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Water Pollution and Japan's Declining Fish Catch

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Abstract

The decline in Japan's fish catch that started in 1989 can be attributed mainly to stock depletions due to overfishing in deep seas and offshore waters and polluting of water in inland and coastal waters. Animal wastes, nitrogen, phosphate fertilizer, and pesticides are the most serious sources of water pollution originating from the agricultural sector. Household wastes are another major source of water pollution affecting Japan's inland and coastal fish resources.

Keywords: Japan's fish catch, water pollution in Japan, eutrophication, livestock and urbanization wastes, government environmental regulations.

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About the current ERS fish research

The recent decline in Japan's fish catch and its economic consequences for U.S exporters of beef, pork, poultry, and fish and shellfish has been the topic of two ERS publications. The first paper, entitled "Water Pollution and Japan's Declining Fish Catch," and attributed the decline in Japan's catch, which started in 1989, mainly to stock depletions due to overfishing in deep seas and offshore waters and polluting of water in inland and coastal waters. Animal wastes, nitrogen, phosphate fertilizer, and pesticides were found to be the most serious sources of water pollution originating from the agricultural sector. Household wastes are another major source of water pollution affecting Japan's inland and coastal fish resources. The first report concluded that the decline in Japan's fish and shellfish catch is not a shortrun phenomenon, and may extend into the medium to long term.

This conclusion prompted further ERS assessment of trade flows and consumption patterns to develop the relationship between demand, supply, prices, and substitution effects of meats, fish, and shellfish in Japan. The ensuing publication was entitled "Japan's Fish Consumption Patterns, Production, Trade, and Prospects for U.S. Exports," and was published as ERS Staff Paper No. AGES-9609. The database for the study covered over 40 years and established the perennial importance of fish and shellfish in the Japanese diet, despite increasing demand for beef, pork, and poultry. To meet rising fish and shellfish demand, Japan has become the world's largest importer, absorbing nearly a third of global fish and shellfish imports; and the United States has become its largest supplier. The outlook for exporting to Japan is excellent, because the U.S. catch contains most of the species prized highly in the Japanese market, such as salmon, crabs, and Alaskan pollack.

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Introduction

The main purpose of this paper is to clarify whether the recent marked decline in Japan's fish catch is a result of pollution problems within Japan's coastal and inland waters. Since 1989, the total fish catch has decreased by more than one-third to a 25-year low, pushing fish prices relatively higher than meat prices. The clarification of this issue has economic importance because the fish catch is tied indirectly to developments in Japan's livestock industry, production, consumption, and trade. Traditionally, fish has been central to the Japanese diet and provides nearly 50 percent of animal protein.

First, the paper identifies the major sources of water pollution in Japan. Then it discusses the structure of fishery resources and traces the impact of water pollution on the fish catch within each category. The paper then assesses the economic impact of the declining fish catch on Japan's fish trade and consequences for substitution by other protein sources such as beef, pork, and poultry.

Fish and the Environment

In 1956, Japan became the focus of world attention and curiosity. Fish in Minamata Bay died and rose to the surface, cats went mad before dying in Kumamoto prefecture, many people were hospitalized suffering from poisoning, and many newborns had deformities. All of those occurrences were referred to as the Minamata disease, whose cause, at the time, was not clear. In 1968 the Minamata disease, a disorder of the central nervous system, was linked to the long-term consumption of fish and shellfish from Minamata Bay, which was contaminated with mercury released from industrial wastes. The mercury contaminated the local fish by combining with organic material to become methylmercury, a nerve system toxin that caused blindness, numbness, retardation, and cerebral palsy (17). 1/

The quality of water directly affects the health of fish and shellfish, including their size, numbers, and the residue levels of pollutants absorbed in their tissues. Because fish and

1/Underscored numbers in parentheses refer to sources listed in Bibliography at the end of this paper.

shellfish filter water from the environment they live in, they absorb and accumulate dissolved chemicals and other compounds that resist degradation, such as DDT, mercury, and dioxin. These chemicals are transferred to people when the fish are consumed.

Seafood can also transfer harmful microbes to people, depending on the type and severity of water contamination. Some of the vibrio bacteria cause gastroenteritis, septicemia, and salmonellosis. Among the viruses are the hepatitis-A virus, which is widespread among Asians. Aniskid nematode is mostly associated with eating raw fish such as sushi and sashimi. Other fish toxins, including ciguatoxin, scombrotoxin, and tetratoxin, cause nausea, abdominal cramps, diarrhea, vomiting, fever, headache, etc. The risk of contracting such illnesses increases when seafood is consumed raw, as is frequently the case in Japan.

The risk of a food poisoning outbreak is 25 times greater from seafood consumption than from beef, and 16 times greater than from poultry or pork. The risk is even greater in shellfish and in mollusks such as clams, oysters, and mussels (3).

The Role of Fish in the Japanese Diet

Fish is a mainstay of the Japanese diet, usually eaten raw as sushi and sashimi. Japan is also the world's largest market for tuna, and its per capita consumption of tuna is one of the world's highest. The Japanese diet has traditionally relied mainly on rice for calories and on seafood for animal protein. An island nation, Japan has looked to the sea to supplement the limited food supply derived from its relatively small agricultural land area. Raising livestock to supply animal protein for meat consumption is a relatively new phenomenon in Japan's history, dating back only to the beginning of the Meiji era (1868-1912) (2).

Per capita fish consumption has been and still is larger than per capita consumption of all kinds of meat together, including beef, pork, chicken, lamb, goat, and horse (80 pounds of fish versus 65 of all meat in 1992). Japan is one of the highest fish- and shellfish-consuming countries in the world and the world's largest importer. In 1992, the Japanese consumed 5.4 times more fish than Americans did (80 pounds per capita versus 14.7) and a little over one-third as much poultry meat (23.3 pounds versus 60 pounds) and red meat (41.6 pounds versus 114.1 pounds) (table 1). Fish and shellfish are to the Japanese what hamburger and chicken are to Americans.

Table 1--Consumption of red meat, poultry, and fish: Japan and United States, 1970-1995

Year	Red meat		Poultry		Fish and Shellfish	
	U.S.	Japan	U.S.	Japan	U.S.	Japan
	Pounds per capita per year					
1970	131.7	18.7	33.8	8.4	11.7	69.6
1971	135.5	21.1	34.0	9.5	11.5	73.1
1972	131.8	22.9	35.4	10.4	12.5	72.9
1973	121.8	24.2	33.7	11.2	12.7	74.4
1974	130.4	24.2	33.8	11.2	12.1	76.7
1975	125.8	26.0	32.9	11.5	12.1	76.9
1976	133.0	26.7	35.5	12.8	12.9	77.5
1977	132.3	28.9	35.9	14.3	12.6	75.3
1978	127.5	30.2	37.3	15.6	13.4	77.1
1979	124.4	32.2	40.1	16.5	13.0	74.9
1980	126.4	31.5	40.8	17.0	12.4	76.7
1981	125.1	31.9	42.1	17.2	12.6	75.1
1982	119.8	32.4	42.2	18.3	12.4	73.6
1983	123.9	32.8	42.7	18.9	13.3	76.7
1984	123.7	33.0	44.0	19.8	14.1	78.6
1985	124.9	34.6	45.5	20.3	15.0	78.9
1986	122.2	35.9	47.4	21.6	15.4	80.2
1987	117.4	38.1	51.0	22.2	16.1	80.8
1988	119.5	39.0	51.9	22.9	15.1	81.5
1989	115.9	39.4	53.9	22.9	15.6	81.5
1990	112.3	40.3	56.0	22.7	15.0	81.7
1991	111.9	40.7	58.4	22.9	14.8	79.1
1992	114.1	41.6	60.9	23.3	14.7	80.0
1993	112.1	43.2	62.6	22.7	14.9	80.8
1994	114.8	44.3	63.7	23.1	15.1	N/A
1995F	115.0	N/A	64.8	N/A	15.1	N/A

N/A =not available data

Notes: Red meat and poultry data reported on boneless, trimmed equivalent and fish and shellfish on edible meat-equivalent basis. Factors converting carcass weight to boneless are .70 in Japan, .69 in the United States for red meats; .77 for poultry in Japan, .597 for chicken and .79 for turkey in the U.S. Edible weight for fish is 52.1 percent of liveweight in Japan, and 32.3 percent. in the United States.

Sources: Food Consumption, Prices, and Expenditures, 1996: Annual Data, 1970-94, United States Department of Agriculture, Economic Research Service, Statistical Bulletin number 928, March 1996. Statistical Yearbook of Ministry of Agriculture, Forestry, and Fisheries, Tokyo, 1992/93 and previous issues. Livestock Industry Promotion Corporation (LIPC), Monthly Statistics, number 75, Tokyo, February 1996. Fisheries of the United States, Department of Commerce, 1994.

Sources of Water Pollution in Japan

Six major types of waste contribute to water pollution.

Industrial Waste

Rapid industrial growth in the 1950's and 1960's greatly enhanced Japan's national economy and standard of living but also resulted in substantial industrial pollution problems. During this time, Japan emphasized production and profit, but acknowledged only a few pollution problems requiring only small investments to control. However, in 1970, Japan issued the Water Pollution Control Law to combat industrial and health-related pollution problems. These regulations were intended to reduce pollution from industrial plants, businesses, and sewage treatment systems. Japan's environmental laws with regard to water pollution were extended in 1987 to reduce the amount of effluent nutrients (especially nitrates and phosphates) in closed water areas, such as rivers, lakes, reservoirs, and inland seas.

Other possible industrial chemicals that affect drinking water include inorganic substances such as cadmium, mercury, selenium, and arsenic, as well as organic materials such as paint thinners, glues, dyes, and pesticides.

Agricultural Chemical Use

The modernization of agriculture was a major policy objective for Japan in the postwar era to meet expanding food requirements. Farmers have found it profitable to use more agricultural chemicals to increase crop yields and income. The government has subsidized the use of chemicals such as fertilizers and pesticides to increase agricultural production from limited land resources.

Fertilizer use in Japan is one of the heaviest in the world. In 1990, total fertilizer use per hectare of crop and pasture land was 348 kg, 8 times higher than in the United States. Per hectare of crop and pasture land, Japan is the world's largest user of phosphate fertilizer, and the world's third largest user of nitrogen (table 2). Both phosphate and nitrogen potentially pose great environmental damage, contributing to the eutrophication process (see definition below).

As with fertilizers, use of pesticides increased during the postwar years, causing serious concern among Japanese consumers. Pesticide residues, from insecticides, herbicides, fungicides, etc., can be toxic to humans and animals in food, feed, or drinking water. Fish and shellfish absorb and accumulate pesticide residues, especially in their fatty tissues and thus transfer them to humans when consumed. At high concentrations, pesticides are also hazardous to fish and shellfish and could cause their immediate death (16).

Table 2--Fertilizer use on cropland and pasture land, 1990/91

Country	Total (N+P2O5+K2O)	Nitrogen N	Phosphate P2O5	Potassium K2O
	Kilograms per hectare			
Taiwan*	566.6	360.8	92.4	113.4
Korea, South*	432.0	228.0	103.6	100.5
Japan	348.2	115.9	130.7	101.5
Netherlands	281.7	197.0	37.2	47.5
Belgium-Lux.	257.7	124.8	52.3	80.5
Germany, Fed.	246.9	115.2	51.3	80.4
Denmark	227.1	141.6	31.8	53.7
France	185.6	81.4	44.0	60.1
Malaysia	185.3	53.4	31.3	100.6
U.K.	133.1	85.6	21.3	26.1
Ireland	122.9	65.7	24.6	32.6
Italy	108.2	50.6	37.5	20.0
Sweden	96.2	62.0	16.9	17.2
Greece*	75.7	46.5	20.9	8.3
Indonesia*	75.7	48.6	17.6	9.5
Spain	64.8	34.8	17.5	12.4
China*	64.5	46.4	13.9	4.2
Philippines*	63.7	43.5	11.4	8.8
Portugal	61.4	33.1	17.7	10.6
Thailand*	45.5	25.1	13.9	6.5
United States	43.1	23.7	8.8	10.6

*Note: * indicates data for 1990.*

Source: World Fertilizer Consumption Statistics, International Fertilizer Industry Association, No. 24, Paris, November 1992.

Livestock Manure

Contamination of water resources from livestock production activities has become an important public issue in Japan due to the rapid increase of livestock production on limited land.

Areas of intensive livestock production (especially confinement operations) accumulate large amounts of animal waste in solid and liquid form. Manure, in concentration or untreated, is considered a potential hazard for water pollution because of its high content of nitrate, phosphate, potassium, and ammonia, as well as micro-elements like zinc, copper, manganese, and iron (table 3). If the volume of these elements exceeds the absorption capacity of the soil, they wash directly into surface rivers and lakes, or leach through the soil to ground water sources. In addition, ammonia gas is released into the air with the potential to cause acid rain. In addition, acid rain is caused also by other gases including sulfur dioxides, nitrogen oxides, and carbon dioxide. Acid rain can directly damage crops and cause forests to atrophy and eventually die. Indirectly, acid rain causes acidification of water in lakes, rivers, and water reservoirs with adverse impacts on fish and other water fauna and flora.

Table 3--Average chemical content of manure by type of animal (Netherlands)

Animal	Nitrogen	Ammonia	P2O5	K2O	Copper	Zinc	Cadmium
	Kg/year/animal				gram/year/animal		
Cattle	64.0	18.0	20.0	100.0	50.0	100.0	0.7
Pigs	13.0	2.8	12.0	13.0	100.0	100.0	0.2
Poultry	0.5	0.3	0.3	0.5	0.8	3.0	0.0
Horses	34.0	9.4	N.A.	N.A.	N.A.	N.A.	N.A.
Sheep*	20.0	6.0	8.0	19.0	0.0	N.A.	N.A.

N.A. = not available

* *Data on the composition of manure produced by sheep are based on information from the Institute for Soil Fertility in Haren, the Netherlands.*

Source: Koopman, Tom T.H., An application of an agri-economic model to environmental issues in the EC: A case study. Center for World Food Studies, Free University Amsterdam, Netherlands, 1987.

Urbanization

Following World War II, rural migration to urban and industrial centers resulted in overpopulation of the country's major cities. Construction of sewer systems, septic tanks, and other facilities that control domestic waste outflows lagged behind the development of urban centers in Japan. In 1965, 10 percent of all Japanese had sewage disposal facilities connected to their homes. By the end of fiscal 1990, 44 percent of Japan's total population had such facilities, compared with 6 percent of the Japanese population in farm, mountain, and fishing villages(9). This resulted in the dumping of household waste, including effluent from cooking, washing, bathing, and sewage, into water supplies. These materials contribute substantially to water pollution through the eutrophication process.

The discharge of untreated raw sewage became illegal in 1984. Discharge of other household effluent from cooking, washing, and bathing is still allowed in some public water without any treatment.

Oil Pollution

Oil pollution comes mainly from ships discharging ballast water, or deliberately spilling oil, and from individual industrial plants along the coast. Pollution from oil has also been decreasing since its peak of 2,060 cases in 1973 (fig. 1). Likewise, the number of cases in the Seto Inland Sea, a major oil pollution center, dropped from 874 cases in 1972 to 142 in 1989, representing 23 percent of all oil pollution in Japan in that year.

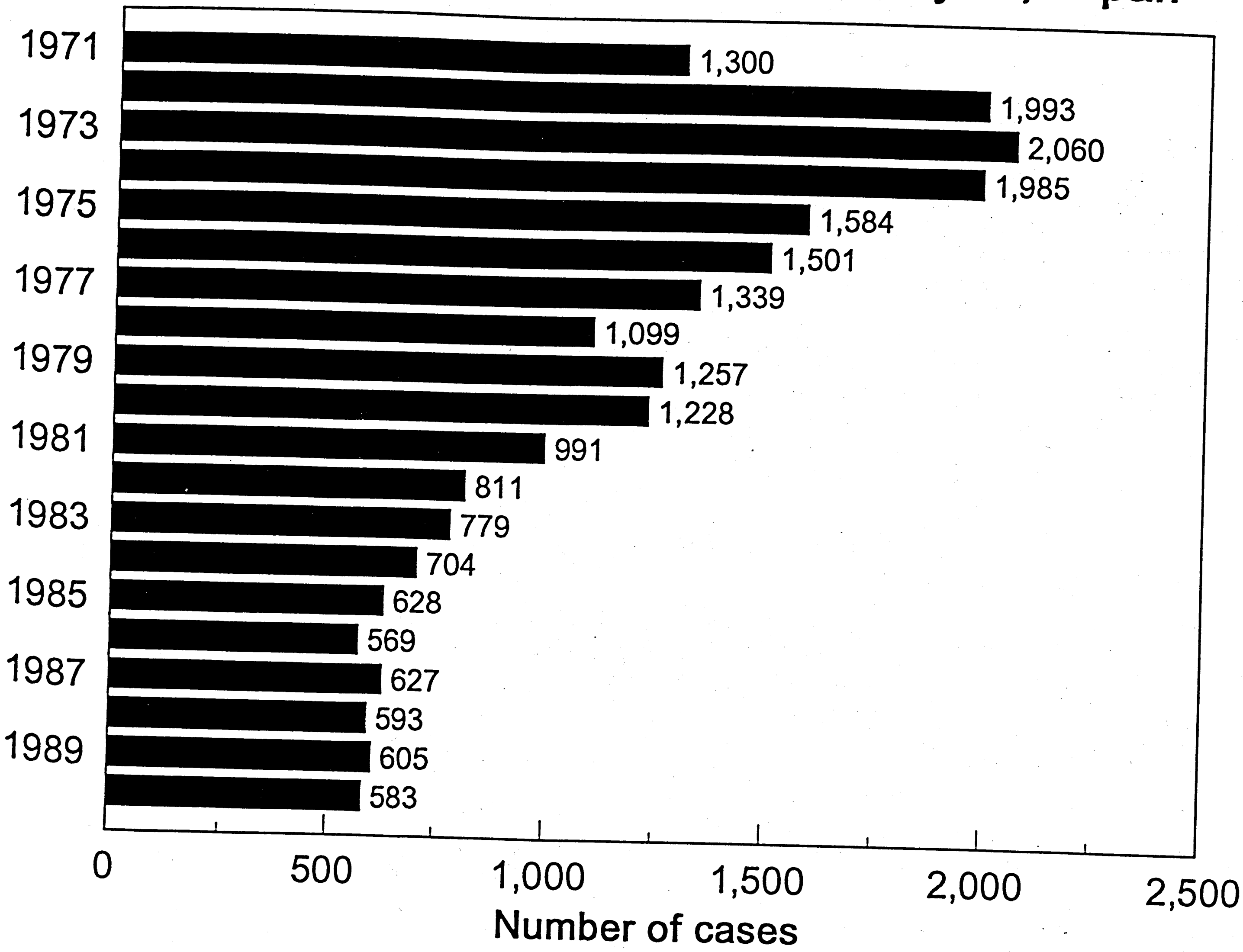
Other Types of Pollution

Other minor sources of water pollution are pollutants that float on the sea's surface, such as polystyrene and plastics, which do not disintegrate naturally and can trap fish, shellfish, and other wildlife. Currently in Japan, eutrophication and oil pollution are the two major types contributing to water pollution, and damaging coastal and inland fisheries.

The Eutrophication Process

Excessive nitrogen and phosphate in water stimulate the growth of algae and other aquatic organisms on the water's surface, a process known as "eutrophication." Algal growth extracts soluble oxygen in water, thus competing with fish and shellfish. It also dims sunlight penetration into water, adversely affecting the underwater habitat, which affects the catch and the quality of fish and shellfish. For example, in the early 1970's, Lake Erie and Lake Ontario were overgrown with algae, due to high phosphate

Figure 1. Cases of marine pollution by oil, Japan



Definition of a case: compiled numbers of oil spills reported by the Environment Agency of Japan.

Sources : (4, 19)

concentration from laundry detergents, runoff from excess fertilizer use, and untreated livestock and human waste. Oxygen shortage caused the entire fish population to perish. But, when restrictive measures were introduced, the phosphate level dropped substantially, allowing the fish population to regenerate (3).

In Japan, the eutrophication process has occurred in lakes and marshes, including Biwa, Kasumiguara, and Suwa lakes, and in the semi-closed bodies of sea water, such as the Seto Inland Sea. The increase in nitrates and phosphates has frequently induced the massive growth of phytoplankton which causes the outbreak of "red tides." In 1973, Japan imposed strict Environmental Quality Standards (EQS) on effluent containing nitrogen and phosphate that had been dumped from the 13 prefectures surrounding the Seto Inland Sea (4). Later, these EQS measures were extended to lakes, reservoirs, Ise Bay, Tokyo Bay, Osaka Bay, and Hiroshima Bay, among others. As a result, the quality of the water improved substantially in Seto Inland Sea, Ise Bay, and Tokyo Bay, but not in Osaka Bay, Hiroshima Bay, or other inner bays, due to higher concentration of polluting industries in the surrounding area (4).

The Structure of Japan's Fishing Resources

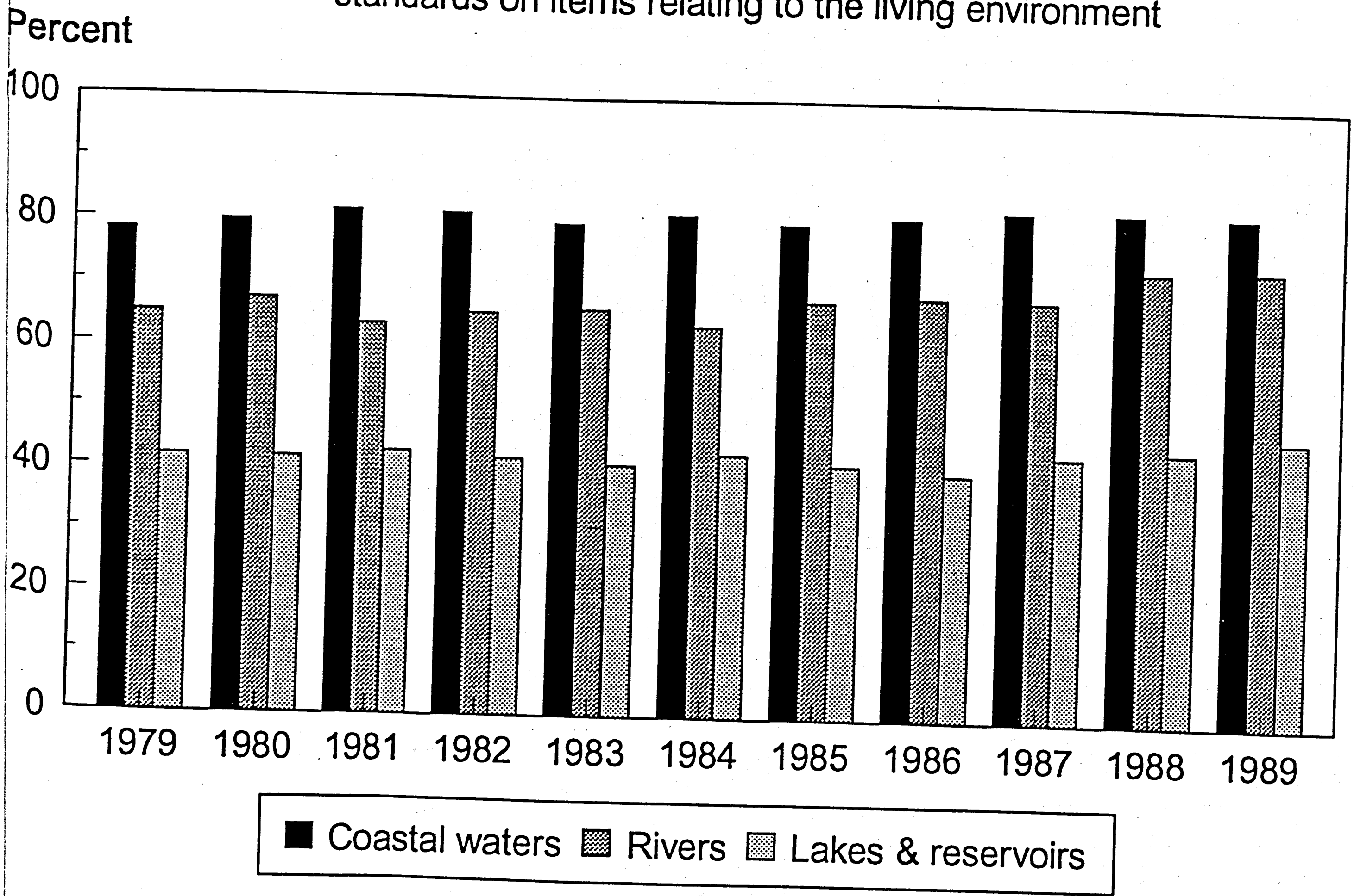
Two major ocean currents affect Japan's main fishing areas: the Kuroshio or black current which flows northward on the Pacific side of Japan and warms areas as far north as Tokyo, and the Oyashio current which flows southward along northern Pacific Japan and cools adjacent coastal areas. The meeting point of the two currents gives Japan's coastal fisheries access to some of the world's richest waters (13).

Japan's total fish and shellfish catch is divided into three main categories: marine, aquaculture, and inland waters (fig. 2).

Marine. Marine fish and shellfish are the most valuable catch economically, accounting for 84 percent of Japan's total catch in 1992, down from 94 percent in 1960. They include tuna, salmon, Alaskan pollack, yellowtails, flounder, herring, mackerel, sardines, and mollusks.

Marine fishing is subdivided into three categories: pelagic (deep sea), offshore, and coastal. From 1960 until 1973, the fastest growing share of the total yearly catch came from the *pelagic* fisheries due to the rapidly increasing number of distant water trawls, especially in the North Pacific Ocean. However, it was hit by the rise in fuel prices in 1973 and by the enactment of 200-mile exclusive economic zones (EEZ) around most of the world's coastal nations in 1977. Japan negotiated agreements with the United States, the Soviet Union, and several other countries to fish within their 200-mile zones. These agreements prevented a sudden fall in Japan's fish catch.

Figure 2. Compliance rate* with environmental quality standards on items relating to the living environment



* Compliance rate is the number of water areas complying with Environmental Quality Standards (EQS) divided by the number of water areas to which the EQS applied times 100.

Source : (4)

Since 1984, fish allocations to Japanese vessels have been decreased continuously by the United States and the Former Soviet Union, the two largest fishing zones for Japan. By 1988, fish allocations by the United States to foreign countries were totally phased out (16). This action and a 1991 agreement to ban Alaskan pollack and salmon fishing in the north Pacific beginning in 1992 caused a substantial drop in Japan's pelagic catch from an all-time peak of 3.9 million tons in 1973 to 1.05 million tons in 1992. The decline was totally attributed to man-imposed restrictions to preserve species following years of overfishing in the high seas. Pollutants in deep seas are uncommon, except for floating plastic and polyethylene pollution.

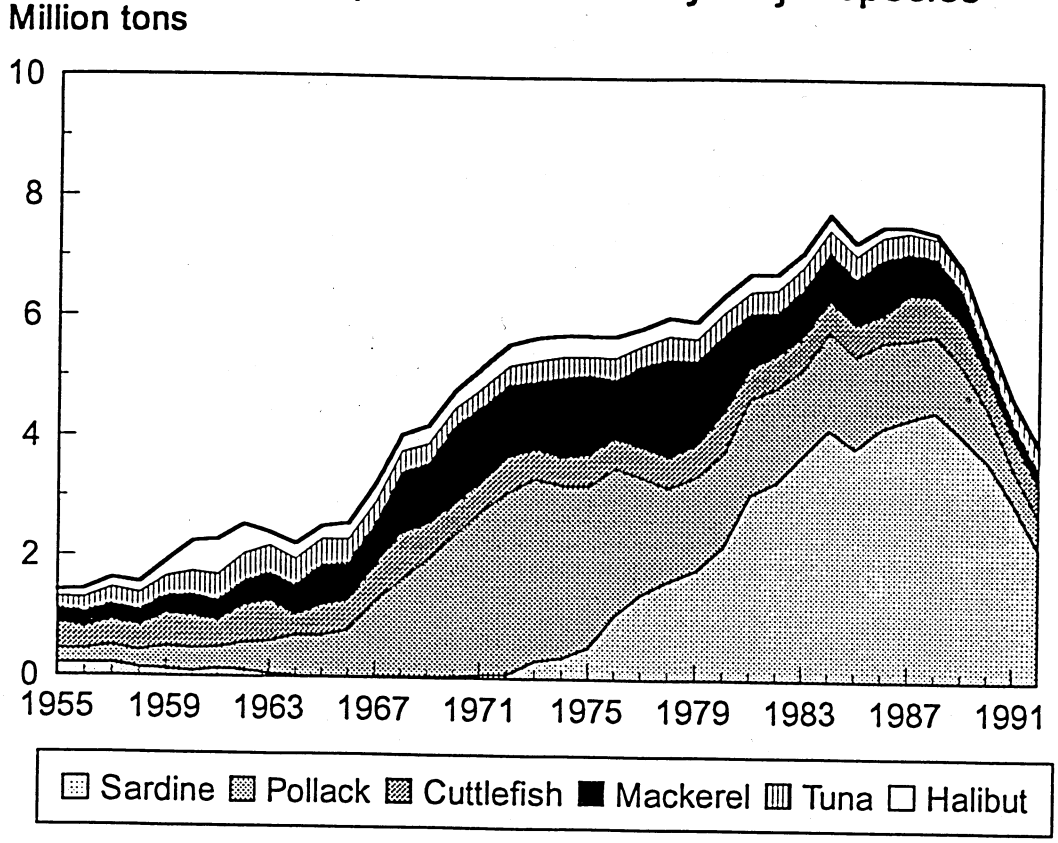
The offshore catch currently accounts for 66 percent of total marine catch, up from 43 percent in 1960. Following the high oil prices in 1973, many trawlers shifted from fishing in deep seas to offshore areas to reduce high fuel costs. After the imposition of the 200-mile EEZ, only vessels that obtained quotas were allowed in deep seas, while all others were limited to offshore and coastal areas closer to Japan. As pelagic fishing decreases, the offshore catch has become proportionally the largest source of the marine catch. Within offshore fishing, the most rapidly growing was the sardine catch, which increased sharply from only 9,000 tons in 1965 to a peak of 4.5 million in 1988, then fell as rapidly as it had risen, declining to 1.7 million in 1992 (fig. 3). The rise and drop of the sardine catch are attributed to climatic and other unknown reasons, not excluding water pollution problems.

Coastal fishing, in extremely close waters, needs little fuel and produces a high proportion of luxury varieties. In addition to fish operations aimed at medium- and high-price varieties, sardine, mackerel, and other types are caught in large quantities using huge round haul nets. Methods are highly mechanized and little human labor is required. The coastal waters around Japan are a rich breeding ground for such surface fish. However, recent scientific observations show a declining harvest related to pollution problems and/or depleted stocks of targeted resources. Over the 1960-92 period, Japan's coastal catch decreased from one-third to one-fifth of the total marine catch.

By 1993, total marine catch (pelagic, offshore, and coastal) had declined to 7.15 million tons, or 36.5 percent below the 1988 level, causing Japan's total catch to drop to the lowest level in 25 years. Japan's total catch declined from a peak of 12.78 million tons in 1988 to only 8.67 million in 1993, a decline of 32.2 percent.

Aquaculture. Marine and fresh-water fisheries production is the only fish sector that has increased production since 1960. It grew from 4.8 percent of total catch in 1960 to 16.2 percent in 1993. It accounted for 27.3 percent of Japan's 1992 value of total catch. Marine aquaculture harvests accounted for over 90

Figure 3. Japan's fish catch by major species



Source : (23)

percent of aquaculture production in 1992. Major products are silver salmon, yellowtails, sea beams, "Nori" laver, and oysters. Fresh water aquaculture produces species such as eel, trout, and common carp.

Aquaculture is the only feasible way to increase fish production in Japan, but it is limited to few species. Japan may maintain or increase output from its aquaculture operations, but at a high price, due to problems of water rights, riparian rights, and high costs of production.

Water quality is under strict control to avoid contamination from any source. Nonetheless, there were some cases of massive fish death due to water pollution.

Inland Water Fisheries. The inland water fisheries provide a wide variety of fish and shellfish, including, salmon, trout, sweet fish, crucian çarps, and the fresh water clams found in the rivers, lakes, and water reservoirs in Japan. It is the least important fish and shellfish sector in Japan, accounting for only 74,000 tons, or 1.2 percent of total catch in 1960. The inland fisheries catch peaked at 138,000 tons in 1978; by 1993, it had decreased by nearly one-third from its peak by 1993. Reasons for the decline were mainly eutrophication and other pollution problems.

Government Regulations to Restrict Water Pollution

The important role of fish in the Japanese diet has stimulated efforts to improve environmental conditions for domestic fish supplies. The Japanese Government introduced several policy instruments to restrict pollutants from reaching water resources and to control the amount of pollutant runoff.

In 1967, the government issued the Basic Law for Environmental Pollution Control, and set quality standard values for public waters according to their use. These standards consist basically of two major categories: protection of human health and conservation of the living environment.

The first set of standards set maximum concentration levels of nine chemicals for rivers, lakes, and coastal waters. Among those chemicals were mercury and polychlorinated biphenyl (PCB) because these pollutants have the characteristics of being built up in fish and shellfish that may be consumed by humans. In 1971, the Agricultural Chemical Regulations Law was issued to control the use of pesticides and resulted in a ban on the sale of many chemicals from the market such as DDT and BBC and regulated the use of Dieldrin, Endlin, Aldrin, Telodrin, PCP, acid lead arsenate, and organic mercury agents. Waters not meeting human health standards have decreased from 0.69 percent of total samples tested in 1971 to 0.01 percent in 1990.

The second set of standards included guidelines for the levels of biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO), suspended solids (SS), and number of coliform groups (table 4).

Table 4--Items related to the quality of water and living environment 1/ 2/

Item	**Permissible limits**
pH	5.8-8.6 for effluent discharged into public water bodies other than coastal waters 5.0-9.0 for effluent discharged into coastal waters
BOD, COD 3/	160 ppm (daily average 120 ppm)
Suspended solids (SS)	200 ppm (daily average 150 ppm)
Nitrogen 4/	120 ppm (daily average 60 ppm)
Phosphorus 4/	16 ppm (daily average 8 ppm)
Phenols	5 ppm
Copper	3 ppm
Zinc	5 ppm
Dissolved iron	10 ppm
Chrome	2 ppm
Fluorine	15 ppm
Number of coliform groups (per cc)	3,000 (daily average)

Notes :1/ Prefectures may set more stringent standards.
2/ Standards applied to the effluents from business whose effluents per day is more than 50 cubic meter.
3/ BOD (biological oxygen demand) is applied to public fresh waters and COD (chemical oxygen demand) is appied to coastal waters.
4/ Standards for nitrogen and phosphate are applied for lakes and reservoirs with eutrophication problems. The nitrogen standards are applicable to any reservoirs where the figure obtained by dividing the N content of the water by the phosphate content is less than 20 and the P content of water is less than 0.02 mg/liter.
Source: (19) Quality of the Environment in Japan, 1990.

In addition, tests on the living environment include estimation of total nitrogen and phosphate concentrations in waters, especially lakes and reservoirs, to detect the eutrophication process. Compliance with these environmental quality standards (EQS) in 1988 was highest (82.7 percent of total samples tested) in sea areas, 73 percent in rivers, and lowest (43.3 percent) in waters of lakes and reservoirs (table 5).

Table 5--Compliance ratio with the enivronmental quality standards (EQS)

Year	Coastal waters	River waters	Lakes & reservoirs
		Percent	
1979	78.2	65.0	41.8
1980	79.8	67.2	41.6
1981	81.6	63.3	42.7
1982	81.3	65.3	41.7
1983	79.8	65.9	40.8
1984	81.3	63.4	42.7
1985	80.0	67.7	41.2
1986	81.2	68.6	40.0
1987	82.6	68.3	43.1
1988	82.7	73.3	44.2
1989	82.4	73.8	46.4

Note: Compliance rate is the number of water areas complying with Environmental Quality Standards (EQS) divided by the number of water areas to which EQS applied times 100.
Source: (4)

Consequently, eutrophication, as indicated by the growth of red tides, could still be seen in Tokyo Bay, Ise Bay, the Seto Inland sea, and Osaka and Hiroshima Bays. Still more intensive water bloom and freshwater red tides occur in several lakes and reservoirs.

Japan also initiated several projects to recover and raise the productivity of coastal and inland-water fishing grounds by controlling pollution. For example, subsidies were provided for the removal of accumulated sludge (along the seacoasts in the prefectures of Ichikawa and Goi Anegasaki), and the removal of mercury (in the Minamata Bay, Kumamoto prefecture) and PCB's (in the Sasebo Port, Sasebo city).

In June 1990, The Water Pollution Law was further revised to establish standards and countermeasures and to promote measures against domestic effluent. Still, however, organic matter constitutes the most problematic single pollutant in Japan's water, originating mainly from livestock and household waste.

As recently as 1992, The Ministry of Agriculture, Forestry, and Fisheries allocated funds for completing several programs oriented toward promoting an environmentally friendlier agricultural sector, and to achieve three major goals (17):

1) reduce the application rates of chemical inputs such as fertilizers and pesticides, promote organic farming, and develop new technologies to sustain agricultural production;
2) find feasible methods to dispose of livestock waste; and
3) enhance the role of agriculture in attaining cleaner environmental conditions.

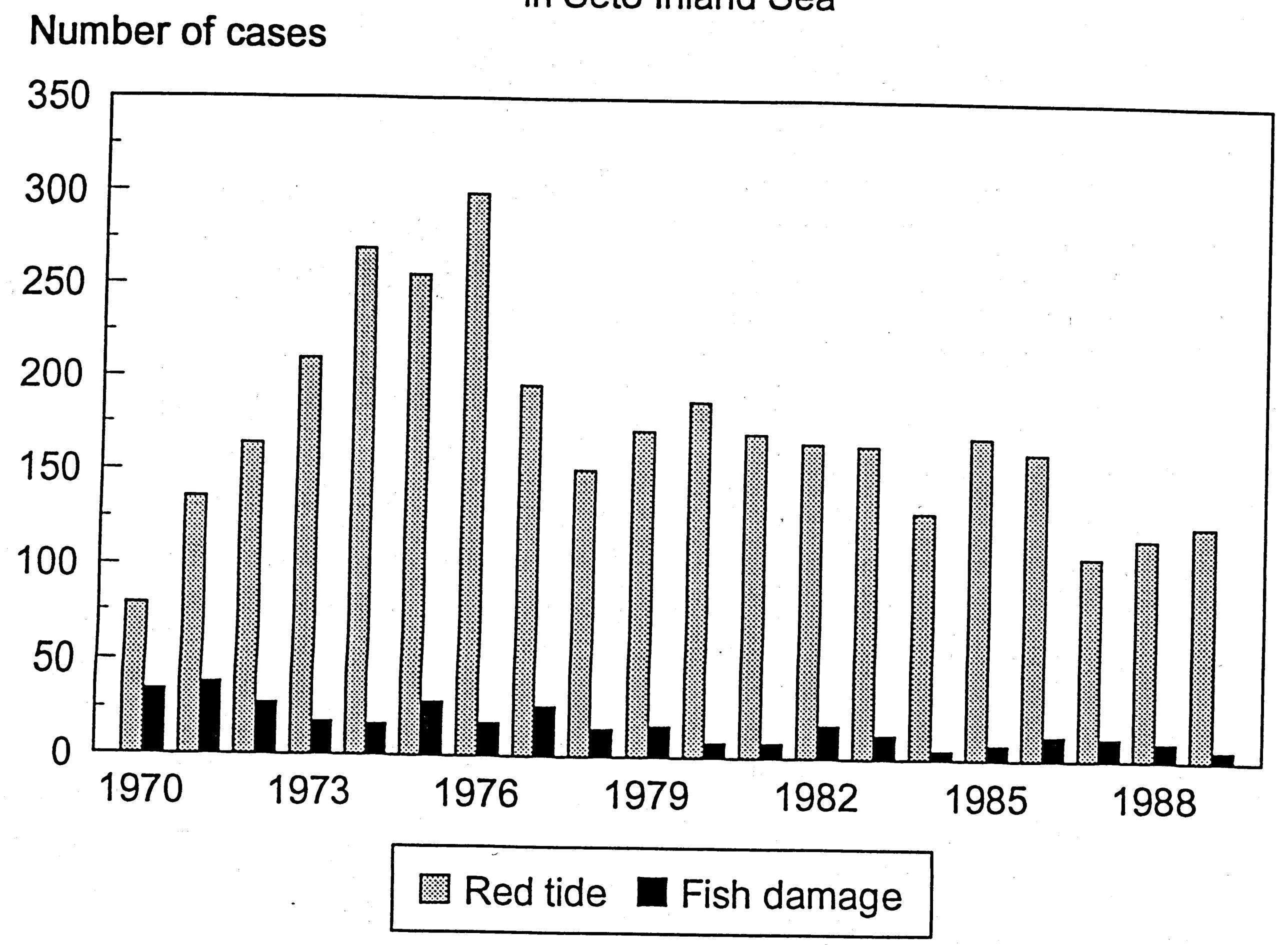
In addition, the government subsidizes research to control the growth of red tides and to minimize pollution damage to coastal fishing resources. One of the most interesting research projects includes the development of technology for the detection of red tides, especially the Chattonela red tide. The ultimate goal is to be able to prevent damage in the early stages. Another research project deals with the urgent need to develop methods to detect the degree of pollution and the suitability of fish for consumption before its arrival at market.

To control agricultural pollutants is not an easy task. The major problems facing policymakers is how to design effective regulatory instruments and how to induce polluters to be more accountable for their impact on environment. Policy instruments for environmental protection are easy to solve in the case of "point" source pollution, where polluters are well defined. Externalities problems could be decided at local courts without government intervention. However, when it comes to "nonpoint" polluters, where too many partners are involved, as is the case with most agricultural activities, the government's role becomes difficult.

Economic Impact of the Declining Fish Catch in Japan

Enforcement of the exclusive 200-mile EEZ in 1977, the phase-out of fish allocations inside other countries' EEZ's, overfishing, and to some extent water pollution were setbacks to Japan's total fish catch. Several statistics indicate that environmental pollution is a contributing factor to Japan's fishing catch. For example, there were 313 cases of polluted fish reported in 1987. Of these, 59 were cases where damage was caused by oil pollution, and 47 were cases of the red tide phenomenon. In the Seto Inland Sea, red tide accounts for most of the fish damage cases (fig. 4).

Figure 4. Red tide and fish damage cases
in Seto Inland Sea



Definition of case: compiled numbers of red tide or fish damage reported by the Environment Agency in Japan.

Source:(4)

Market prices of fish damaged by oil pollution are low and sometimes the catch is not sold at all. In 1987, the value of fish affected by water pollution amounted to Yen 3,013 million, and the value of fish damaged by red tides alone was highest at Yen 2,597 million (19).

Japan's 1993 marine catch declined to 7.15 million tons (the lowest level in 25 years) from 11.26 million tons in 1988, a drop of about 36 percent over a period of just 5 years (11, 12). The growing gap between production and consumption caused prices to rise rapidly. However, demand stayed nearly unchanged due to the fact that fish is considered an integral part of the Japanese diet (fig. 5). Other protein sources such as meat were not substituted for fish and seafood in any great quantity in spite of high fish prices. During that period, prices of fish and shellfish rose faster than those of beef, pork, chicken, etc. Fish prices rose and are still rising more rapidly than meat prices and all food items (fig. 6), despite declining tariffs and (since 1991) increasing imports. Japanese demand for fish and shellfish is relatively price inelastic.

Falling fish catch and continuing demand despite higher prices caused the Japanese to rely more and more on imports to meet domestic requirements. By 1994, Japan had become the world's largest importer of fish and shellfish, with imports valued at nearly $16 billion, approximately one-third of the world trade in fishery products.

While it is difficult to indicate what proportion of the decline in Japan's fish catch is attributable to pollution, a high estimate would be 5 percent and a low estimate 2 percent. The technologies and systems aimed at scientifically evaluating the degree of damage are not adequate. Actual damage is probably underestimated. Water pollution affects mostly fishing waters including water reservoirs, semi-closed seas, bays, rivers, and lakes. Prospects for improving the water quality standards, especially runoff from households and agriculture, will proceed slowly and may need one or two decades to be completed. Meanwhile, consumption is likely to shift toward imported fish and other substitutes.

The worldwide fish catch has also been declining, but not as sharply as Japan's catch. The worldwide catch dropped from its all-time peak of 100.3 million tons in 1989 to 98 million tons in 1993 due mainly to excessive fishing and environmental problems. The global marine catch, estimated at 82 million tons of the 98-million-ton total global catch (which includes aquaculture and inland waters), is unlikely to increase unless stocks are allowed to recover. This requires closer cooperation between concerned governments and effective management between governments and fisheries.

Figure 5. Japan's fish and meat consumption

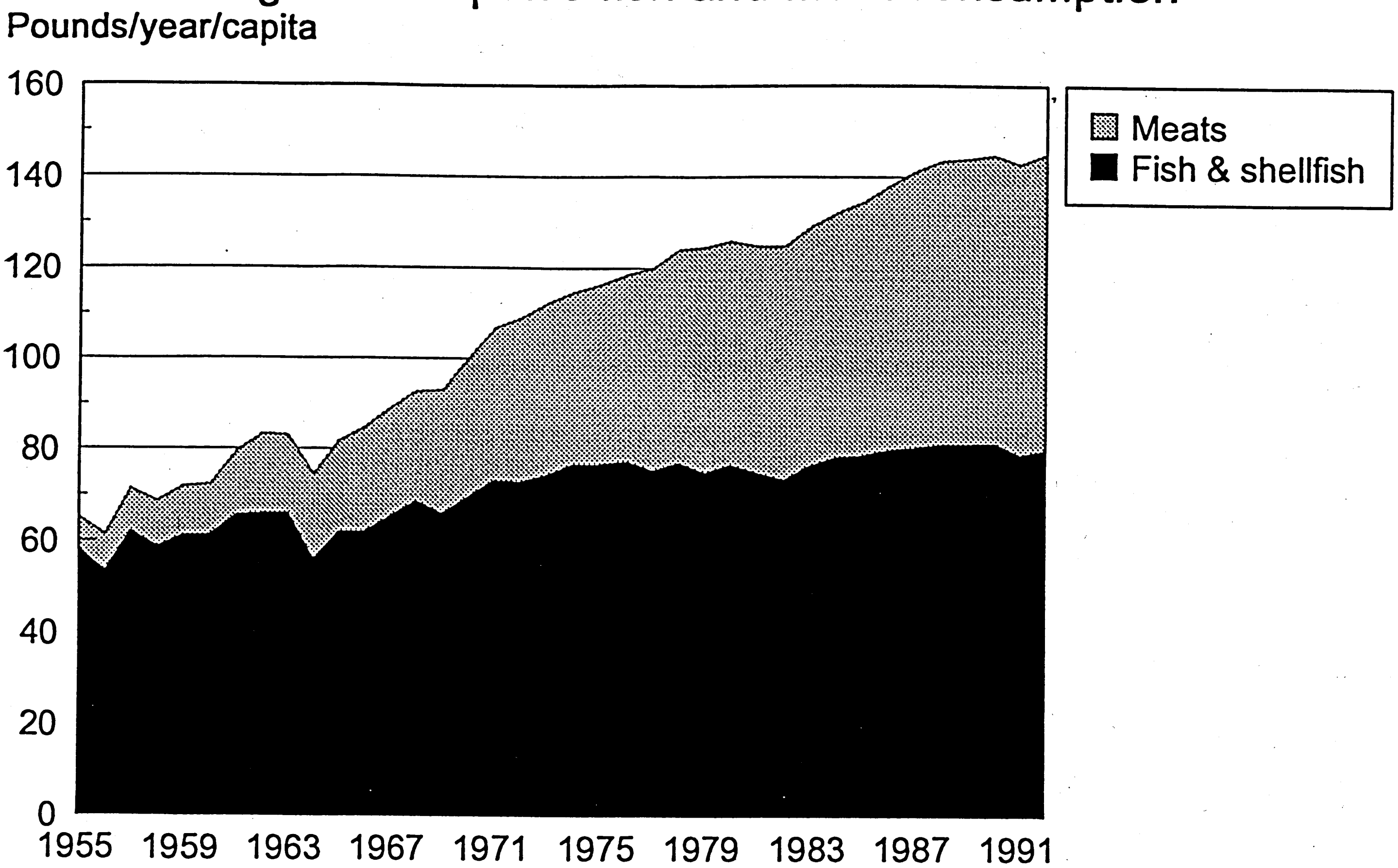
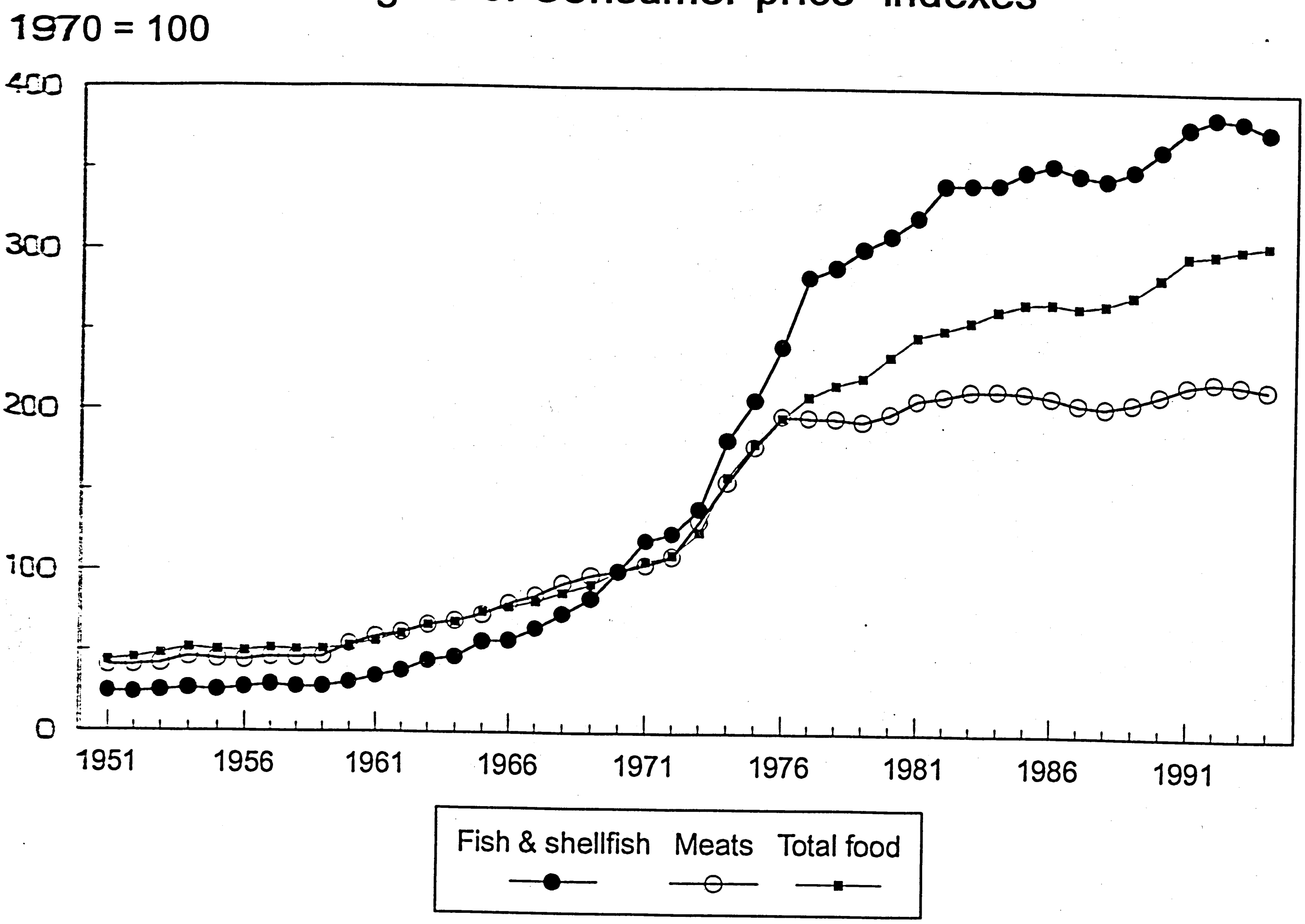


Figure 6. Consumer price indexes



Source: (20) and (23)

Conclusions

The sharp decline in Japan's fish catch that started in 1989 could be attributed mainly to stock depletions caused by overfishing in the deep seas and offshore waters, as well as increasing water pollution in the inland and coastal waters.

The environmental impact on Japan's fisheries has been modest, concentrated mainly in inland fish sources, and partially in some coastal fisheries. Of all sources of water pollution, eutrophication and oil pollution are currently the most serious in Japan. Animal wastes, nitrogen, phosphate fertilizer, and pesticides are the most serious polluters originating from the agricultural sector. Industrial wastes were identified in the 1950's and 1960's, and legislation was issued for their control. Currently, however, agriculture and household wastes are the major sources of water pollution affecting Japan's inland and coastal fish resources.

Japan started to combat nitrate pollution and intensified research to protect its water resources from the eutrophication process and save its fishing resources. Scientists are currently looking for new technologies to combat phosphate and nitrate pollution by using microorganisms and enzymes to bind them in animal waste. They are also looking for economically efficient solutions to reduce the traditionally easily-leached nitrogen fertilizers by improving the use of the slow-release fertilizers, and breeding new crop varieties with high response to less fertilizers (14).

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