ROY I. JACKSON

FAO'S JACKSON VIEWS FOOD NEED AGAINST PLANET'S 'LIFE-CARRYING CAPACITY'

Roy I. Jackson, Assistant Director-General (Fisheries), Food and Agriculture Organization (FAO) of the United Nations, looked at the future of world fisheries in the decades ahead against the background of "increasing world population and deteriorating aquatic environment" and saw both problems and hope--"if we behave rationally."

Mr. Jackson was keynote speaker at centennial celebration of American Fisheries Society in New York City on Sept. 14, 1970.

World population is doubling every 37 years, he said. If current rates of increase continue to apply, 3.7 billion population today will reach 29 billions in 100 years.

Industrial development--with its alteration of environment, pollution, and consumption of resources--increases exponentially in relation to population growth. Most of this development is profitable by conventional economic standards, but it often overlooks social costs and leads to uses that would deny the earth to future generations.

Jackson said: "Aquatic environments, communities, and species, once lost, are nonrenewable resources. To keep fish stocks and other living aquatic resources as renewable resources may require that fishery biologists become true guardians of the waters."

Estimates of Future Fishery Production

Estimates of future production from world fisheries range from values already exceeded to values 30 times the present catch. Estimates for FAO's Indicative World Plan indicate possible annual catches of 140 million metric tons before the year 2000. About 100 million tons of these would come from marine species such as those fished today. The balance would come from freshwater fisheries, fish and shellfish culture, and species unused or underused today. Developments of aquaculture and fisheries on new species could increase the estimates several times. "The need for research and management will become increasingly acute as fisheries continue to develop," Jackson emphasized.

Difficult Period Ahead

"The total picture of world problems is obscure and somewhat grim. But there are reasons to take heart," said Jackson. The population problem is at least recognized. In highly developed countries, environment has the limelight. "Famine is not necessarily imminent. The world food supply, which includes fish protein, can be adequate in the decades immediately ahead." But to have supply produced where it is needed most will require changes in traditional social and economic practices.

Jackson concluded: "We have a formidable and exciting task in implementing our concern for the future. We must remain aware that even a century is too little foresight. The truly long-term life-carrying capacity of the planet must be our most vital concern."

ROY JACKSON'S SPEECH

Mr. Jackson's speech was titled: "Famine and the World Fisheries." Nearly all of it follows.

In the century just past we humans have changed our numbers, our way of living, and our environment faster than in any comparable period of history. The rate of change continues to accelerate. Our fisheries problems are sometimes regarded as minor among growing world concerns. But they are ecological concerns, and are part of what Garrett Hardin calls "the tragedy of the commons". The commons is the earth, and the essence of the tragedy resides in the remorseless consequences of not obeying Nature: the ever-expanding world population, accumulation of its wastes, and disruptions from expanding technology.

Nature and man's fate are inseparable, and future fishing cannot be evaluated apart from the world of men or from the environment. We must estimate how many people may exist in the future. It is imperative that we recognize that both the quality of human existence and the quality of the environment in which fish live will be determined largely by what we humans do to the total environment. We must determine how much food, particularly animal protein, the future population will require, and consider possible new foods. We can make informed guesses about the sizes and kinds of future catches and which sea and freshwater area will produce them. None of us believes any longer, if any of us ever did, that aquatic resources are limitless. ...

The Future Population

Today we are 3.7 billions. Many of us have lived through one doubling of the world's population and many of us will live through a second--in 37 years. (Based on the UN medium assumption for population growth rates.)

There are enormous differences in population distribution by countries and by regions. Today 28% live in the so-called "developed regions", which include Europe, the Soviet Union, North America, Oceania, and Japan; and 72% live in the so-called "developing regions", which include the Far East (excluding Japan), the Near East, Africa, and Latin America.

Undoubtedly these differences will be aggravated. Some countries will be less interested or less successful in limiting their populations. If present regional trends continue for the next 100 years, 10 per cent will inhabit the developed countries and 90 per cent the developing regions.

The demographers' predictions that I have seen stop at the year 2030, because unknown changes in the rate of increase are expected. If intrinsically desirable progress in health and social justice continues, the population could, for a time, become even larger than

present trends indicate. But rates of population growth will eventually decrease. Wars, disease and famine will reduce survival in proportion to our failure to limit births. This aspect of the tragedy of the commons has no purely technical solution.

The Future Environment

Our multiplying population and advancing technology combine to make us the most influential part of the earth's ecosystem. We are responsible for the most precipitous changes, both damaging and beneficial. Peoples of advancing cultures have always prided themselves in being "conquerors of nature". We have been paramount among them, and we are increasingly prodigious consumers as well.

I use the word "consumers" advisedly, because it is as consumers of natural resources, renewable and nonrenewable, that we must see ourselves. On the average, with massive inequalities, we enjoy higher standards of nutrition, health, and shelter than society has ever known. To acquire these essentials--and many nonessential amenities--for our greatly increased numbers we are increasing greatly our per-capita consumption of the resources of the earth that are essential for our life processes.

We know that every stock, every living population, if its numbers are to be sustained, must come into balance with its environment and its food supplies. As we now live, our renewable living resources depend on nonrenewable natural resources: oil, coal, other minerals, environments, and ecosystems. Since they include self-reproducing organisms, ecosystems are not customarily listed among nonrenewable resources. But once destroyed, their former structure cannot be reconstituted. The supply of all these nonrenewable resources, including conventional energy sources, is limited. All the food that is produced or caught or distributed by modern methods costs a great deal in energy, whether this be used to make steel, or to fuel chemical fertilizer plants, tractors or fishing boats. Therefore, we must be aware of the eventual consequences that can come from exercizing our clear capability of looting the commons.

We create wastes in proportion to our use of resources. Wastes that are not neutralized, stored, or put to beneficial use become pollutants. The quantities and varieties of pollutants increase exponentially in relation to our population growth. In the United States the rate of increase of industrial wastes is three times as high as the rate of population increase. And in the U.S. today there is three times as much industrial pollution as domestic pollution.

The waters where our inland fisheries and the artificial culture of fishes take place are highly sensitive to pollutants. Our coastal fisheries are in zones that are first to be affected by the outpourings from the land. The Federal Water Quality Administration lists five major kinds of pollution in coastal areas: bacterial contamination; decomposable organic materials that deplete dissolved oxygen; pesticides, herbicides, and toxic wastes from chemical manufacturing; materials that act as fertilizers for some life forms at the expense of others; and inert materials that fill invaluable estuarine areas and smother benthic life forms.

To this list we can add thermal pollution, oil spillages, and, for heightened drama, dumpings of leftover mustard gas in the Baltic and nerve gas in the Atlantic. Even what we cast into the air finds its way into the sea.

We know that the blight is broad and spreading. The historic Rhine has been an historic sewer for a long time. The deeper layers of the Baltic have much less oxygen and much more phosphorus than at the beginning of the century. The Soviet Union, in spite of its vast area and centralized authority, finds that its rivers, lakes and coastal waters are rapidly deteriorating. More examples, of varying scope, can be found in every continent and on most inhabited islands of the world.

In his keynote address to the 93rd Annual Meeting of the American Fisheries Society, Justin W. Leonard spoke of the "ecological illiterate", those who plan and operate our technological society but think that food comes from the supermarket and water from the tap. Seven years ago he said, "ecology and natural history have become old-hat. They aren't quite respectable anymore". Times have changed again. Everywhere we hear loud alarms, read passionate convictions, and see action to protect or restore the quality of our environment.

But there is still a danger that the subject can become old-hat again if we let up on either investigating or publicizing the continuing issue. We must continue to examine and report the more obvious effects of pollution. But as specialists we should continue to uncover and relate the less obvious effects of conflicting uses of water as well.

The effects of altered water flow regimes on snails can be taken as examples. In the Potomac River the oyster drill, a snail, is killed each year during spring freshets. This permits an extension of oyster culture up the estuary. Proposed dams on the Potomac will regulate spring flows, the drills will not die, and fewer oysters will live to be eaten by man. In the Nile River region perennial irrigation replaces seasonal flooding. This also favours increases in a snail, the intermediate host of a parasitic worm. The worm causes extremely debilitating schistosomiasis disease in man. In Upper Egypt the new Aswan High Dam development may increase the intensity of infestation. At the same time it may seriously reduce the Eastern Mediterranean sardine fishery while providing an impoundment for freshwater fish.

In the case of the Nile, man faces the immediate problem of evaluating whether the increased electrical power and starch and freshwater protein are worth the increased disease and decreased marine protein. A less immediate but perhaps more important problem is whether the impoundment behind the dam, which has a lifetime probably measurable in decades, has a long-term value equivalent to the marine environment that will be affected.

An economist might calculate, by using widely accepted economic value criteria, that the most profitable use of the Nile can be obtained by damming it, and that the most profitable use of the Rhine is as a sewer. Also some apparently calculate that the most profitable way to obtain oil from Saudi Arabia is to first flame off the natural gas and add a

bit more carbon dioxide to the already overburdened atmosphere. I disagree with most conventional profit valuations. They include private costs but overlook social costs, and lead to uses that would deny the earth to our generations of progeny.

Besides the continued expansion of present multiple uses of water, we can expect more kinds of uses, especially in the ocean. The ocean floor is criss-crossed with cables, and pipelines are following suit. Oil derricks now line the horizon in many nearshore areas, and underwater oil storage tanks may become common. Mining from the sea floor will certainly increase. Except that boats must dodge and gear may foul, these physical structures and activities do not conflict greatly with fishing. Accidental release of oil from wells, huge tanks, or pipelines, however, could cause much pollution. Other uses of the sea might, for example, require diversion of currents to change weather patterns. This kind of activity should be approached very cautiously. It could, in some ways, be very useful to terrestrial man while very harmful to aquatic systems.

The Future Fisheries

The fisheries can do much to help meet the continuously increasing demands for food. Estimates indicate that the world catch of fish today could supply about 70% of the animal protein requirement of the present population. This figure is subject to many qualifications, and it should not be interpreted to mean that fish does supply that much of human needs. More than half of it is consumed by livestock, and the world distribution is very uneven. But it shows how important fish protein could be in the world diet.

The record of the past quarter-century is encouraging for the decades immediately ahead. Since 1946, catches have increased about 6% per year--considerably faster than the world population--to reach a total of 64 million metric tons in 1968. . .Of this total, about 7 million tons came from fresh water. Forty-one per cent of the marine fish catch is taken in the Atlantic, 55% in the Pacific, and only 4% in the Indian Ocean. Divided another way, 54% is taken in north temperate waters, 29% in south temperate waters, and 17% in tropical waters. The north-south division shows the great expansion of fishing beyond the northern waters, where 73% of the total was taken 10 years before (1958). . . .

A detailed estimate of the potential was completed by FAO this year as part of the Indicative World Plan for Agricultural Development. The FAO study produced several figures for the world aquatic potential, because much depends on what is included in the potential. The largest possible harvest source is the plants of the sea--plus freshwater fisheries. . . .Ocean plant production is fairly generally agreed to be in the range of 150-200 billion tons per year. Man's annual harvest could approach this production if it were technically feasible to catch and process the very small plants and animals at an economic cost. Although the technological and economic possibilities for the year 2070 are not predictable, no method for economically harvesting or using a significant proportion of this material is even conceivable at present.

The FAO study succeeded in making estimates for nearly all those animals that now support major fisheries: whales, large pelagic fishes (tunas, bill-fishes), medium to large demersal fishes (cods, flounders, seabreams, etc.), and shoaling pelagic fishes. Under ideal conditions of exploitation, these together could provide catches of about 100 million tons. But the limit of the "traditional" ocean fish (excluding squid and other molluscs) is likely to be reached in the 1970s. Even this may be optimistic, because it would require that we obtain the maximum catch from all stocks. Preliminary figures suggest that the 1969 world fish catch was somewhat less than that of 1968--the first decline since FAO started collecting comprehensive world statistics nearly a quarter of a century ago.

The familiar types of crustaceans (shrimp, rock lobsters) could provide somewhat over 2 million tons per year. Large quantities (1.2 million tons in 1968) of squid, cuttle fish, and octopus are being caught. No estimates could be made of their potential, but since various species of squid are found commonly in all parts of the ocean, their potential must be large.

No projected estimate was made for the other molluscs (clams, oysters, mussels) of which the 1968 world harvest was 2.2 million tons, because the possibilities for increased harvest come more from cultivation than from natural production.

Finally, estimates of potential catches from the sea must include the smaller but exceedingly abundant animals, such as the krill (euphausids) of the Antarctic and the lantern fish (myctophids). At present it is not possible, to my knowledge, to harvest these economically, though the Soviet Union seems close to using krill on a commercial scale. The potential of these small animals is vast--probably several times the present world catch of all fishes.

The yield of freshwater fisheries for 1968 was 7.4 million tons, about 11.5% of the total world production. This excludes the very large subsistence and sport fisheries, estimated to be at least half as large as the recorded commercial catch. Inland fisheries could provide much more food than they do now. Their future depends largely on the prevention of further deterioration in water quality, and on the improvement of those waters that are already despoiled. On the brave assumption that this will be done, let us consider the future production of fish from fresh water.

The catch from large inland lakes and rivers probably could be doubled, but the major increase from lakes and reservoirs will come from smaller bodies of water where management techniques can be applied. In these waters up to five times the present catches seems possible. But controlled culture is our greatest opportunity for increasing fish production. The larger lakes produce about 5 kg/ha. (a hectare, ha., is 2.471 acres); the smaller lakes produce up to 150 kg/ha. Managed ponds in tropical and subtropical areas commonly produce 1,500 to 2,000 kg/ha., and under very intensive management 6,000 to 7,000 kg/ha.

Generally fish are fed supplemental materials that are not now consumed by humans,

and some convert vegetable proteins into animal protein, including all ten essential amino-acids, very efficiently. For example, some work in the United States has shown that channel catfish have a feed conversion of 1.3 (that is, it takes only 1.3 pounds of feed to produce 1 pound of flesh). By contrast, beef cattle have a feed conversion of about 16.

The Lines of Action

Our action must be fundamental. To deal with effects without also dealing with causes is inadequate and superficial. What M. King Hubbert has written applies to fishermen as to all men. As he sees human history, the period of rapid population and industrial growth that has prevailed during the last few centuries is an abnormal, brief, transitional episode. He foresees a period of non-growth that will pose no insuperable physical or biological problems but that will entail a fundamental revision of our current economic and social thinking.

Future non-growth of the human population is a certainty. When this will occur, at what maximum number, and through what mechanisms--barring natural catastrophe--depends entirely on us humans. This is not just a problem for Asians, Africans, or Latin Americans. It must be faced by every one of us in our own neighbourhood.

In many of our activities, we, the technologically developed cultures in particular, follow the archaic approach to the problem of the commons, that of free and unlimited access. If this approach is justifiable at all, it is justifiable only under conditions of low population density. As the human population has increased the commons has had to be abandoned in one aspect after another. Traditionally we have treated the air we breathe and the waters of the earth, along with their inhabitants, as commons. This is changing, and it must change more radically, and soon.

Properly oriented changes can only occur where there are perceptive and knowledgeable persons to show the way, to monitor, and to be watchdogs. Most natural history movements have addressed themselves to terrestrial communities; there has been a dearth of guardians of the waters. Meanwhile we fishery biologists have to a large extent allied ourselves with conventional exploitive processes. Even personally we have not been sufficiently appalled by the demise of environments and the extinction of aquatic species and communities.

Within the framework of the problems we must face as citzens of the world and as general watchers of the waters there are particular fisheries problems that we must face as fisheries scientists and administrators. The pressing problems of the world fisheries, at least for the early part of the coming century, are three:

(1) to manage the limited resources of "traditional" fisheries in the most effective way;

(2) to develop fisheries on the large resources of less familiar animals;

(3) to increase cultivation, especially of species (for example some molluscs and freshwater fish) that feed directly on plants.

We must be particularly concerned with proper management. The past record of management shows the effects of our reluctance

to abandon the commons with respect to fisheries. On the high seas, the Antarctic whales were rescued on the limit of commercial extinction--possibly absolute extinction of blue whales. Where only one country is concerned the record often is not much better--the California sardine is an example. But there have been successes; effective conservation of the whales in the Antarctic is beginning, and fishing is controlled in several major fisheries.

Future Management of Fisheries

Three forms of jurisdiction have been proposed for future management: wide extensions of fishing limits, to place most fish stocks under national jurisdiction; direct international, United Nations, control of high seas resources; and expansion of the present pattern of regional international fishery bodies and commissions. . .

Management must start with control of the individual fisherman. We generally assume that anyone should be free to fish on the high seas, or any national within his own territorial waters, so long as he does not use obviously damaging methods like poisons, explosives, or devices that catch immature fish. Fishing is constrained by restricting the effectiveness of each fisherman--by explicitly prohibiting the most effective gear, or by closing areas or seasons.

The traditional assumption, that fishing is free to all, is unrealistic and has led to inefficient resource management. Each fish stock is limited. If it is accepted that fishing is a privilege, not a right, then one likely method of controlling excess fishing is to charge for this privilege. This control could be accomplished if the payment, license fee, were in proportion to the privilege conferred. In several major fisheries, for example Pacific salmon, the gross value of the catch greatly exceeds the basic cost of harvest--sometimes several fold. There the right to fish with the most efficient gear might be worth up to 80% of the gross value of the catch.

Who gets this license fee is a matter of jurisdiction. Inshore it could clearly go to the coastal state, offshore it might, under one scheme, go to the proposed international agency.

If we optimistically assume that improved management practices are instituted, it is possible to visualize the ocean fisheries of the early twenty-first century. On the fishing grounds that are familiar today--the Grand Banks of Newfoundland, the anchovy fishery off Peru--the fishing vessels will be fewer. They will be helped by a flow of information on the distribution of fish, and on weather and water conditions from satellites and buoys. These vessels will make large catches and pay substantial license fees. Some of these fees will be used to provide the satellites and other information systems, and the scientific research on which the management is based.

The other major sea fisheries, dominant in weight but probably not monetary value, will be in the Antarctic on krill, and along the major upwelling systems on the small lantern fish and other animals. By harvesting the traditional stocks efficiently, it would become possible for men and vessels to be diverted to these less familiar stocks as well as to stocks like squid and whiting that are not being used to the extent they might be.

Technology's Role

The development of the technology to harvest and use the less familiar fish will demand initially the resources of the richer developed countries, and will at first be of less concern to the developing countries, for whom FAO has a special responsibility. But there are already shifts in emphasis and interest in fisheries from the highly developed countries to the intermediate nations. Because labour costs are less and other economic opportunities are fewer, the new fisheries are likely to be developed and used by developing countries in the long run. This is probably economically desirable for the world as a whole.

Fish flesh contributes about 11% of the animal protein now consumed by man. This percentage should increase considerably in the future. In order to do this we must develop more efficient catching methods and provide adequate transport and processing, especially in the developing countries. For example, the control of insect infestation of fish products in Africa could double the amount of fish reaching consumers. Above all we must alter our eating habits. Thousands of tons of good protein are unused because even people who do not already have adequate protein in their diets refuse to eat all but a few traditional species.

Controlled culture of marine and freshwater species is a great opportunity for increasing production. By using techniques such as the raft method developed for mussels in Spain, the possibilities for shell fish seem very large. Running freshwater cultures are highly efficient in converting fish food to human food. We must develop and apply these techniques to commercial production. Controlled culture is limited by economic considerations rather than natural productivity, at least until we run short of nonrenewable resources.

Some Hopeful Signs

I have said earlier that the total picture of world problems is obscure and may be short on hope. But there are some developments from which we can take heart. The population problem is at least recognized as the central theme of the tragedy of the commons. And in highly developed countries the environment has the limelight. There is action as well as talk.

National and international actions are having some positive effects on fisheries management, and initiatives that affect fisheries resources have multiplied in recent years and even months. The President of the United States has proposed fundamental changes in the agencies that deal with environmental problems, including fisheries research and administration. Pacem in Maribus, the convocation on the oceans, held at Malta in June 1970 highlighted the growing competence of the world to exploit the oceans' resources. The need to strengthen present measures and introduce new ones to preserve renewable resources and make beneficial and equitable use of the others was clearly expressed. We in FAO are striving to strengthen the growing network of regional international fishery bodies. A third Conference on the Law of the Sea is expected to be held soon. Many other important initiatives could be added to this short list. A great value of the exploited ocean

may be that it will encourage nations to regard one another as partners in world progress.

About "Famine and the World Fisheries" we can conclude that famine is not necessarily imminent. The Second World Food Congress, held in June 1970, in The Hague under FAO auspices, concluded that world food supplies can be adequate in the decades immediately ahead. Animal protein, which includes fish, is an essential part of this food supply. It is both humane and very pragmatic that we increase production and that it ends up--preferably is produced--where it is needed most. This will require some changes in traditional economic practices, and it will certainly require that we eschew the disruptions of warfare, which bring famine and disease faster than any other human activity.

New Protein Sources

Whatever its portents for the far future, carefully applied technology is needed to grow or catch the foods that the growing population will require. In addition it could provide some new sources. Scientists apparently have isolated bacteria that require only methane to multiply. The bacteria are 50% protein. In Britain a plant is being built to produce 60,000 tons of protein per year, and a hydrocarbon-based yeast factory to produce 4,000 tons per year is due to be finished in 1970. An American scientist states that in less than 10 years it will be possible to produce protein artificially from petroleum in unlimited quantities. These developments could become important in providing protein, so long as the limited supply of fossil fuel lasts.

This is my view of the near future. But to conserve nonrenewable resources and preserve the environment for ourselves and the renewable resources in the increasingly crowded and technically complicated world of the next 100 years will be a formidable as well as exciting job. Fisheries workers must shoulder much of the aquatic part of that job. If we do not, who will? And we must remain aware that even a century is too little foresight. The truly long-term life-carrying capacity of the planet must be our most vital concern. There is still time to implement this concern, and fortunately Nature eventually corrects many of our mistakes--if we behave rationally.