Reprinted from Seafood Export Journal
Vol. V – No. 1, January, 1973

CAN THERE BE FAMINE IN THE SEA?

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Without sowing any seeds or using fertilizers, we have been harvesting millions of tonnes of food from the sea every year. In return we have been giving to the sea millions of tonnes of pollutants, toxins, sewage and garbage, even radioactive wastes — in fact practically everything which we want to get rid of from land. Thus the sea has been the biggest receptacle of many undesirable substances, but so far at least it has never responded in an unkind fashion. Can this go on for ever or will the sea begin to show signs of scarcity or ill health?

Let us examine the question of famine first. The dictionary meaning of famine is extreme scarcity of anything particularly of food — thus the common usage "I am famished" — means starved. In the days of modern science and technology, famines occur in those countries where technology is not developing fast enough to avoid the scarcity. In India practically every year we face conditions of drought in some parts, excessive rain or floods in the other, and finally the overall picture which emerges from the country as a whole is rather unsatisfactory, if not grim. Nature has been blamed for many things — for instance if timely rains do not occur or if there has been too much rain in an area or in a given period. Even for the shortage of electrical power in the country we are holding nature responsible. Are we, as scientists, really justified to blame nature for these things? Do we expect that all the natural cycles on which we continue to be entirely dependent must be so synchronized as to be repeated with utmost accuracy year after year? It is true that many of our activities are very intimately linked with the mercies of nature, but surely if all countries in the world are going to be just as much dependent on natural cycles as we are, one should expect scarcity or famine in the United States, in Russia or in the other European countries. Not that many of these countries have not gone through a similar phase of scarcity in their past histories, but to expect that these things can happen now, would mean that we have not understood what science and technology can achieve for us. Fewer hours of work each day, longer week-ends, bigger packets of pay, automation, departmental stores stacked to capacity

with foods and other goods, highways choked with automobiles, faster travel, labour-saving devices etc., such as we see in the technologically advanced countries, are some of the indices of what modern science can do for our comfortable living. Even in the event of any unfortunate natural calamity in any part of these countries, we see no serious repercussions in the other parts. And as soon as the hazard subsides, signs of recovery begin to appear almost instantaneously and what finally emerges is a picture more beautiful than before.

From this example it becomes clear that under abnormal circumstances of scarcity when we begin to blame nature, we should give a serious thought to another aspect just as important, if not more–our own failure. I am fully aware that such a statement in a populous country like ours may sound ridiculous. When I put forward a similar logic in another context before a well-known scientist in Delhi, he smilingly set aside the entire issue by calling it " whimsical and grotesque ". Perhaps he is right, but I do not mean that human failure has any direct relationship with the natural calamity. All I am trying to indicate is that although India has learnt to live under worst scarcities for centuries, at any time if we could visualize this country as a land of plenty—and I say it with confidence that we can achieve it fairly soon—then the natural cycles all of a sudden would not become unduly favourable towards us. They will behave just as they do now; the difference would simply lie in our capacity to appreciate the situation and work harder without blaming each other or shifting the responsibility safely to gods. Surely in this very context Mahatma Gandhi has said " Nature never fails those who will help themselves ".

Natural cycles in the sea

The motivation behind arguing this point in the context of sea harvest, which is just as much dependent on seasonal exigencies as the land, is quite evident. All living resources, whether on land or in the water, which are regenerated by the process of natural reproduction, have a seasonal harvest. The period of harvest in the sea is called fishing season. It varies from one fish to another and for the same fish from region to region. One of the most interesting features of the sea is the magnitude and diversity it provides in its crop in different geographical areas. The sea has its own pastures and deserts–the pastures are just as productive as the fertile areas on land and the deserts are perhaps far more unproductive than any desert on land. We must also examine what sort of relationship the sea has with the land. It is well established that without the energy that the sea provides, the survival of any living organism on land would become impossible. The seasonal monsoon is an outcome of the energy released by the sea. The extra amount of rainfall, through the rivers and land runoff, is returned to the sea. Thus, through these agencies, the sea is enriched, but the effect of this enrichment is felt only in coastal waters—i.e. the areas which are close to the shore. The rest of the ocean, is simply too large to be affected by the freshwater runoff.

What, then, are the mechanisms by which the sea is periodically enriched. Figure 1 gives a portion of the sea with its boundaries. As can be seen from this figure, only up to a depth of 100 metres or so the sunlight can penetrate in the ocean. This would also mean that only within this depth the floating microscopic plants will be able to manufacture

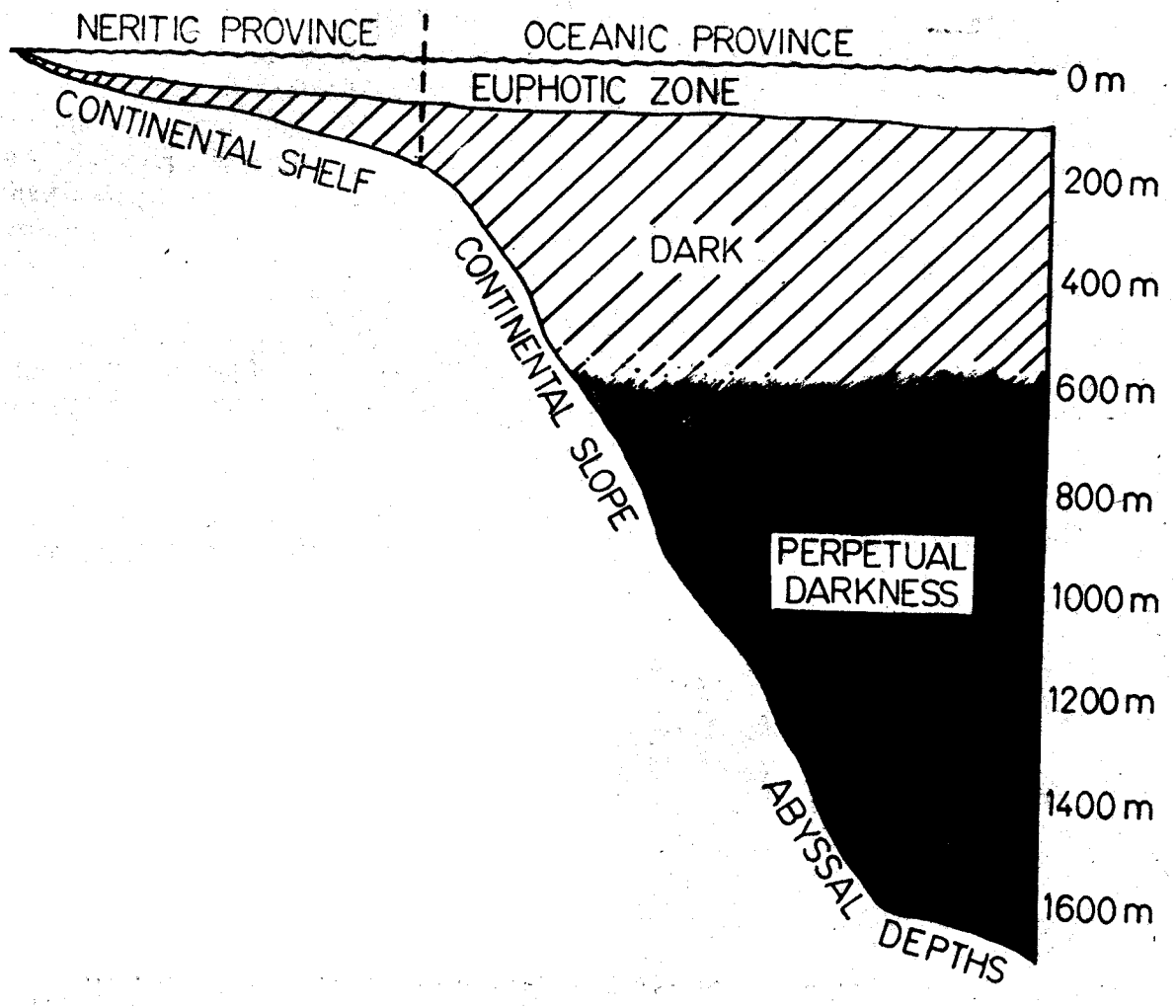

Fig. 1. Diagrammatic representation of a portion of the sea showing its major boundaries. Sunlight can penetrate only up to a depth of 100 metres in the sea (euphotic zone). The major part of the ocean remains in a state of perpetual darkness.

their food material—an activity called photosynthesis, which is restricted to green plants and occurs only in the presence of light. Evidently, the rest of the ocean remains more or less in a state of perpetual darkness. The changes induced by the wind and waves also do not penetrate deep down. Thus in certain parts of the oceans, the waters at great depths remain more or less stagnant and have been termed as " old waters ". These waters have been identified from their physical and geochemical properties as thousands of years old. The possible ways in which the waters are renewed include the ocean currents which give rise to a circulation system in the ocean. Any intrusion of another water mass, having different physical and chemical properties, can easily be identified by the oceanographers. The other pheno-

menon by which the water from deeper parts of the ocean is lifted and brought upto the surface is called " upwelling " (see Fig. 2). The energy required to lift the water from the deeper parts would be so enormous that it is doubtful if the effect of upwelling can ever reach beyond a certain depth. Thus the areas which have been well-known for upwelling are the coastal waters. Upwelling from great depths of the ocean has seldom been recorded, but this may be due to lack of observations.

the production of microscopic plants (phytoplankton or primary producers) which in turn leads to a greater production of floating animal life (zooplankton or secondary producers) and finally the production of tertiary animals (fish, shrimps etc.) which are harvested by man. All these processes in the sea are cyclic and the restriction imposed on any one would affect the production of the other. The Indian Ocean is perhaps the only ocean which is greatly influenced by the monsoon system. In

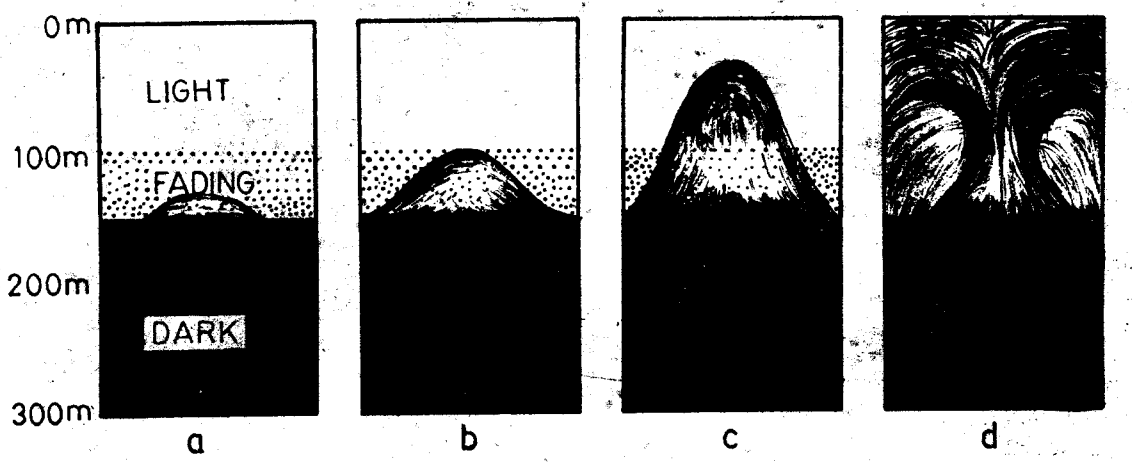

Fig. 2. A simplified representation of the phenomenon of upwelling in the sea. a-d indicate the stages in lifting of the water from the dark zone to the surface.

All those processes which introduce mixing or renewal of water are associated with enrichment, for the waters from deeper layers have a greater concentration of nutrients (phosphate, nitrate, silicate, trace elements etc.) than those from the illuminated zone, where, as a result of photosynthetic activity of plants, the nutrients are gradually used up. Enrichment, therefore, accelerates

fact during the monsoon period, the sea undergoes spectacular changes and it is thought that the energy for lifting the water from greater depth during upwelling is provided by the monsoon. In other words, for a better and bigger harvest, a good monsoon season seems to be a very important feature for the sea.

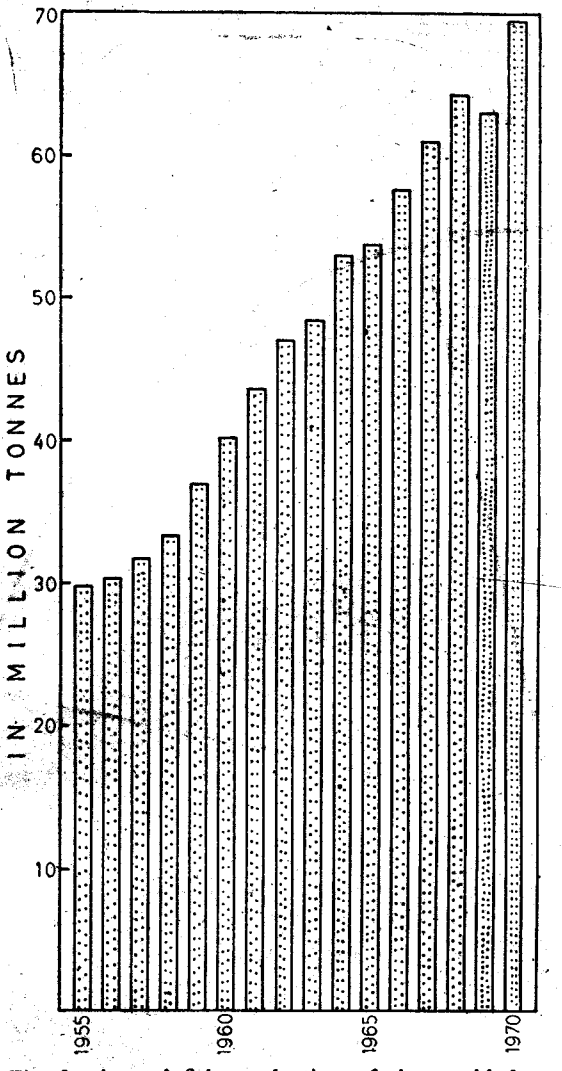

Fig. 3. Annual fish production of the world from 1955 to 1970.

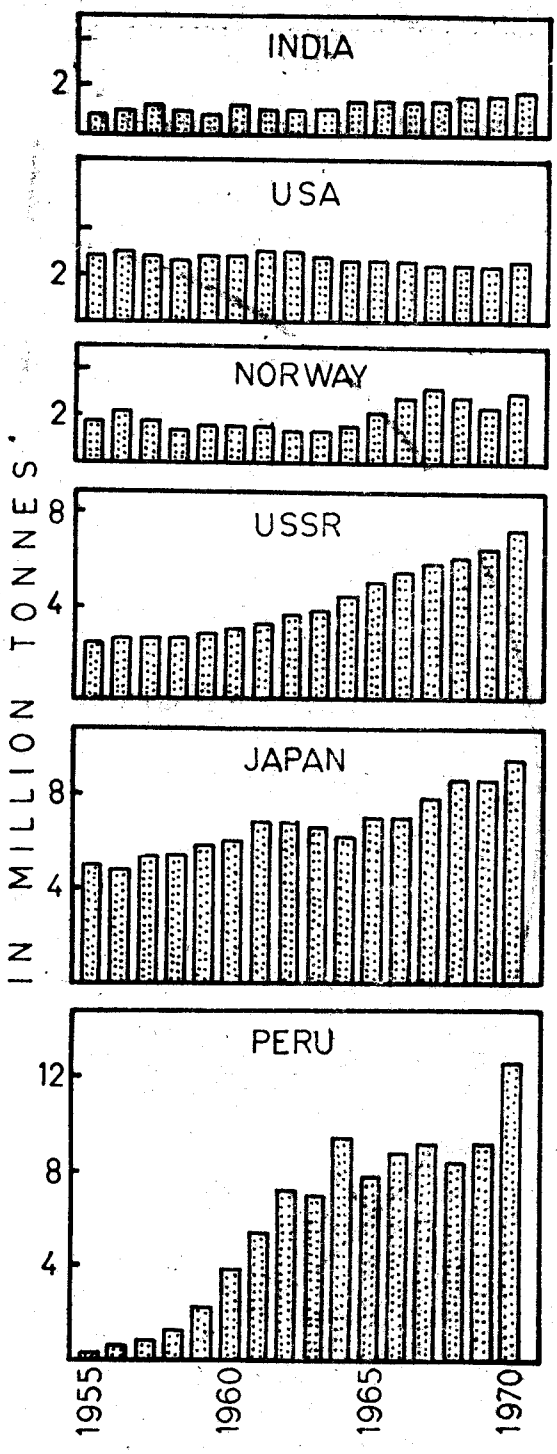

Fig. 4. Annual fish catch of 6 foremost fishing nations in the world from 1955 to 1970, as given by the FAO (marine and freshwater inclusive). Each year about 85% represents the marine catch and the rest from freshwater. ——>

Seafood harvest of the world

The total quantities of food harvested from the world oceans each year

have been shown in Figure 3 for a period of 16 years. From 1955 to about 1966, the seafood production in the world almost doubled. This would mean that the annual rate of increase has been of the order of 10%. From 1965 onwards, the rate of increase has been higher than in the previous years, and although in 1969 the world's catch decreased, in 1970 it recorded a sharp increase.

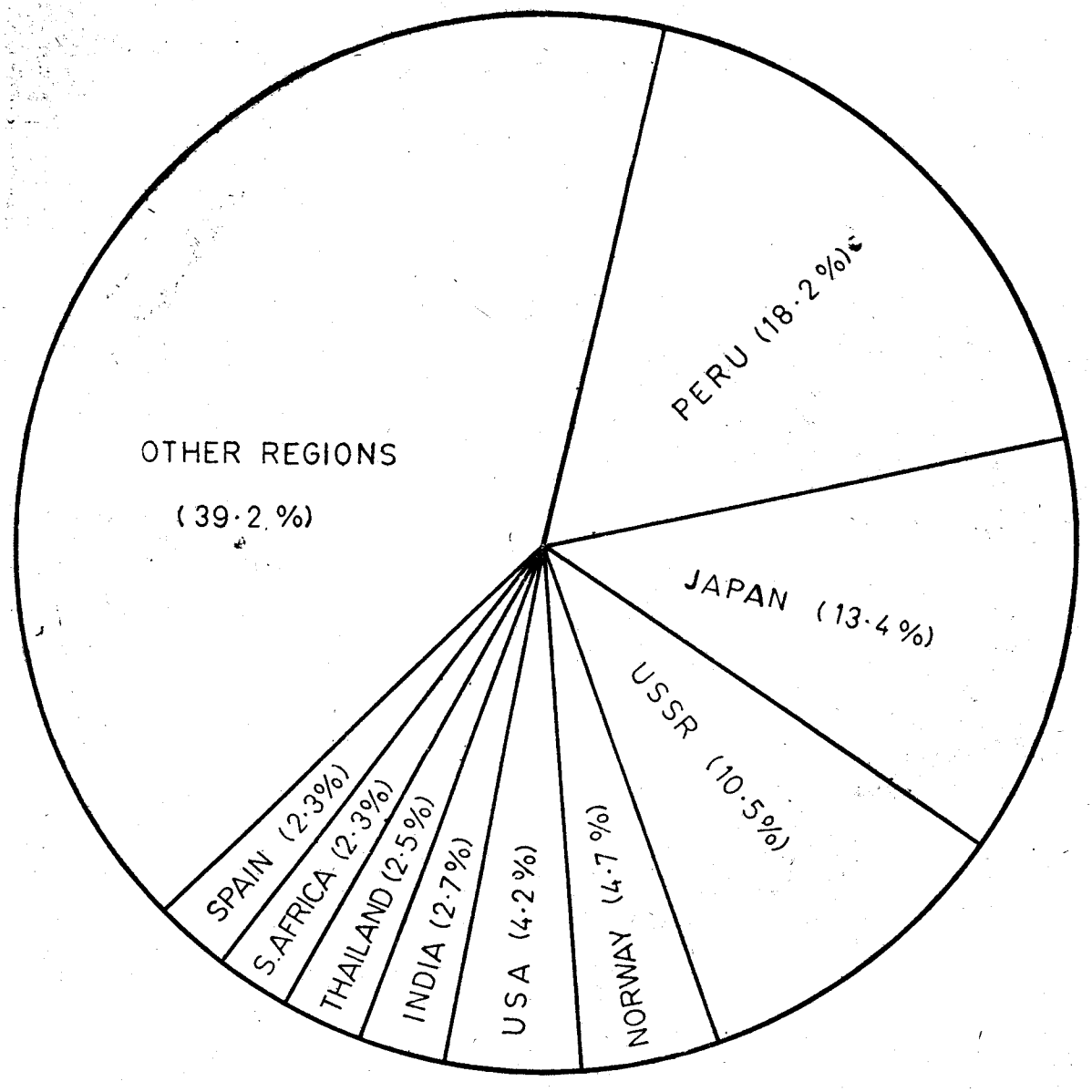

Fig. 5. Percentage contribution of 9 principal countries in the total world's catch.

Contribution from different countries

Figure 4 gives the annual catches of 6 major fishing nations of the world for a period of 16 years. As can be seen from the figure, up to 1961, Japan was the foremost fishing nation; but from 1962 onwards, Peru emerged as the greatest seafood producing country in the world. In 1970, Peru's fish catch reached an all-time record of 12.6 million tonnes. From 1965 onwards, Japan's catch also showed a steady increase. However, one of the most significant developments in world fisheries has been the emergence of USSR as the third biggest fishing nation. During the last decade, there was a progressive increase in the fish catch of the USSR and in less than 8 years the Russians have been able to double their total catch. During the last five years, Norway became the fourth major fishing nation, while in America the total catch declined and got stabilized at about 2.5 million tonnes. Today India occupies the sixth place in the world fisheries and stands only next to the USA. From 1964 onwards India's fish catch has been increasing steadily and it is hoped that in less than 8 years from now, India will also be able to double its fish production.

The percentage contributions of 9 major fishing nations have been shown in Figure 5. These 9 countries collec-

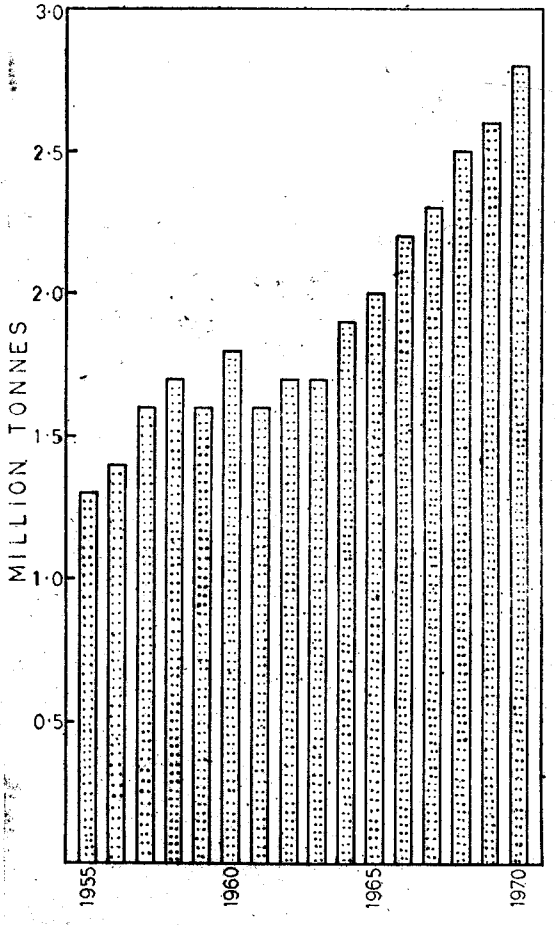

Fig. 6. Annual fish production from the Indian Ocean for a period of 16 years.

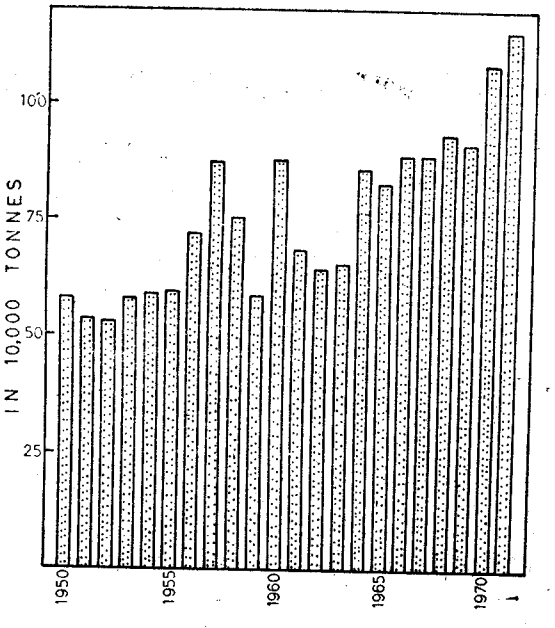

Fig. 7. Annual marine fish landings from India during the past 22 years.

tively produce nearly 61% of the world's total fish production, whereas the remaining countries share the rest of the catch together.

Figure 6 shows the total fish catch from the Indian Ocean. From 1964 onwards, the fish production of the Indian Ocean has been consistently increasing largely because of the greater efforts put in by India, Thailand, Philippines, Malaysia and other countries bordering the Indian Ocean, towards exploiting their seafood resources.

The annual marine fish landings in India over a period of 22 years have been shown in Figure 7. From 1950 to 1965, the year-to-year fish production in India was somewhat erratic. This was mainly because mechanization of fishing crafts had not reached a high proportion till 1965. From 1965 onwards the annual catch recorded a significant increase each year.

These days shrimps form a highly valued commodity for export and, therefore, they deserve a special men-

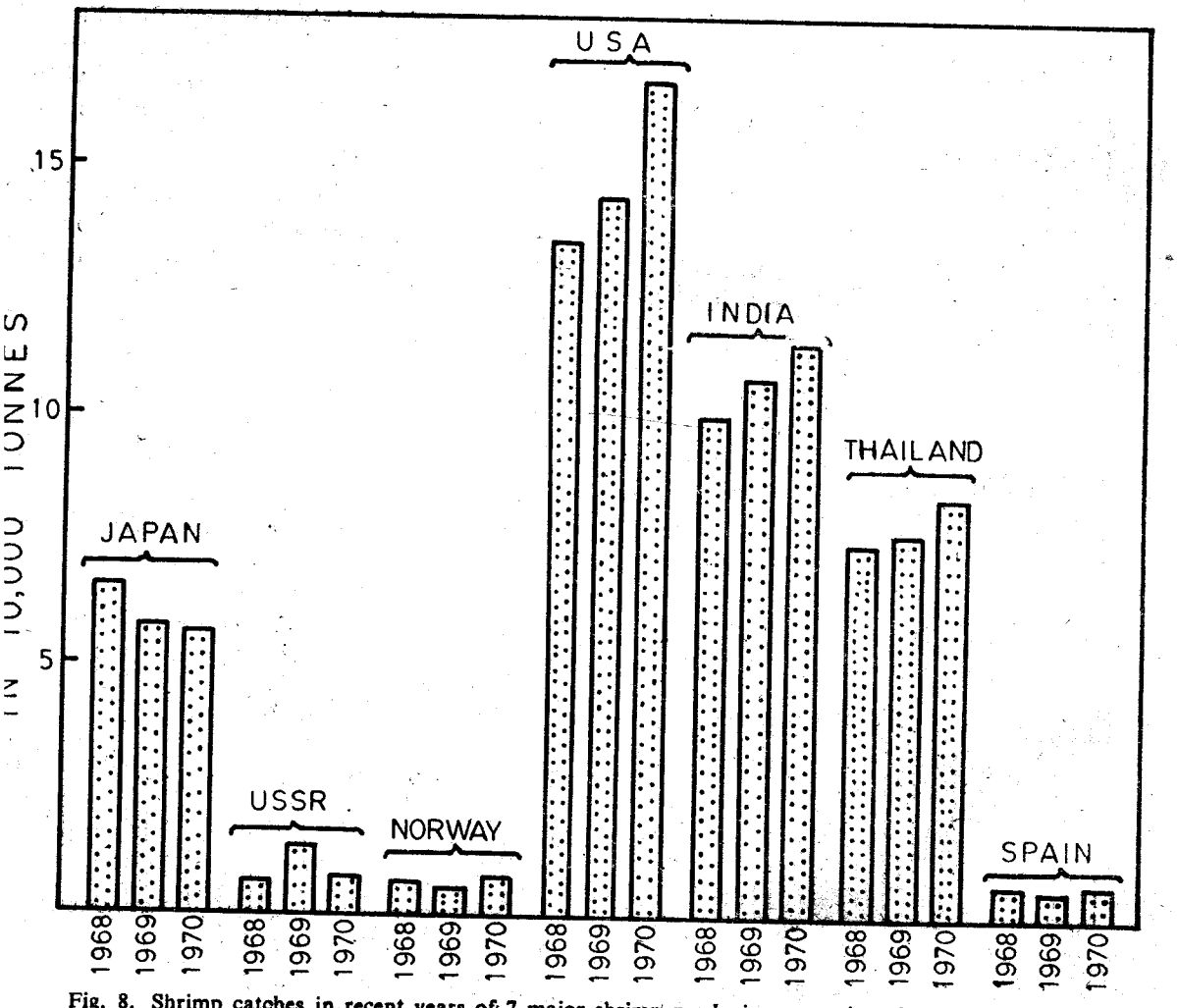

Fig. 8. Shrimp catches in recent years of 7 major shrimp-producing countries of the world.

tion. Figure 8 shows the annual prawn catch of 7 major shrimp-producing countries for a period of 3 years. As can be seen from this figure, the USA, in recent years, has been producing the maximum catches of shrimps and India is occupying the second place. In 1971 the Indian shrimp production increased sharply from 1.2 lakh tonnes to 1.5 lakh tonnes (23% increase from 1970). This happened despite the fact that 1971 was considered a bad year for shrimps in Kerala (see article of the present author in *Seafood Export Journal*, Vol. 4, No. 1, 1972, pp. 1–13), and reflects that the shortage of one type of seafood in any part of the country would not mean a similar shortage in the other parts. The shrimp production in Thailand also increased steadily in recent years, whereas in Japan the total shrimp catch declined (Fig. 8).

Seafood potential

The other question often asked is how much food can the sea give us? Some biologists give a very conservative estimate by putting the world's limit to about 100–120 million tonnes, while the other scientists, on theoretical grounds, are of the opinion that the total seafood potential lies within the range of 2 billion tonnes. However, whatever may prove to be the realistic figure, from both the estimates it is evident that there is no likelihood of the potential being achieved within the next few years. Moreover, the potential for the Indian Ocean alone has been estimated to be around 10–12 million tonnes, and hence as far as the countries bordering the Indian Ocean are concerned, there is hardly any cause for anxiety, as we are at present exploiting only 2.8 million tonnes from this ocean.

The question that follows from these estimates is what will happen once the maximum has been achieved? The answer to this question is quite simple. So far, we have been exploiting only the natural populations of the sea which are self regenerating every year. We have neither done anything to improve the marine stocks, nor have we adopted any practices of animal husbandry for generating extra food resources from the sea. Once the technical competence for sea farming (mariculture) becomes fully understood — and there are indications that it will be known fairly soon — the world's present annual seafood production of about 70 million tonnes can be realized from a few thousand square kilometres of the sea area. The well-known idea that the food resources of the sea are inexhaustible, therefore, appears to be true.

Conclusion

From the foregoing account it is evident that at least in recent years neither the world nor India has faced a situation which could be called "sea famine". Of course, with reference to certain countries there have been good and bad years. The available evidence, however, shows that even in the leanest year the total seafood production has seldom decreased more than 10% of the previous years. If, on the contrary, such an unfortunate situation as the sea

famine ever arises, we cannot escape the logical conclusion that it could only happen when our technology for detecting and harvesting the resources in the vast ocean completely fails, or when we make the sea, as a result of pollution or over-exploitation, incapabte of supporting large-scale plant and animal life. Under both these conditions, we must accept the fact that the fault will be ours. The rate at which our knowledge of the sea and its resources is advancing at present, it seems most unlikely that we shall face a situation which could be called "acute shortage". I say this not because I have a professional obligation to make an optimistic remark, but because it is only in recent years that we have begun to appreciate that the technological progress of our country will be judged from the ways in which we are able to make an effective use of the sea and its resources. In spite of this if we face a crisis, and if we hold nature responsible for it, we shall surely make the heavens laugh at us.