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CONSIDERATIONS AND TECHNICAL ASPECTS REGARDING THE DEVELOPMENT OF "MARINE-BASED INDUSTRY" AS PART OF UNIDO'S INDUSTRIALIZATION PROGRAMME */

by

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*/ This document has been translated from an original that has not been formally edited.

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INTRODUCTION

1. The purpose of this document is essentially to present some thoughts relating to the development of marine-based industry. The problems involved are both economic and technological in nature, taking into account the fact that the availability of marine resources is a matter of immediate and long-term concern for the economies not only of the industrialized countries, but also, and in particular, of the developing countries. Accordingly, the aim of this document is to make a contribution, within the framework of UNIDO's operational activities, by calling attention to certain dynamic factors in the development of marine-based industry, in the light of the opportunities for, and limitations on, the industrial utilization of marine resources in the context of the goals of industrial growth in the developing countries.

2. The potential impact of the industrial exploitation of marine resources in terms of the new international economic order is a matter of great general interest, bearing in mind important scientific and economic factors:

(a) Scientific factor: A knowledge of the economic potential of the sea is a vital element in economic planning, since the sea is an immense reservoir of goods and resources essential for long-term economic growth and the resources of the land are growing scarce and, in some cases, even nearing exhaustion;

(b) Economic factor: In many recent studies the point has been made that, within the context of the new international economic order, the sea represents an inexhaustible source of assets and the only possible solution to the problem of satisfying the steadily increasing requirements of the world's peoples, and particularly the peoples of the developing countries.

3. Twenty years ago the economic exploitation of most marine resources was considered virtually impossible. Today, however, as a result of the higher costs of mineral extraction, scarcities of a number of land resources, and technological advances, their exploitation is becoming more and more economically justified and necessary for the establishment and expansion of a series of new industrial activities, constituting a significant element in the effort to accelerate world-wide industrial and economic growth.

The resources of the sea

4. The industrial exploitation of marine resources is a factor of vital importance for the acceleration of the industrial growth of the developing countries and is destined to develop considerably over the long term taking into account the increasing requirements, throughout the world, for food and industrial products.

5. At present, the principal resource of the sea is fish, which accounts for 11 per cent of the protein consumed annually throughout the world. In addition, the sea possesses very important vegetable and mineral resources, which are still largely unexploited. Two-thirds of the fish take goes to human consumption, with the remaining third put to industrial uses, which are increasing in relative importance every year, thanks especially to the production of fish meal.

6. Of the world's three oceans, the Pacific contributes the largest share of the total catch, although it may be noted that it is the Atlantic which is the most intensively worked. Acoording to recent statistics published by the Food and Agriculture Organization (FAO), the world's leading fish-producing nations are:

(i) Peru (12.6 million tonnes of fish), where the use of fish meal in stock-raising has opened up new possibilities and has caused a veritable restructuring of the country's economy. This is an encouraging example for other developing countries where conditions are similar (particularly, West Africa), and shows that there are untapped resources in the sea which could yield a high return and become a driving force in accelerating the economic and industrial development of these countries.

(ii) Japan (9.3 million tonnes) has always looked to the sea to offset the deficiencies of a land area that is of limited dimensions and poor in raw materials. Fishing is a vital activity in Japan and permits the country to derive twice as much protein from the sea as from its cultivatable lands. With the building of larger and more efficient ships, and floating factories for fish-prccessing, Japan's marine-based industry now plays a key role in the economy of this country, which today, with the creation of immense industrial fish farms, leads the world in the field of marioulture.

(iii) The USSR (7.2 million tonnes) has, in the past ten years, mounted a very substantial effort to develop its marine-based industry. Large floating factories have been built to facilitate the preparation, conservation and processing of fish products; they are equipped with ultramodern electronic systems for detecting schools of fish, controlling the catch and co-ordinating the processing and packaging of up to 300 tonnes of fish per day for each of these factory-ships.

(iv) The United States of America (2.7 million tonnes) ranks in sixth place behind China (5.9 million tonnes) and Norway (2.9 million tonnes). The United States has promoted mariculture as well as the development of technologies and industrial systems for the processing, conservation, packaging and distribution of fish products. These activities are regarded as contributing substantially to economic development, particularly of coastal regions. In the United States the industrial processing of marine products absorbs a large portion of the fish haul and is particularly profitable because of the great commercial value of these resources when full use is made of them in protein concentrate, fish meal, oils, etc.

(v) In Europe, Norway, Spain, Italy, France, Denmark and Great Britain are the countries which are most active in the field of marine-based industry and mariculture, and in the expansion of these activities.

7. The total demand for marine-derived products is made up of: (a) the demand for unprocessed products; (b) the demand for processed, conserved or prepared products; and (c) the demand for fish meal, animal protein concentrates, and other products of vegetable, mineral, gaseous and other origin. This demand corresponds to three consumption sectors which are well defined in both the developed and the developing countries, and is destined to grow larger as the needs of the populations increase, economies expand and habits of consumption change. The development level of marine-based industry is a direct function of this elasticity of demand, and the trend in this area suggests continued growth over the long term.

Mariculture

8. For a long time mariculture remained a relatively impracticable area of enterprise, but it appears today that, thanks to scientific and technical advances, this activity is finally acquiring a high degree of economic interest. Proof of this can be seen in the increasing importance which the

developing countries and the organizations of the United Nations system, FAO in particular, have begun to attach to this area. The problems to be faced in developing mariculture are still far from solved, and there is still much room for expansion in this sector, which is of interest to developed and developing countries alike because it permits: (a) the utilization of locally available human and technical resources; (b) the development of important markets for certain high-technology industries (e.g., producers of electronic equipment); (c) the processing and sale of marine products other than fish in a highly profitable and expanding market; (d) the creation of new sources of economic wealth; and (e) the employment or retraining of steadily increasing numbers of local workers, such as fishermen who have been adversely affected by the industrialization of fishing activities.

9. The development of mariculture is based principally on the creation of conditions favourable to the industrial and commercial exploitation of the sea's animal, vegetable and mineral resources and on the enhancement of its productivity and economic yield.

10. What is involved here is the industrial application of methods for fertilizing the illuminated layer of the sea through the use of special fertilizers having the effect of causing the mineral salts to rise from the depths, perhaps by heating the lower-lying waters, by means of electronic and nuclear reactors, restoring to the water the nutritive and other substances that are essential to the development of marine animal and vegetable life. Lagoons and atolls are especially suitable for mariculture, and can be developed into virtual marine farms or laboratories, with the help of nitrates, phosphates and other organic and inorganic substanoes. Operations of this kind are currently in progress in Great Britain under the auspices of the Whitefish Authority, in France with the support of the National Centre for the Exploitation of the Oceans (CNEXO), in Italy in co-operation with the National Mariculture Centre, and in several other developed countries and also developing countries.

11. A serious research effort is required if mariculture is to be developed on a rational industrial basis, as it is a sector which requires specialized technologies. The developing countries should be made aware of this problem and given the assistance necessary to develop this sector, which could contribute substantially to faster economic and industrial growth.

Vegetable resources

12. The sea contains two categories of plants: algae and plankton. Each offers excellent prospects for industrial exploitation.

13. There is nothing very new in the exploitation of algae. Geographical and demographic conditions have obliged the Japanese to cultivate them for their food value for thousands of years.

14. Algae are also cultivated in certain developing countries in order to improve the protein and vitamin content in the local diet. The magazine Chemical News, published in Washington, recently reported that a large industrial facility had been built in Thailand for the transformation of algae into protein concentrate, using a German process.

15. Plankton, which floats freely on the surface of the sea, has a renewal rate higher than that of land plants or even algae, and represents an immense food and economic reserve. Plankton constitutes the basis of the food intake of fish and it can also be adapted as human food by a process transforming it into a paste. In addition, it contains a high proportion of cellulose and of silica, one of the principal constituents of glass, so that it can also be profitably put to industrial use.

16. The use of plankton and algae in the chemical and pharmaceutical industries is certain to increase rapidly in the years ahead, producing a high added value and a rate of return not compromised by difficulties of harvesting.

17. Still other potentially great areas of application exist for plankton and algae, particularly in the manufacture of beauty or pharmaceutical products based on the fact that these vegetable substances are rich in ingredients that have a beneficial effect on the skin, hair and nervous system, on growth, and in the treatment of many diseases, including cancer.

18. The prospects for the industrial exploitation of marine vegetable resources in the developing countries are of major interest from both the economic and the scientific standpoint, since these resources represent a valuable asset which has to date been practically untapped, but which it will be possible to develop considerably in the years ahead with the aid of technological advances.

The other resources of the sea

19. The sea is today no longer regarded as a mere reservoir of animal or vegetable resources. Progress in oceanology has cast a fresh light on the marine environment, which is now being called the "sixth continent".

20. As a result of the evolution of economic activity and technological progress the sea has come to occupy a front-rank position as a world supplier of energy, gas, minerals and biochemical substances. Sea-derived hydrocarbons and natural gas already account for 20 per cent of world production, and this percentage is destined to increase rapidly.

21. Accordingly, coastal regions are in a position to benefit from a boost to their economies which should not be long in bringing enormous advantages, provided that at the same time steps are taken to develop the kind of industrial infrastructure capable of ensuring the exploitation of these marine resources on the industrial scale.

22. The creation of drilling platforms and of storage, loading and processing reservoirs, as well as the development and installation of floating factories, represent an industrial sector of the highest importance. In the Bahamas, an artificial island is being used for the dredging of conchitic sand. Throughout the Mediterranean basin many artificial-island projects are in progress, and operations to exploit the sea's petroleum, mineral and fossil resources are acquiring increasingly greater scope.

23. Sea-water itself is an enormous source of industrial resources, containing as it does a great volume of minerals in addition to sodium chloride. The chemical and mining companies of the developed countries are already looking to the oceans as the world's largest reserve of fresh water as well as other vital resources which are nearing depletion on the continents.

24. The fact is that sea-water contains so many substances in dissolved and floating form that it presents a kind of catalogue of chemical elements in solution: sodium, potassium, manganese, lead, iron, thorium, titanium, magnesium, bromine, uranium, zinc, cobalt, gold, silver, etc. What is more, covering the ocean floor is a mineral layer of at least 150 metres in thickness. In addition, it has recently been discovered that in certain places there are pockets of water with an unusually high saline content as well as enormous concentrations of minerals of undeniable economic importance. These facts explain the interest that is being shown in industrial mariculture and why some experts consider the seas to be a more economical source of mineral wealth than the dry land.

25. Another aspect of great industrial interest is the realization that enormous quantities of energy can be obtained from the natural movement of sea-water. Such phenomena as waves, currents, tides and thermal discontinuities can be harnessed and transformed into power and electricity, thereby providing a solution to the energy supply problem, which is one of today's principal economic concerns. The use of this type of energy is on its way to becoming a subject of the keenest interest in view of the nearing exhaustion of petroleum resources on the land, and has already led to the development of a hydro-electrical technology. A large tidal generating station has recently been built in France, in the Rance estuary, providing nearly a billion kilowatt-hours a year. Similar tidal power plants are to be built in Canada, Argentina, Great Britain, the USSR and the United States.

26. This technology is certain to take on added importance as traditional energy sources are depleted and attention turns to techniques for the intensive working of marine resources.

Off-shore hydrocarbons

27. Hydrocarbons, i.e. petroleum and natural gas, are an important factor in world industrial and economic development, not only because they satisfy a major portion of the related energy requirements, but also because they play a vital role in a number of industrial sectors. Accordingly, the demand for these products rises in pace with the growth of economic and industrial activity.

28. By about the year 2000, however, there may be a sharp decline in the production of hydrocarbons and natural gas, as these are fossil fuels whose regeneration requires periods of time measured in terms of geological eras. It is obvious that a crisis of this kind could seriously upset the economic order and prejudice the efforts that are being made to achieve world industrial and economic development. The Governments of all countries are aware of the gravity of this problem and have, for about the last fifteen years, taken steps to encourage the research and development of marine hydrocarbon extraction. At present, this sector ranks directly behind fishing as a marine activity, with a growth record of 27 per cent in the period 1970-1974 as reflected in an increase from 2,737.5 million barrels a year at the beginning of that period to 3,796 million barrels at its end. During that same period, off-shore hydrocarbons moved from 16.4 to 18 per cent of total world production, and off-shore natural gas from 9 to 12 per cent.

29. The figures for reserves are even more striking: the sea-bed contains 27 per cent of the world's petroleum resources and 24 per cent of its natural gas, thus accounting for most of the world's reserves until the end of the century.

30. However, the depletion of hydrocarbon and natural gas reserves on the continents is not the only reason why Governments are turning their attention to the sea. It happens that the hydrocarbons located in the seas have been found to be superior in quality to those contained in continental deposits, and drilling operations carried out as part of the Deep-Sea Drilling Project have confirmed the presence of large quantities of oil and gas off the shores of the Gulf of Mexico and the Mediterranean, Caspian, Black, Japan and Bering Seas - all regions with conditions extremely favourable to the formation of hydrocarbons. The latest estimates published in France by CNEXO put marine

hydrocarbon resources at nearly 150 billion tonnes. In the face of a potential source of this magnitude, it is hardly surprising that so many Governments have undertaken to develop techniques for recovering oil and natural gas at sea.

31. Certain political factors also come into play in the expansion of offshore extraction activities. Confronted with rising requirements, both the industrialized and the developing countries are looking to the sea's resources as a way of securing a greater degree of self-reliance for their supplies. The related increase in production costs, they feel, is offset, over the long term, by enhanced reliability in respect of petroleum and natural gas supplies.

32. All the maritime nations of the world are interested in the development of this new marine-based industry, which has undergone spectacular growth in recent years. On the whole, marine hydrocarbon extraction in unquestionably a very profitable activity, where non-productive investments are compensated by a high rate of economic growth as well as by the creation of new industrial and commercial activities and the generation of new employment opportunities (small companies specializing in services, engineering consultancy, diving operations, drilling platform construction and maintenance, equipment of various types, insurance, transport, etc.).

33. The developing countries are destined, in large measure, to benefit from the expansion of these activities, which will contribute in a very material way to speeding their economic and industrial progress.

Minerals

34. From the point of view of the industrial exploitation of the sea, marine minerals are classified as:

(a) Sedimentary deposits, usually located close to the shore;

(b) Sands containing heavy minerals (tin, gold, platinum and diamonds) on the shore of the South East Atlantic, Alaska, West Africa, South Africa and Siberia;

(c) Deposits of light minerals (ferrous oxide, titanium, thorium, etc.), particularly in Australia, the United States, Brazil, Sierra Leone, Mozambique, Sri Lanka, and in the Mediterranean, and Baltic seas;

(d) Deposits of abyssal minerals (red clay, alumina, manganese, copper, cobalt, nickel, lead, barium, etc.) off the shores of the United States, Africa, Portugal and the Mediterranean countries, and the Philippines;

(e) Manganese nodules (in association with nickel, cobalt, copper, iron and other minerals), particularly in the Atlantic, Pacific and Indian Oceans;

(f) Phosphorite nodules (containing phosphate, strontium, barium, magnesium, iron, uranium, thorium, etc.), particularly off the coasts of the Americas and Africa.

35. In addition to these deposits, which are located on the ocean floor or relatively near the coast, great mineral wealth lies hidden beneath the floor as well. These latter deposits contain mainly hydrocarbons, sulphur and salt, along with veins of coal, iron and tin, and are located specifically in the Mediterranean, the North Sea, the Gulf of Mexico, off the coast of Austrlia, and in the Sea of Japan, the Red Sea and the Indian Ocean.

36. Despite the high costs of research and processing, there is evidence that a number of countries are devoting increasing attention to the industrial recovery of marine minerals, as they look beyond the economic factors involved to certain strategic and political factors which may be of decisive importance.

37. For certain industrialized countries which depend mainly on foreign sources for their ore supplies, the threat of unstable prices and an unreliable supply situation represents a permanent factor of uncertainty. Accordingly, these nations are particularly interested in moving immediately towards an industrial marine mining capability.

38. As far as the developing countries are concerned, the development of marine-based industry and the related economic activities would mean:

- Access to new technologies and new markets;
- An improvement of their economic terms of trade on international markets;
- The channelling of investment capital from the developed countries to marine-based industry, a sector with the potential for enormous future expansion and with a major role to play in speeding economic and social development.

38. The parallel industrial working of the resources of the sea and those of the land is entirely feasible, to the definite advantage of the producing nations (which are largely developing countries) and with no disruption to their markets. The problems in this area are essentially technical in nature and relate to the development of appropriate industrial technologies and the rational establishment of a specialized marine-resources sector out of which might arise a whole series of collateral activities which would have significant economic impact and guarantee fresh sources of employment, especially in coastal areas.

Conclusions

39. In the light of the sea's great wealth of animal, vegetable and mineral resources, and the economic advantages to be gained by working them, it is clear that there will be a marked expansion of marine-based industry in the years ahead. Industrial activities centred on marine resources will prove increasingly attractive to the developing countries because of their favourable economic and social impact on the efforts of these countries to achieve industrial and economic growth.

40. When considering this brief catalogue of the advantages to be gained through expanded marine-based industrial activities, it is well to remember that the spin-off of development opportunities from this sector depends on parallel progress in the areas of research, production and distribution.

41. Development of marine-based industry offers an efficient means of accelerating socio-economic progress in the third world. This sector must not remain mainly under the control of the industrialized nations, as its purpose should be to enable all the countries of the world, and especially the least advantaged of them, to pursue a course of economic growth even at a time when the resources of the land near depletion and mankind turns to the sea for the products required to satisfy growing international demand.

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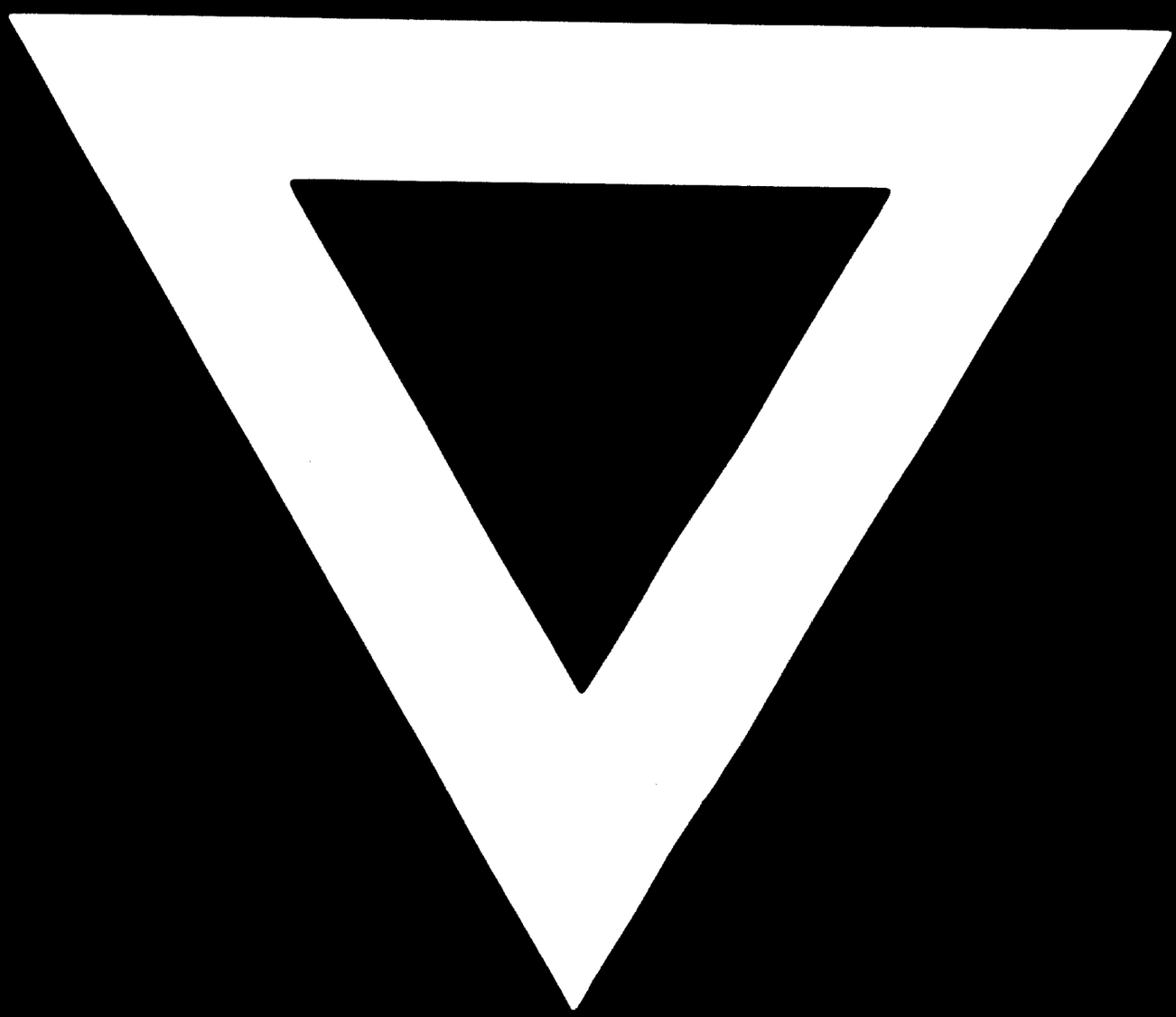

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