundaries. Theory and the experience with the Sumilon reserve also suggests that reserves could effectively maintain or increase yields from reefs surrounding reserves. Future studies and experiments [note 2] will help answer this unexplored potential.

Policy Implications and Research Recommendations

Artisanal fisheries are extremely important to the livelihood and

nutrition of many developing countries. However, overfishing and destructive fishing methods often reduce harvest well below its potential and threaten the resource base itself.

Traditional systems of managing artisanal fisheries frequently break down. And regulatory methods developed for modern commercial fisheries are often not appropriate for artisanal fisheries. Marine reserves may offer a way to both increase fishery yields and protect the resource base.

Evidence supporting the use of marine reserves for fisheries management is encouraging but not conclusive. More experience and research will provide policymakers with practical information about the effects of reserves on fishery production and the appropriate size and location of reserves.

Research has focused almost exclusively on marine reserves on tropical reefs. It now needs to investigate the applicability of reserve management to other habitats such as mangrove swamps, estuaries, and even deep-water fisheries.

So far, analysis of marine reserve policy has not properly studied the economic implications for the fishery [note 3]. The economic analysis would compare future gains to earlier losses since the fishery may benefit from the reserve only after an extended transition period.

It is also important to explore how establishing a reserve affects fishing effort and how that effort affects the performance and the appropriate design of the reserve. A comprehensive economic evaluation must consider benefits (or losses) to the fishery together with nonfishery benefits such as conservation and amenity values such as sightseeing. Policymakers must compare these benefits to the cost of implementing and managing the reserve.

The eventual failure of the Sumilon reserve points to another, equally important policy implication for development of reserves. The success of the reserve will ultimately depend on its acceptance by fishers and other coastal residents, particularly if there are limited resources for enforcement. Reserve design and development must include a politically and financially feasible system of governance, usually requiring local support (White 1989).

Fishers must be able to see the long-term benefit of the reserve to fishery production if production initially drops from area lost to fishing. Fishers may also require temporary aid to sustain them until fishery production recovers.

Marine reserves are valuable because they protect biological diversity and habitat and may also increase fishery production. Reserves deserve much wider use in areas that are currently ineffectively managed. Developing country policymakers responsible for marine resource management should investigate the potential of marine reserves and ensure that their design addresses social, economic, and ecological concerns.

NOTES

1. In lagoon or sea tenure systems, an individual, family, clan or other group holds the exclusive rights to fish a specific geographical area of a lagoon, reef, or coastline. Transforming the resource from open access to private property creates an incentive to manage the resource efficiently.

2. Large-scale, long-term studies of effects of reserves on reef fisheries have recently been started by Australia's Great Barrier Reef Marine Park Authority and in California's Channel Islands Biosphere Reserve. Proposals for a fishery reserves system in the U.S. Virgin Islands also offer chances for important research (Roberts and Polunin 1993).

3. There is a large literature on design, value of, and experience with marine reserves (see Salm and Clark 1984, Dixon and Sherman 1990, Tisdell and Broadus 1989). However, it focuses on the benefits of protection of species, habitat, and tourist sites inside the reserve and sheds little light on their effect on surrounding fisheries.

REFERENCES

Alcala, Angel C. 1988. "Effects of Marine Reserves on Coral Fish Abundances and Yields of Philippine Coral Reefs." AMBIO 17(3):194-199.

Bailey, Richard. 1988. "Third World Fisheries: Prospects and Problems." WORLD DEVELOPMENT 16(6):751-7.

Bohnsack, J.A. 1982. "Effects of Piscivorous Predator Removal on Coral Reef Fish Community Structure." In G. M.Caillet and C. A. Simenstad, eds., GUTSHOP 81: FISH FOOD HABITS AND STUDIES. San Diego, California: Academic Press.

Bohnsack, J. A. 1990. THE POTENTIAL OF MARINE FISHERY RESERVES FOR REEF FISH MANAGEMENT IN THE U.S. SOUTHERN ATLANTIC. Miami, Florida: National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NMFS-SEFC-261.

Clark, J. R., B. Causey, and J. A. Bohnsack. 1989. "Benefits From Coral Reef Protection: Looe Key Reef, Florida." In O. T. Magoon, H. Converse, D. Miner, L. T. Tobin, and D. Clark, eds., COASTAL ZONE 89: PROCEEDINGS OF THE SIXTH SYMPOSIUM ON COASTAL AND OCEAN MANAGEMENT, CHARLESTON 11-14 JULY 1989. New York: American Society of Civil Engineers.

Cunningham, Stephen. 1983. "The Increasing Importance of

Economics in Fisheries Regulation." JOURNAL OF AGRICULTURAL ECONOMICS 34(Jan):69-78.

Davis, Gary E. 1989. "Designated Harvest Refugia: The Next Stage of Marine Fishery Management in California." California Cooperative Oceanic Fisheries Investigations (CalCOFI) Report 30:53-57.

Dixon, John and Paul B. Sherman. 1991. ECONOMICS OF PROTECTED AREAS: A NEW LOOK AT THE BENEFITS AND COSTS. London, England: Earthscan Publications.

Doherty, Peter J. and David Williams. 1988. "The Replenishment of Coral Reef Fish Populations." OCEANOGRAPHY AND MARINE BIOLOGY, AN ANNUAL REVIEW 26:487-551.

Johannes, R. E. 1978. "Traditional Marine Conservation Methods in Oceana and Their Demise." ANNUAL REVIEW OF ECOLOGICAL SYSTEMS 9:349-64.

Munro, J. L. 1984. "Yields from Coral Reef Fisheries." FISHBYTE 2:13-15.

McManus, John W. 1988. "Coral Reefs of the ASEAN Region: Status and Management." AMBIO 17(3):189-193.

Roberts, Callum and Nicholas Polunin. 1991. "Are Marine Reserves effective in Management of Reef Fisheries." REVIEWS IN FISH BIOLOGY AND FISHERIES 1:65-91.

Roberts, Callum and Nicholas Polunin. 1993. "Marine Reserves: Simple Solutions to Managing Complex Fisheries." AMBIO 22(6):363-368.

Russ, G. 1985. "Effects of Protective Management on Coral Reef Fishes in the Central Philippines." PROCEEDINGS OF THE FIFTH INTERNATIONAL CORAL REEF CONGRESS TAHITI 4:219-224.

Salm, Rodney and John R. Clark. 1984. MARINE PROTECTED AREAS: A GUIDE FOR PLANNERS AND MANAGERS. Gland, Switzerland: International Union for the Conservation of Nature.

Tisdell, Clem and James Broadus. 1989. "Policy Issues Related to the Establishment and Management of Marine Reserves." COASTAL MANAGEMENT 17:37-53.

White, A.T. and G.C. Savina. 1987. "Reef Fish Yield and Nonreef Catch of Apo Island, Negros, Philippines." ASIAN MARINE BIOLOGY 4:67-76.