

FISHERIES AND AQUACULTURE: TOWARDS SUSTAINABLE AQUATIC LIVING RESOURCES MANAGEMENT

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Keywords: Fisheries, aquaculture, fish, aquatic living resources, protein, sustainable development, developed/wealthy country, developing country, ecological resource, aquatic ecosystem, coastal zone, artisanal fisheries, industrial fisheries, marine fisheries, freshwater fisheries, fisheries economy, overfishing, overcapacity, postharvest, bycatch, discard, subsidy, fisheries policy, institutional strengthening, coastal resource management, pollution, employment, environment, fisheries management

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Summary

Fishing has been a major source of high-protein food for humanity, and has had significant impact on economic growth. The principal focus in the fisheries sector until the mid-1980s, was the marine fisheries sub-sector, and in some regions, the support of the rapid expansion of aquaculture. The wealth of aquatic living resources was assumed to be an unlimited gift of nature. This myth has faded in the light of the realization that aquatic resources, although renewable, are not infinite and need to be properly managed, if their contribution to the nutritional, economic and social well-being of the growing world population is to be sustained. A downturn in global fish production in the early 1990s brought about by overfishing, and continuing environmental degradation, called for improved management schemes and sustainable utilization of aquatic resource systems. Fisheries operations need to emphasize policy reform, explicit environmental and community considerations, strengthening of institutions, and research and training. The fisheries sector remains special, complex, and often difficult to understand for people from outside, such as development specialists involved in credit and investment for fisheries, policy analysts and decision-makers, as well as scientists and fisheries biologists. Conventional wisdom has it that concern for the sustainability of the aquatic living resources is a luxury only the wealthy world can afford; and that only people whose basic needs for food and shelter have been met, can start worrying about the health of the planet. However, developing countries with pressing concerns, such as food security and poverty reduction, should also be thinking about the sustainability of their natural resources. At the dawn of the new millennium, there is an urgent need for a new approach to deal with fisheries around the world so that the drastic depletion of fish stocks and other aquatic living resources may be stemmed. The sector suffers from inappropriate incentives and subsidies, which are worsening the “tragedy of the commons.” Fisheries and aquaculture are critically important to the developing world. Consumption of fish and aquatic products is often the only source of animal protein for many coastal rural communities. The most biodiverse ecosystems in the world are found in many coastal waters, and these require adequate and effective conservation and protection to enable both local and global benefits. The wealthy countries should give more attention and aid to these basic fisheries and aquaculture management issues in developing countries. However, too often, developed countries have their own agenda dictated by domestic politics and home-grown green or blue fashions, whereas governments of developing countries have to face up to tackling most of these problems themselves. If they fail, they will be risking not the just the health of their citizens but certainly the health of our “blue planet” as well.

1. Introduction

Commercial fishing should not compromise the sustainability of fisheries and the responsible utilization of aquatic living resources. Why is it important now, as never before, to know better and understand more deeply the current status of fisheries and aquaculture? Why are conservation and management of natural aquatic resources urgent concerns? The crucial answers might come from the following warning case study, which could be considered as one of the best descriptions of the current situation in the fisheries sector, and introduces this Theme article on Fisheries and Aquaculture, which summarizes the major issues of the sector.

Nowadays, somewhere on our planet, in an archipelago with one of the world's longest coastlines, you would think people will never want for fish and other marine resources. The country's coastline is more than 18,000 kilometers long, with coastal waters covering 266,000 square kilometers. Of the country's 1,500 municipalities, 54% are in coastal areas. More than a million local people are engaged in fisheries, a sector that accounts for about four percent of the gross national product. Up to 60% of the country's total fish catch comes from coastal fishing.

Yet as the century draws to a close, local people are faced with dwindling fishery resources. Coastal areas are deteriorating from pollution, overfishing and destructive fishing methods, logging and coastal development. Mangrove forests, which serve as shelters for fish, have dwindled from 450,000 hectares at the start of the century to less than 150,000 hectares. Up to 50 percent of seagrass beds, which support over 300 species of marine life, have been lost to coastal development and heavy siltation. The country has 27,000 square kilometers of coral reefs, of which only five percent remain in excellent condition.

Overfishing and destructive fishing methods are costing the nation up to US\$400 million a year in lost catch. For years the world lived with the thought that the ocean could replenish itself with around 100 million tons of fish annually. Overfishing, however, has led to a decline in fish catch. Now overfishing as well as the destruction of marine ecosystem is endangering the world's food supply.

The situation is not irreversible. Through aggressive information campaign, communities that depend on the ocean for their livelihood can cooperate in efforts to conserve marine ecosystems. The central government can improve the enforcement of fishery laws and increase penalties for major fishing operators caught employing destructive fishing methods. Pollution control must be improved. Much will depend on local governments. The local executives must move swiftly to ensure the survival and sustainability of the ocean.

From ancient times, fishing—as sport or business of catching fish and other aquatic living resources—has been a major source of high-protein food for humanity, particularly for lower income groups, and has had a significant impact on economic growth as a provider of employment and economic benefits by means of foreign exchange earnings to those engaged in this activity. The wealth of aquatic living resources was assumed to be an unlimited gift of nature.

The term “fisheries” is often used broadly to include “fisheries and aquaculture,” and in the same manner, the generic term “fish” is often used to refer to all living aquatic resources, including finfish, molluscs, crustaceans, and aquatic plants. The development of the fisheries sector has often been based on fisheries resource availability and the economic and financial viability of national programs. An integrated approach has frequently been adopted, incorporating a chain of operations from the capture or culture of fish to preserving and marketing in domestic and/or export markets, with emphasis on appropriate technology and methodology wherever feasible.

Until the mid-1980s, the principal focus in the fisheries sector was the marine fisheries subsector, with emphasis on improvement of fishing technology, fishing vessels, and shore-based support facilities and related infrastructure. In some regions, such as the Asian and Pacific Regions, the focus was to support the rapid expansion of aquaculture.

However, with increased knowledge and the dynamic development of fisheries—especially in the last half of the twentieth century—the myth of unlimited aquatic resources has faded in light of the realization that these resources, although renewable, are not infinite, and need to be properly managed, if their contribution to the nutritional, economic and social well-being of the world’s growing population is to be sustained. A downturn in global fish production in the early 1990s brought about by overfishing and continuing environmental degradation generated public alarm and calls for improved management schemes and sustainable utilization of aquatic resource systems. Fisheries operations needed to emphasize policy reform, explicit environmental and community considerations, strengthening of institutions, and research and training.

In the new millennium, special attention should urgently be given to fisheries management, because the fisheries sector is special, complex, and often difficult to understand for people from outside—in particular for development specialists involved in credit and investment for fisheries, policy analysts and decision-makers in the public and private sectors, and many scientists and fisheries biologists.

Significant developments have emerged in the fisheries sector that impinge on the sustainability and the renewal of the resources. With increases in population, human impacts have become more pronounced on the environment and its renewable resources, such as fish. Conflicting demands for the use of scarce resources complicate the question of how best to manage, conserve, and use such resources sustainably. Recently, the poverty-environment-fisheries nexus has received increasing attention from national governments and international organizations. There is an economic problem of overinvestment and overcapacity, and a range of biological interventions can be implemented to solve it. Nevertheless, fisheries management does not mean only managing the fish stocks (which cannot be done directly and requires environmentally sound technology and methodology) but managing fishermen and boats too. Fleet restructuring has to be fully considered, as do the establishment and the enforcement of appropriate policies and the institutional framework of fisheries resources management.

It should be noted that institutional capabilities in many regions of the world—mainly in developing countries—are still weak. It is essential, perhaps crucial, to underscore the need for institutional strengthening of the fisheries agencies to enhance their

capabilities, and their scientific knowledge and technical understanding, in order to handle efficiently the management of the fisheries towards sustainable development for the sake of our Earth and its aquatic life.

This contribution presents an overview of the fisheries sector, discusses aquatic living resources that are considered as the major components of commercial fishing, with emphasis on their role and importance, gives a general outline of the sector and its major issues, and introduces trends and perspectives related to marine and inland fisheries and aquaculture, with special attention to aquatic living resources management. In-depth detailed presentations of the micro-level details of the fish and other aquatic living resources that are commercially exploited and/or farmed, are given in the following Topic-level and/or Article-level contributions to this Theme.

2. The Role of Fisheries

As are gathering and hunting, fishing is as old as humankind. Aquatic living resources play an important role in nutrition, employment generation, and foreign exchange earnings all around the world. However, their cultivation has not yet received the same attention as that of other agricultural systems.

2.1. An Important Agricultural Resource

Aquatic living resources, including fish, molluscs, and seaweed, represent the world's fifth largest agricultural resource, after rice, forest products, milk, and wheat, and account for 7.5% of total world food production. Fish production (which for the purpose of this discussion includes finfish; crustaceans—e.g., shrimps, lobsters, prawns; molluscs,—e.g., oysters, mussels, scallops, squid, and octopus; and seaweed) remains comparable with those of major land husbandry systems where productivity is enhanced by technological intensification.

2.2. A Source of Foreign Exchange Earnings

In 1996, global aquatic production reached 130 million metric tons, almost doubling the average per capita food fish supply of 8 kilograms in 1950 to over 15 kilograms. First sale values of capture fishery and aquaculture production were estimated at US\$85 billion and US\$47 billion, respectively. In terms of volume, fish products far outweigh any one of the four main terrestrial animal commodity groups—beef, sheep, pig, and poultry meat. In the developing world, fish production, totaling about 60 million tons, is nearly as great as the total of all the four animal commodities combined (about 70 million tons).

2.3. A Source of Protein

More than a billion people around the world depend upon fish as their primary source of animal protein. About 19% of human protein intake comes from the marine and inland aquatic living resources, but in many developing countries aquatic products provide 30–70% of the animal protein consumed in the human diet. On average, fish provides about 28% of the total animal protein consumed in Asia, compared with 21% in Africa, 8% in

Latin America, 7% in North America, and 10% in Western Europe. In some countries, such as Bangladesh, the Maldives, Philippines, and the Pacific Islands, fish supplies over 75% of the total animal protein consumed by the human population. In affluent countries, fish products are appreciated for their taste and their nutritive properties (natural products low in calories, fat, and cholesterol contents).

2.4. A Source of Income

A third of the world capture fisheries production is transformed into meal and oil, which are important components in the preparation of feeds used in large-scale farming systems (poultry and pig farming and fish and shrimp culture). Fisheries and aquaculture provide income to more than a hundred million people who are involved in and/or depend, directly or indirectly, on fishing for their livelihood (See also *Marine Organisms as Food, Forage, Industrial, and Medical Products*, EOLSS on-line, 2002).

2.5. A Source of Employment

In developed countries, maintaining employment in coastal fisheries is an important goal of sector policies. For many developing countries, exports of fishery and aquaculture products are major sources of foreign currencies. Small-scale fisheries contribute to the attractiveness of coastal zones everywhere. About fifty million people rely on small-scale fisheries, through catching, processing, trading, or marketing as a source of income. In affluent countries, sport fishing ranks high in leisure activities.

In addition to its role as a basic food commodity, fish are used for ornamental purposes (aquarium fishes), for recreation (e.g., game fishing) (See also *Recreational Sport Fishing in Fresh Waters*, EOLSS on-line, 2002), and for conservation (as integral parts of freshwater and marine ecosystems). In addition to human foods and food additives, fisheries yield products that are used in animal and crop feeds, cosmetics, detergents, jewelry, and a wide range of industrial and pharmaceutical products (See also *Marine Organisms as Food, Forage, Industrial, and Medical Products*, EOLSS on-line, 2002).

2.6. A Valuable Ecological Resource

About 83% of the global value of ecosystem services comes from aquatic ecosystems, which in their natural state, support high biodiversity, immense biological productivity and other natural functions, and where aquatic living resources are major components. A total economic valuation of these ecological services has been estimated at US\$ 21 trillion (coral reef ecosystems are estimated at US\$375 billion per year for seafood and coastal protection services alone) (See also *Rational Use and Conservation of Marine Ecosystems*, EOLSS on-line, 2002, knowledge in depth).

2.7. Towards Sustainable Fisheries Development

Rapid developments in the coastal zone that result in altered environments for human use present potential conflicts in its sustainable management. At the start of the new millennium doubt is cast on the sustainability of the fisheries sector due to overfishing and overcapacity, as a result of open access policies and subsidy-driven over-

capitalization, that have led to a global crisis in fisheries. It is in the productive areas—mainly shallow inshore waters of up to 50-m depth and continental shelves—that the fishing pressure is most intense.

Fishing has often been the exclusive right of specific groups but in many areas of the world, especially in developing countries, it attracts the poorer and often landless elements of the community. The rapidly increasing human population is resulting in increased pressure on aquatic resources. It is estimated that by the year 2010, an additional 40 to 50 million tons of fish will be needed to maintain the present global per capita availability of food fish. At an international level, but more specifically at regional and national levels in the developing world, the need for an integrated approach to agriculture, fisheries, livestock and forestry is being considered in the effort to alleviate poverty, ensure food security and manage natural resources.

The importance of fisheries emanates from their contribution to the economy and their relevance to the social and physical environment. Especially in developing countries, this introduces an important social dimension that links the policies of governments on poverty reduction with efforts to conserve fisheries resources.

3. An Outline of Fisheries

The fisheries sector is traditionally divided into (i) artisanal fisheries, including inland and coastal fisheries, (ii) industrial fisheries, and (iii) aquaculture.

3.1. Artisanal Fisheries

Artisanal or small-scale fisheries are generally limited to near-shore or coastal waters and inland water bodies, and employ labor-intensive fishing technologies. Artisanal fishing operations are typically family-based, using small craft—usually smaller than 12 meters (m) long—and fishing gear such as beach seine and gill nets, hook and line, and traps. In the Asia-Pacific, artisanal fisheries are estimated to contribute approximately 50% of total fisheries production, and support extensive rural employment, especially in countries where fisheries have become the employers of last resort (See also *Fisheries Engineering and Technology; Fishing Fleet Operation and Economical Considerations*, EOLSS on-line, 2002, knowledge in depth).

3.2. Industrial Fisheries

Industrial fisheries include business concerns of varying sizes, with boats usually ranging from 12 to 24 m. This sub-sector employs relatively capital-intensive fishing technologies, with the equipment owned by commercial entrepreneurs and operated by salaried crews. Industrial fishing vessels are usually licensed to operate in offshore waters, but in most of the developing countries they often encroach on inshore waters, thus competing with the artisanal sub-sector. The rapid technical development in vessel design, which began with the British factory trawler experiment at the beginning of the 1950s, and demonstrated the great advantage of large stern trawlers that processed their catch on board, increased substantially throughout the 1980s and 1990s and has been further developed by countries engaged in deep-sea fishing operating modern fleets with

vessels ranging from 24 to 100 m in length (See also ‘*Harvesting the Seas*’ and ‘*Fisheries Engineering and Technology; Fishing Fleet Operation and Economical Considerations*,’ EOLSS on-line, 2002, knowledge in depth).

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Bibliography

Asian Development Bank (1997). *The Bank's Policy on Fisheries*, 84 pp. Manila: ADB. [This paper provides the recommended strategy and policy for the Bank in the fisheries sector.]

FAO (1995). *Code of Conduct for Responsible Fisheries*, 41 pp. Rome: FAO. [The Code sets out principles and international standards of behavior for responsible fisheries practices.]

FAO (1999). *The State of World Fisheries and Aquaculture, 1998*, 112 pp. Rome: FAO. [This report provides initial overview and trends in world fisheries and aquaculture.]

ICLARM (1999). *ICLARM's Strategic Plan 2000-2020. Report*, 153 pp. Penang: ICLARM (The World Fish Center). [This report presents a global view of fisheries and aquaculture and future research priorities.]

Milazzo M. (1998). Subsidies in world fisheries: a reexamination. *World Bank Technical Paper No. 406, Fisheries Series*, 86 pp. Washington, DC: The World Bank. [This article presents a comprehensive discussion of the world fisheries subsidies.]

OECD (1998). *Review of Fisheries in OECD countries*. 93 pp. OECD Publications. Paris: OECD. [This report presents a review of fisheries in OECD countries]

Pacific Economic Cooperation Council (1998). *The Impact of Government Financial Transfers on Fisheries Management, Resource Sustainability and International Trade*. Report of Proceedings for the PECC Workshop, Manila, 17-19 August 1998, 124 pp. Singapore: PECC [This documents presents information on financial support to the fishing industry.]

The Economist (1998). Dirt poor. *The Economist* March 21st 1998, 16 pp. [This article presents a survey of development and the environment.]

United Nations (1997). *The Law of the Sea, Official Texts of the United Nations Convention on the Law of the Sea of 10 December 1982 and the Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982*, 294 pp. New York: United Nations. [This volume contains the official texts.]

World Trade Organization (1998). *GATT/WTO Rules on Subsidies and Aids Granted in the Fishing Industry. Note by the Secretariat*, Document No. WT/CTE/W/80, 9 March 1998. 74pp. Lausanne: WTO [This paper provides information on fisheries subsidies.]

Biographical Sketch

Patrick Safran born in France (1957), graduated from Lille University, France with a D.Sc. in Biology (1987) and Ph.D. in Natural Science (1995). He also has a Ph.D. in Agriculture from Tohoku University (1990), Japan and an MBA from Knightsbridge University (1998), UK. He is currently (2000) Project Specialist (Natural Resources) to the Forestry and Natural Resources Division West of the Agriculture

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