

A PLAN FOR FISHERY DEVELOPMENT
IN THE INDIAN OCEAN

By

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The Indian Ocean Programme

The International Indian Ocean Fishery Survey and Development Programme, or Indian Ocean Programme for convenience, was formally conceived by The Indian Ocean Fishery Commission and its activities are conducted through that body. The Programme is supported by the UNDP and is being carried out by the FAO Department of Fisheries. Put simply, the objective of the Programme is fishery development in the Indian Ocean region.

John C. Marr
Programme Leader

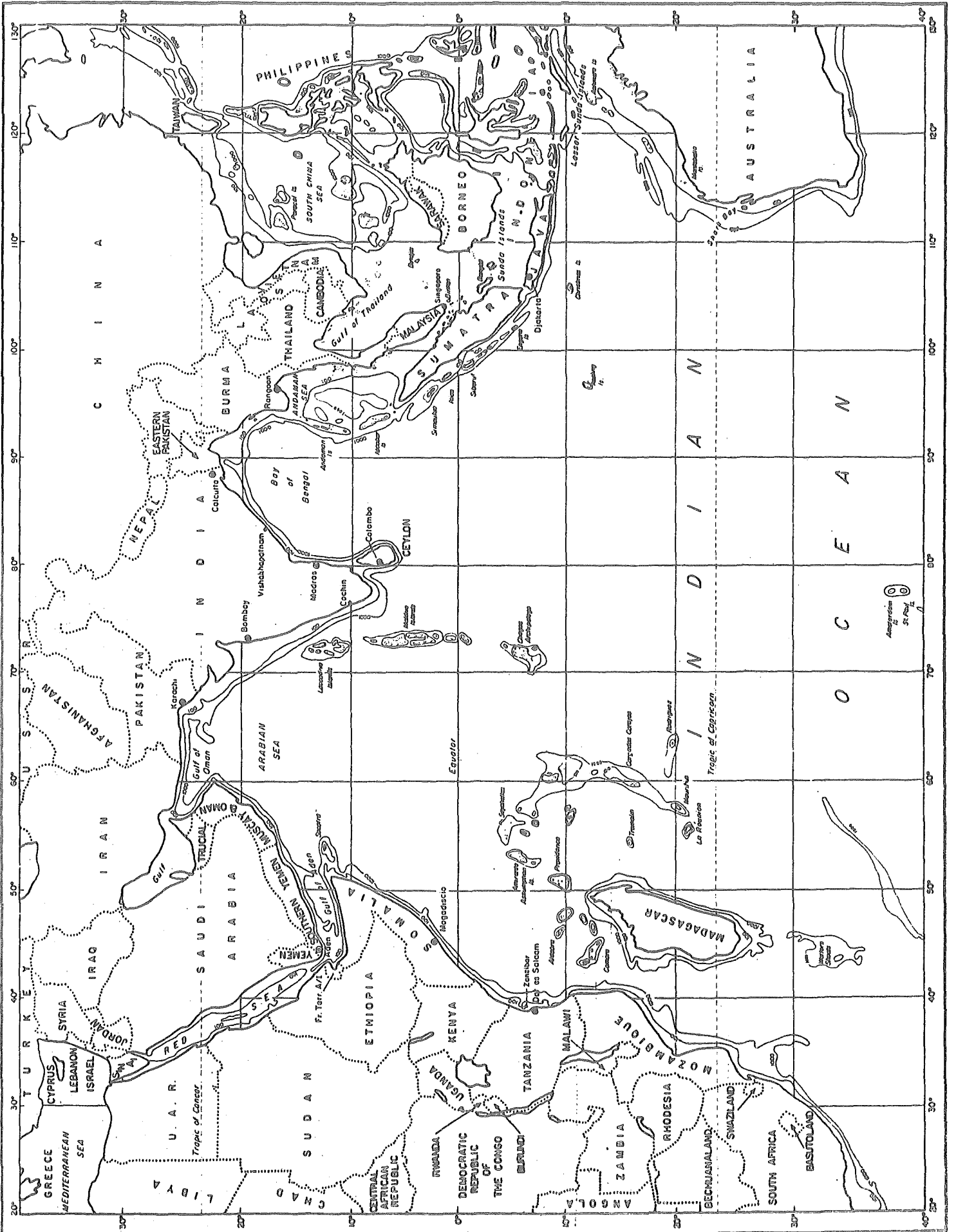


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CHAPTER I

SUMMARY OF RECOMMENDATIONS

In Chapters VI and VII we have set out our recommendations for the stimulation of fishery development in the Indian Ocean. These may be categorized as: (1) specific undertakings or action proposals, and (2) policy guideline proposals. The action proposals are grouped in five categories. The categories are not listed in order of priority, but within each category priority judgements have been indicated. The policy-guideline proposals are listed in the order in which they occur in the text, costs and other information relating to the recommendations are given in Chapter VIII.

The action proposals are:

| I. | Investment projects | Priority | Page |
|-----|--|----------|------|
| 1. | That there be a feasibility study of the trawl fishery in the Gulf between Iran and the Arabian Peninsula. | A | 49 |
| 2. | That there be a feasibility study of the trawl fishery in the northeast Arabian Sea. | A | 49 |
| 3. | That there be a feasibility study of the skipjack tuna-fishery in the Indian Ocean | A | 51 |
| 4. | That there be a feasibility study of the small-boat tuna longline fishery in the Indian Ocean. | A | 47 |
| 5. | That there be fishing trials of a small tuna longline boat in the Indian Ocean | B | 47 |
| II. | Pre-investment fishery development surveys | | |
| 1. | That there be a pelagic fish-assessment survey in the northwest Arabian Sea. | A | 49 |
| 2. | That there be a demersal fish-assessment survey in the Gulf between Iran and the Arabian Peninsula. | A | 49 |
| 3. | That there be demersal fishery development through the introduction of trawling in Indonesia. | B | 50 |

| | Priority | Page |
|---|----------|------|
| 4. That there be pelagic fishery development through the introduction of purse-seining with light in Indonesia. | B | 50 |
| 5. That there be a shrimp, lobster, and demersal fish assessment in East Africa. | C | 46 |
| 6. That there be an exploratory fishing/fishery-development survey in Burma. | C | 49 |
| 7. That arrangements be made to obtain resource-assessment information from collection of fish eggs and larvae. | D | 58 |
| III. Feasibility and other studies | | |
| 1. That there be a feasibility study of marketing Red Sea demersal fishes. | A | 48 |
| 2. That there be a review of joint ventures and the drafting of model agreements and laws. | A | 45 |
| 3. That there be a review of shrimp fisheries in order to develop management guidelines. | A | 51 |
| 4. That the problems of currency valuation in relation to the fishing industry be reviewed. | A | 60 |
| 5. That the possibility of increasing the value of tuna fisheries to East Africa be investigated. | B | 47 |
| 6. That the oil-sardine stock-identity problem in the Arabian Sea be reviewed. | B | 48 |
| 7. That the chub mackerel stock-identity problem in the eastern Bay of Bengal be reviewed. | B | 50 |
| 8. That the possible function and form of a Regional Fishery Development Agency be investigated. | C | 45 |
| 9. That there be a review of vessels and equipment to determine potential improvements. | C | 60 |
| 10. That there be an inventory of harbour needs and potential sites. | C | 60 |
| 11. That there be a review of government cooperatives and enterprises to determine factors making for success or failure. | C | 61 |

| | Priority | Page |
|--|----------|------|
| 12. That there be a review of the knowledge of mangrove swamps as they relate to commercial fisheries. | D | 58 |
| 13. That there be a review of the knowledge of coral areas as they relate to fish production, harvesting, and management. | D | 58 |
| IV. Institutional and management arrangements | | |
| 1. That there be established a Technical Staff of the Commission. | A | 40 |
| 2. That there be established a regional statistical centre. | A | 43 |
| 3. That there be established a Fisheries Joint Venture Advisory Board. | A | 45 |
| 4. That there be established a coordinating mechanism for fishery=survey activities in the Gulf of Aden. | B | 48 |
| 5. That there be established a coordinating mechanism for fishery=survey activities in the eastern Arabian Sea. | B | 49 |
| 6. That there be established a mechanism for the storage and retrieval of project=resources information. | B | 59 |
| 7. That there be a meeting on the management of shrimp in the Gulf between Iran and the Arabian Peninsula. | C | 53 |
| 8. That information on shrimp=sorting trawls be made available in the region. | C | 51 |
| V. Conference and training | | |
| 1. That there be arranged management fellowships and seminars. | A | 57 |
| 2. That provision for on=the=job training be included in project proposals. | A | 57 |
| 3. That there be a Conference on Product Acceptability and Marketing. | A | 54 |
| The policy guidelineproposals are: | | |
| 1. That there routinely be consideration of the execution of new projects by contract to existing institutions or firms and/or chartering to meet vessel requirements. | | 59 |

| | Page |
|--|------|
| 2. That testing and demonstration of new gear be made part of all projects involving ships and following the completion of feasibility work. | 60 |
| 3. That there be provision for shipyard facilities for construction and repair in or adjacent to fishing harbours as these are developed. | 60 |
| 4. That there routinely be provision for assessment of harbour requirements, sites, and costs in fishery-development projects. | 60 |
| 5. That there be provision for fishing-harbour development distinct from commercial harbours. | 60 |
| 6. That there be provision for managerial training in the various fishery-education institutions. | 61 |
| 7. That use be made of existing facilities when possible. | 61 |
| 8. That the functions of economic-feasibility trials and training of crews be clearly separated in fishery projects. | 62 |
| 9. That the Commission confirm its interest in mariculture as a part of fishery development. | 62 |
| 10. That the Commission keep itself informed on the status of FPC. | 63 |
| 11. That the Commission keep itself informed on the subject of contamination. | 63 |

CHAPTER II

INTRODUCTION

About one thousand million people — one third of Earth's population — live in the countries bordering the Indian Ocean and adjacent seas. These people have an annual protein deficit (difference between requirement and supply) of three million tons. The annual yield of Indian Ocean fisheries is only slightly less than 2½ million tons, and there is ample reason to believe that this yield can be increased by seven to 10 times with existing technology. The juxtaposition of these facts — population, protein deficit, underutilized marine resources — undoubtedly accounts for much of the initial and present interest in fishery development in the Indian Ocean. Yet it is obvious that increased protein production will not help these individuals now on a sub-minimal protein diet unless they also have the purchasing power necessary to acquire the additional protein or unless it is otherwise made available to them. And in fact the interest of many governments in fisheries is not so much in meeting the protein deficiency as it is in developing resources (such as tuna and shrimp) which can be used to acquire needed foreign exchange. Still others see fishery development as a way of meeting certain social problems, such as providing employment. All of these needs are interwoven, of course, but it does appear to us that fishery development should be viewed first and foremost as part of general economic development leading to generally increasing standards of living and to the diffusion of economic well-being (including the ability to acquire needed amounts of protein) throughout the population.

Thus, fishery development, in the sense in which it is used here, includes the following objectives: (1) to contribute to general economic development, including especially the stimulation of investment, from international as well as national sources, in the fishery sector, (2) to provide a source of foreign exchange, (3) to contribute to meeting various socio-economic needs, and (4) to provide a source of protein. Fishery development

in this sense is the objective or central theme of the International Indian Ocean Fishery Survey and Development Programme (or Indian Ocean Programme, for convenience).

The Indian Ocean Programme was formally conceived by the Indian Ocean Fishery Commission (a regional commission established under Article VI of the FAO Constitution) at its First Session in September 1968 in Rome. At that time the Commission (FAO, 1968) stated that fishery "...development will benefit by, and perhaps be dependent upon, over-all coordinated planning of survey and development activities in the area into which particular national or multi-lateral projects can be effectively fitted and thus enhanced.

"The aim of the Survey and Development Programme would be to increase the knowledge of the resources of the Indian Ocean as a whole, but particularly of those stocks which offered opportunities for early economic development by the countries in the area itself, to study all aspects of their utilization, identify obstacles to development and to plan remedial action. The Programme would thus furnish the basis for early development and the fuller utilization of the resources of the Indian Ocean. The Commission considered that the Programme might be made up of a number of individual coordinated projects, some of which might be primarily national in character while others might involve a number of nations."

1969 FAO/UNDP Mission

Late in 1969 there was a FAO/UNDP Preparatory Assistance to Governments Mission (consisting of three teams which visited a total of 16 countries and territories in the Indian Ocean region). The Report of this Mission states that: "The purpose of the International Indian Ocean Fishery Survey and Development Programme is to assist the Governments in the formulation and initiation of an international programme through which developed countries can assist the countries of the region in increasing the knowledge of and production

from the living resources of the Indian Ocean and particularly of those stocks which offer opportunities for early exploitation, especially by the countries in the area; to study all aspects of their utilization, to identify obstacles to development, and to plan remedial action."

And further:

"It is expected that the project activities will result in the formulation of a long-range cooperative programme which will:

- "a) Provide usable information on the coastal and offshore resources, their distribution, migratory habits, and behaviour patterns influencing fishing activities, their magnitude and maximum sustainable yield, and to consider the need for their management
- "b) Identify the problems associated with exploiting and marketing these resources, including access to capital required for initiating commercially viable fisheries, provision of infrastructure facilities, development of the human resources and merchandising in national and international markets
- "c) Take full account of past and current fishery research and development projects in the area of the Indian Ocean, whether national or assisted under bi-lateral or international sources; and
- "d) Correlate and coordinate existing and proposed national and international activities of this nature."

From these sources it is clear that (1) it was the intent to contribute to the economic development of the Indian Ocean countries through the development of Indian Ocean fishery resources, (2) there was a strong belief in the synergistic effort of coordinating Indian Ocean fishery development activities, and (3) it was intended that economically developed countries outside the region play a large role in the development process. It is pertinent to comment further on (1) and (3). As Marr and Olsen (In Press) have put it, "...there

is the problem of how to facilitate the ability of the Indian Ocean countries to utilize the fishery resources of the Indian Ocean. Intuitively, it does not make much sense to invest Indian Ocean country funds and UNDP funds in developing Indian Ocean fishery resources for the benefit only of countries outside the Indian Ocean. Again intuitively, neither does it make much sense to allow renewable Indian Ocean fishery resources to remain unharvested, and in this sense wasted, just because Indian Ocean countries may not be able, at this point in time, to harvest them, while there are countries outside the Indian Ocean capable and clearly with the right of so doing. Some mechanism must be found which can accommodate these two seemingly opposing views." Aside from the general desirability of contributing to the economic development of Indian Ocean countries, we believe that the economically developed countries interested in the region can also benefit from such development through the provision of managerial skills, technical expertise, through the sales of equipment and gear, and through access to a source of supply of fishery products for their internal markets. We have commented on these benefits more fully in subsequent sections of the report.

At its 1968 meeting, the Commission asked the Director-General of FAO to arrange "...for a request on behalf of the Commission for UNDP assistance in the various stages of the Preparatory Phase of the Programme to be presented to the Administrator of UNDP in suitable form and to expedite the implementation of the Programme." The requested proposal was prepared by the FAO Department of Fisheries and subsequently submitted to the UNDP by a number of interested countries. The process took longer than had been originally anticipated, but support for the Preparatory or Planning Phase of the Programme was provided by UNDP in early 1970, and the Programme Leader was recruited at the end of January 1970.

Activities of 1970

Most of 1970 was used to accumulate the information requisite to planning. A

number of subject areas, in which information review summaries were necessary, were defined, including resource inventory, distribution and abundance of fish eggs and larvae, stock assessment, management, statistics, survey and charting of resources, environmental research, experimental fishing and introduction of alternative techniques, vessels and equipment, shipyards, harbours, handling and processing facilities, general economic characteristics in the development process, international trade, fishery economics, and economic planning for fishery development. By June 1970 or earlier consultants were recruited for each of these subject areas, and their reports were largely in hand by December 1970, although a few were received in January 1971. Of these consultants, nine travelled widely in the Indian Ocean area; the others worked at FAO Headquarters in Rome or in other localities appropriate with respect to sources of information. With some few exceptions, the reports of these consultants will be published in the series following this report. Information in FAO files was available, of course, and certain kinds of information were requested directly from Governments. Finally, in order to gain some familiarity with places, people, problems, and possibilities, the Programme Leader spent a total of four months in 1970 in visits to Mauritius, Madagascar, Tanzania, Kenya, Somalia, Pakistan, India, Ceylon, Burma, Thailand, Malaysia, Singapore, and Indonesia, as well as Korea, Japan, and the U.S.

The authors have worked in Rome for four weeks during January 1971, reading, discussing, sometimes arguing, writing, and then starting the process over again. During this repetitive or continuing process we have been disabused of some previously held concepts and ideas and have improved our understanding of the identity and nature of the problems of fishery development in the Indian Ocean and, hopefully, the steps to be taken toward their solution. (1)

(1) Owing to the impossibility of circulating successive drafts of this report between such distant localities as Fairbanks, Rome, and Delhi in the face of printing schedules imposed by meeting dates of the Indian Ocean Fishery Commission Executive Committee, my colleagues have unfortunately not had the opportunity to review the report in its present form, especially as regards the contents of Chapter VIII. Accordingly, while they should receive full credit for the good features of the report, I must and do assume responsibility for errors of omission or commission. — J.C.M.

In the following chapters we have covered the resources and their potential yields; population and national economics; development prospects and benefits; regional development proposals; other proposals and considerations; costs, funding, scheduling, and priorities; time schedule of events relating to the Indian Ocean Programme; acknowledgments; and references.

The present fishery yields of the Indian Ocean are 2.4 million metric tons. These yields are capable of being increased to 14.0 million tons or more with existing technology. Growth rates in annual yields of five per cent and eight per cent over 20-year periods are feasible in terms of the potential yield, for both the demersal and pelagic fishes. In the case of tuna and shrimp, for which there are already well-developed fisheries and strong international demand, potential yields would be achieved in about ten years.

As would be expected, there is wide variation among Indian Ocean countries with respect to area and population. Areas range from not quite 400 km² for the Seychelles and not quite 600 km² in the case of Bahrain and Singapore to over three million km² for India and almost eight million km² for Australia. Population density ranges from less than five/km² for a number of Middle East countries to almost 400/km² for Mauritius and over 3,000/km² for Singapore. Annual rates of population increase are high, generally exceeding two per cent, and in some cases, three per cent. Very substantial percentages, exceeding 80 per cent in some cases, of the economically-active populations are associated with agriculture, which contributes a large (but not a proportionately large) component of gross domestic product (GDP). With a few exceptions, per capita national income of the Indian Ocean countries is low, and, on this basis, most of the countries would be

classified as "developing". A number of the countries, however, have substantial aggregate national incomes. The growth rates of GDP have been as high or higher than those of Western Europe and North America. Per capita GDP growth have been less satisfactory, owing to high rates of population increase. Consumption standards and levels of living are generally low; lower than might be suggested by the per capita income figures, since the distribution of per capita income is highly skewed. In spite of low incomes, at least five countries have reasonably well-developed infrastructure and other facilities and may be considered as "low-income countries with a developed infrastructure." The remaining countries tend to have underdeveloped infrastructure and unintegrated national economies.

Aim Is Economic Development

The objective of fishery development is taken to be to contribute to general economic development. Providing sources of foreign exchange, employment, or protein are all considered to be sub-objectives of this main objective. In selecting from amongst possible fishery development projects, we believe that the criterion should be the rate of return or profitability. The requisites for fishery development, other than a resource, include labour, skills and techniques, infrastructure and economic environment, capital, and markets. The low-income Indian Ocean countries all suffer from a lack of one or more of these; fishery development will probably depend heavily on inputs from high-income countries outside the region. Even so, fish landings have grown at a respectable rate, although unevenly, since 1964. The potential increase in yield of the Indian Ocean will be worth (gross value) about 450 million dollars (U.S.) ex-vessel and about 1.8 thousand million at the retail level. If as much as 20 per cent of the total were produced in one area, the landed value would be 90 million dollars and the retail value 350 million dollars. Costs of capital are high and may be so high in some countries that the only capital available for fishery development will be from soft loans or in any case from non-private sources. Hypothetical examples, showing money flow,

sources of capital, etc. are given for labour-intensive and capital-intensive fisheries.

In considering regional development proposals and other proposals and considerations, we have considered institutional needs as well as more typical investment and pre-investment proposals. We have recommended a Technical Staff of the Commission, the functions of which would include project identification, coordination of existing projects, investment-opportunity identification, resource management, advisory services, facilitation of communications, review and accountability mechanism, contract supervision and liaison, and support for a Fisheries Joint Venture Advisory Board. We have recommended the establishment of a regional statistical centre to work with the national statistical systems and to improve the availability of information necessary for decision-making. Because we believe joint ventures -- which bring together the resources and low-cost labour of Indian Ocean countries and the capital, technology, and markets of high-income countries outside the region -- will play a big role in Indian Ocean fishery development, we have recommended the formation of a Fisheries Joint Venture Advisory Board in the hopes of eliminating sources of friction and failures. Finally, as a potential mechanism for facilitating development, we have recommended that the possibilities of a Regional Fisheries Development Agency be investigated.

Resource Prospects and Needs

We have also considered resource prospects and needs and have made a number of recommendations relating to sub-regions and have also made recommendations relating to shrimp and tuna. These recommendations may be categorized as: (1) investment projects, such as trawling in the Gulf between Iran and the Arabian peninsular, (2) pre-investment resource-assessment surveys, such as a survey of the pelagic resources of the northwest Arabian Sea or of the demersal resources along the southwest side of Sumatra, (3) feasibility and other studies, such as the desk feasibility study of small (four or five-man) tuna longline

boats or the feasibility study of marketing of Red Sea demersal resources, (4) management and institutional arrangements, such as coordination of survey and development activities in the eastern Arabian Sea or storage and retrieval of fishing-survey information, and (5) proposals for training and conferences, such as a conference on product acceptability and marketing. We have, in addition, made a number of policy-guideline proposals, such as that fishery-development projects should also routinely provide for assessment of harbour requirements, sites, and costs or that the Commission confirm its interest in mariculture as a part of fishery development.

In the discussion of costs, funding, scheduling and priorities, general cost estimates have been supplied for the individual proposals and suggestions made as to the possible sources of support. The duration of each proposal has also been indicated, as well as the commencement year relative to the other proposals. The proposals have been grouped in five categories and some general priorities suggested within each category (but not between categories).

In the time schedule of events relating to the Indian Ocean Programme, particular attention has been called to (1) the meeting of the Commission Executive Committee, 26 - 30 April 1971, (2) the meeting of Programme Consultants from economically developed countries, 8 - 10 September 1971, and (3) the January 1972 deadline for submission of country proposals to the UNDP for consideration at the June 1972 meeting of the Governing Council.

We have concluded the report with acknowledgments and a list of references.

We will conclude this introductory chapter with two comments concerning the frame of reference in which those sections of the report dealing with specific proposals should be viewed. First, we have stated throughout, we hope not too frequently, that the objective of the Programme is to contribute to economic development through fishery development. We trust that

our proposals will be considered in their context. And since they are made in their context, we have not attempted to indicate the steps subsequent to what we have recommended. If we have recommended a resource survey to establish the distribution, abundance, and yield of that resource, it is, we hope, obvious that this is a pre-investment survey. If the results are favourable, investments will follow, with or without additional stimulation. It does not appear necessary to specify this in detail for every proposal. Similarly, it does not appear necessary to specify who might benefit from each resource development. Presumably — and this is the intent of our recommendations — it will be those countries adjacent to the resource plus any others who may be involved with them in some sort of joint-venture arrangement.

Second, it should be obvious that the recommendations we have made are not intended to be detailed proposals. We anticipate that the recommendations relating to single countries will be converted to proposal form by the normal procedures within such countries. The conversion to proposal form of sub-regional or regional proposals can be carried out, on a kind of drafting service basis, by the Programme Leader or otherwise within FAO, if that is the wish of the Commission.

#

CHAPTER III

THE RESOURCES AND THEIR POTENTIAL YIELDS

The Present Fisheries

The yield of Indian Ocean fisheries has risen from 1.5 million metric tons in 1961 to 2.4 million metric tons in 1968. (The figures for 1968 include 10.3 thousand metric tons caught by the USSR as resported to FAO and not the 2.0 million metric tons recently reported in one of the news media.) Of this total, somewhat more than 50 per cent came from the western Indian Ocean. About half the landings in the eastern Indian Ocean are classified as "unsorted miscellaneous fish," whereas in the western Indian Ocean only about one-fifth are so classified. In the eastern Indian Ocean these unsorted landings are primarily in Burma, Indonesia, and Thailand. In the western Indian Ocean such landings are distributed among many countries, with only Muscat and Oman and Tanzania accounting for substantial amounts. In the eastern half the catches of small schooling pelagic fishes and of demersal fishes are about equal, whereas in the western half the catch of small schooling pelagic fishes is about half again as large as the catch of demersal fishes. For the Indian Ocean as a whole the catch of small schooling pelagic fishes is high in relation to the catch of demersal fishes. A substantial percentage of the landings are not identified or reported by species or groups. If the unidentified landings are prorated between demersal and schooling pelagic on the basis of the abundance of these groups in the reported catch, then the percentages of demersal and schooling pelagic fishes in the Indian Ocean catch are almost identical with their percentages in the catch of the rest of the world.

Potential Yields

Just as the development of fisheries has started somewhat later in the Indian Ocean than it has in the Atlantic and Pacific Oceans, so knowledge of the

fishery resources of the Indian Ocean is less extensive than is the knowledge of fishery resources of the other oceans. For these reasons, among others, it is difficult to arrive at precise estimates of potential yields; nevertheless, it is possible to make estimates which are perfectly satisfactory for present purposes.

Projections of potential catch in the Indian Ocean can be made by extrapolating the catch per area in the Atlantic and Pacific Oceans, based on the not unreasonable assumption that these catch rates should be roughly comparable. If this is done on the basis of total surface area (Table 1), then the potential yield of the Indian Ocean is 5.44 to 6.78 times, say 6.00 times the present yield. If the extrapolation is made on the basis of shelf area, then the potential yield is 3.12 to 4.34, say 4.00 times the present yield. These extrapolations relate, of course, to the present yields of the Atlantic and Pacific Oceans. These oceans are not yet producing their maximum potential yield, but rather perhaps only about half or slightly more. Thus, to relate to maximum potential yield, the present Indian Ocean yields would have to be increased by a factor of 12 (total surface area) or 8 (total shelf area).

Shomura (in Gulland, 1970) estimated the potential yield of the Indian Ocean to be about 14.0 million metric tons distributed as follows:

| | |
|------------------------|------|
| demersal fish | 7.5 |
| schooling pelagic fish | 6.0 |
| tunas and skipjacks | 0.3 |
| crustaceans | 0.25 |

There were also "several hundreds of thousands of tons" of squids thought to be produced in the area which are not yet the object of a fishery.

Table 1. Information on total surface area, shelf area, and fish catch for the Indian, Atlantic and Pacific Oceans.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|----------|--|--|---------------------------------|---|----------------|---|----------------|
| Ocean | Total surface area, millions km ² | shelf area within 200M ² millions km ² | 1968 catch millions metric tons | catch per km ² of surface area | raising factor | catch per km ² of shelf area | raising factor |
| Indian | 74.917 | 2.80 | 2.4 | 0.032 | - | 0.857 | - |
| Atlantic | 106.463 | 8.65 | 23.1 | 0.217 | 6.78 | 2.671 | 3.12 |
| Pacific | 179.697 | 8.41 | 31.3 | 0.174 | 5.44 | 3.722 | 4.34 |

Sources: (1) Sverdrup et al. (1946)

(2) Moiseev (1969)

(3) FAO (1970)

(5) Column (4) Atlantic and Pacific values divided by Indian

(7) Column (6) Atlantic and Pacific values divided by Indian

Mention should also be made of information arising from collections of fish eggs and larvae. The atlas by Peter (1970) shows major concentrations: (1) along the eastern and southern coasts of India, (2) off the coast of Somalia, and (3) in the Gulf of Aden. The collection from off India should be examined to determine if in fact these concentrations represent a resource not presently being utilized. Information on the identity of larvae from the north-west Indian Ocean has been furnished by Ahlstrom, Ali Khan, Moser, and Nelling (personal communications). Clupeidae were most frequently collected in the Red Sea - Gulf of Aden area and in the Gulf between Iran and the Arabian Peninsula. Engraulidae were most frequently collected in the Red Sea - Gulf of Aden area and in the southern part of the Gulf. Rastrelliger were taken in the Gulf of Oman. Especially noteworthy were high densities of clupeid larvae encountered off West Pakistan and Somalia.

Comparisons of estimates of the density of demersal fishes in selected Indian Ocean areas with similar estimates from other areas are instructive. The highest density areas, of 50 kg/ha, are Somalia (north of 5°N), Arabia and Gulf of Aden, western India-Pakistan (north of 15°N), and Indonesia. Densities in various areas in the northeast Atlantic include Iceland 80, Faeroes 60, North Sea 17, Biscay 50, and Baltic 6, (Table B3, Gulland, 1970). Thus, these generalized densities (which, of course, are exceeded in specific areas) of demersal fish in the Indian Ocean compare favourably with those of other areas.

For more detail on Indian Ocean fishery resources and their potential, the works of Cushing (1971), Hayasi (1971), Prasad et al. (1970), Prasad and Nair (In Press), Shomura (in Gulland, 1970) and Shomura et al. (1967) should be consulted. Although the specific estimates of the potential of Indian Ocean fisheries varies somewhat from author to author, there is general agreement that the present yield may be increased several-fold with the use of existing technology. There is, of course, some uncertainty as to whether the present yield may be increased by a factor

of 5, 7, 10, or even more. The estimates for demersal fishes are probably more reliable than those for pelagic fishes. Because of their greater mobility and because of their distribution in three dimensions rather than two, so to speak, it has been much more difficult to assess pelagic resources than demersal resources (a difficulty that may be obviated by the use of modern acoustical detection gear). We point out, however, that forecasts of yield potentials have historically tended to err on the conservative side and some forecasts of the potential world yield made 15 to 20 years ago—or in some cases even less than 10 years ago—have already been exceeded.

There is, in the Indian Ocean region, special interest in the tuna and shrimp resources (presumably because of their dollar-earning ability in still expanding world markets), and we therefore comment specifically on these resources. The tuna resource may be thought of in terms of three fisheries or potential fisheries: (1) the longline fishery for yellowfin, bigeye, bluefin, and albacore, (2) a surface fishery (carried out by purse seine, live-bait, or trolling) for these same species, and (3) a surface fishery (carried out by the same three alternative methods) for skipjack. The longline fishery catches the older, larger, non-schooling, subsurface-swimming members of the four species mentioned. The longline fishery for these species is either approaching, at, or beyond (depending upon the species) the level of maximum sustained yields and, in some cases at least, the fishery is already over capitalized (in terms of numbers of boats). (These fish occur in international waters and there is presently no limitation on entry or other form of management.) Thus, the marginal yield in this fishery is very low, except at the expense of countries already in the fishery, a subject which will be touched upon elsewhere in this report. There are no major surface fisheries for these species. Were substantial fisheries of this nature to develop, they would have a substantial effect on the longline fishery by reducing the average age of the stocks and hence the abundance of the fish

Table 2. Potential growth rates of Indian Ocean fisheries, thousands of metric tons

| | (1) | (2) | (3) | (4) | (5) | (6) |
|-------------------|------------|--------------------|-----------------------|--------------------------------------|-------------------------------------|---------------------|
| Category | 1968 catch | pro rate additions | estimated total catch | 5% p.a. increase, 20-year projection | 8% p.a. increase 20-year projection | estimated potential |
| demersal | 440 | 308 | 748 | 1,985 | 3,487 | 7,500 |
| schooling pelagic | 673 | 472 | 1,145 | 3,038 | 5,336 | 6,000 |
| tunas | 276 | -- | 276 | 732 | 1,285 | 300 |
| crustacea | 176 | -- | 176 | 467 | 820 | 250 |
| miscellaneous | 780 | -- | -- | -- | -- | -- |

Sources:

(1) From FAO (1970), Table A2-1: demersal includes species groups 24, 31, 32, 33, and 38; schooling pelagic includes 34, 35, and 37; tunas group 36; miscellaneous group 39.

(2) The miscellaneous (unidentified) catch was prorated between demersal and schooling pelagic on the basis of their ratio in the identified catch. None was prorated to tunas because there is generally not a large incidental catch of tunas, and none to crustacea, which are likely to be sorted out because of their value.

(3) The sum of (1) and (2).

(6) From Shomura (in Gulland, 1970), Table H5.

available to the longline gear. Whether there would be a net gain or loss in the total yield if the harvest were all by surface gear or all by longline gear would depend upon the relationship, for each species, among age (size) at first capture, growth rate, rate of natural mortality, and rate of fishing mortality. The skipjack resource, on the other hand, is virtually unexploited aside from some small local fisheries, a fishery in the Maldives Islands, which produces about 25,000 metric tons annually, and a fishery of similar magnitude in Ceylon. It has been estimated (Hayasi, 1971) that the skipjack resource is capable of an annual yield of 200,000 to 400,000 metric tons. [This estimate is somewhat in excess of that given by Shomura (in Gulland, 1970) and in part is based on the higher density of skipjack juveniles in the Indian Ocean compared with the other oceans.] Bringing this potential yield into production will involve one or both of two technological problems: the provision of an adequate supply of live-bait, and the development or adaptation of effective purse-seining techniques.

Some localized shrimp fisheries are already beyond the point of maximum sustained yield; i.e., they are over capitalized in terms of number of boats. Some are over capitalized at the secondary level; one port has a freezing capacity of 200 metric tons per day whereas the average amount frozen daily is 12.5 metric tons. In general, however, the total yield of shrimp and other crustaceans is capable of increasing by 40 per cent - 70 per cent 50 250,000 - 300,000 metric tons annually.

Given, then, this general picture of

the potential of the Indian Ocean fishery resources, what are the implications for development over some reasonable time scale? In Table 2 the present (1968) catches are projected over a 20-year period at five per cent and eight per cent rates of increase and the projections are compared with the estimated potentials given by Shomura (in Gulland, 1970).

(The effects of shortening or lengthening the projection period and of increasing or decreasing the rate of increase can readily be seen.) Obviously, the five per cent and eight per cent rates are feasible for both the demersal and pelagic groups. The rate could even be substantially higher for the demersal group, but not for the pelagic group (unless its potential has been seriously underestimated). The limits for tuna and shrimp will clearly be reached at both rates well before the end of the projection period. Even if the potential yield of tuna (including skipjack) is taken as 500, this would be reached in about 12 years at five per cent and eight years at eight per cent. Similarly, if the potential yield of shrimp is taken as 300, this would be reached in 11 years five per cent and seven years at eight per cent.

In summary, we may say that the potential for increase in total fishery yield in the Indian Ocean is substantial and that growth rates of five per cent and eight per cent over a 20-year period are feasible for the demersal group and the pelagic group. For tunas and shrimp, for which there are already well-developed fisheries and for which there is strong international demand, it appears that the potential yield will be attained in about a 10-year period.

CHAPTER IV

POPULATION AND NATIONAL ECONOMIES

Diversity is a striking feature of the Indian Ocean countries, especially in regard to area, population size and density, and natural-resource endowment. There are also wide disparities among them in respect to the structure of their economies, the degree of industrialization achieved, and the development of infrastructure facilities, such as transport and communications, power generation, domestic markets, and monetary and financial institutions. Yet, despite these differences, the countries of this region, with very few exceptions, are characterized by low incomes, low levels of education and health, low consumption and levels of living in general, and low rates of saving and capital formation. These latter characteristics stamp these countries as "underdeveloped" and/or "developing," as distinguished from the high-income "developed" countries like Japan and the countries of North America and Western Europe.

In evolving viable fishery-development programmes for these countries, it is not sufficient to locate and assess, in the biological sense, the fishery resources in various areas of the Indian Ocean. It is necessary also to consider the capacity of the individual countries or groups of countries to take advantage, and make effective use, of the fishing resources lying off their shores and beyond in the light of the general characteristics of their national economies, particularly in respect of labour supplies, infrastructure development, and degree of industrialization. For the extent to which countries can undertake and pursue programmes of fishery development will determine the nature and quantum of outside assistance they may need in building up viable fishery activities. At one extreme, there are countries with such rudimentary or even non-existent infrastructure facilities that fishery development can be undertaken only on a basis in which almost all of the inputs would have to come from outside sources. At the other extreme are countries with reasonably well-

developed infrastructures and in which there needs only be identified and eliminated some perhaps relatively minor obstacle to more rapid fishery development.

In what follows, an attempt is made, therefore, to analyze the characteristics of the Indian Ocean countries under various rubrics, such as (1) area and population, (2) economic structure, (3) total and per capita national income and economic growth rates, (4) consumption and levels of living, and (5) infrastructure and other facilities.

A basic difficulty in making a comprehensive study of this kind is the paucity of the relevant statistical and other information for a number of countries. [Clement (1971) has found only 13 countries in the Indian Ocean region for which sufficient statistical and other information is available to enable a proper analysis of their economies and their development problems and prospects. These countries are Ethiopia, Kenya, Madagascar, and Tanzania, in East Africa; Ceylon, India, Iran, and Pakistan, in South Central Asia; Indonesia, (West) Malaysia, Singapore, and Thailand, in Southeast Asia; and Mauritius in the Indian Ocean proper.] Data for the "continental" countries are in general more satisfactory for purposes of economic analysis than those for "insular" countries, barring a few exceptions. Nevertheless, even among continental countries relevant information levels vary widely, and it is not, therefore, possible to cover all of them comprehensively.

Area and Population

Table 3 shows the area, population, and population density of a number of Indian Ocean countries. There is great disparity in both geographical area and population. Leaving on one side the large land-mass of Australia (7,688,810 km²), they range from India's 3,268,090 km² to Bahrain's and Seychelles' 598 and 376 km². Besides India,

TABLE 3 Area, population size, and density

| | Area | Population | Population density |
|---------------------|-----------------|--|----------------------------|
| | Km ² | (mid-year estimate, 1968) thousands | (1968) /km ² |
| <u>Asia</u> | | | |
| Iran | 1,648,000 | 27,345 | 16 |
| Pakistan | 946,716 | 109,520 | 125 |
| India | 3,268,090 | 523,893 | 160 |
| Ceylon | 65,610 | 11,964 | 182 |
| Burma | 678,033 | 26,389 | 39 |
| Thailand | 514,000 | 33,693 | 66 |
| Malaysia | | | |
| East | 201,320 | 1,535 | 8 |
| West | 131,313 | 8,770 | 67 |
| Singapore | 581 | 1,988 | 3,422 |
| Indonesia | 1,491,564 | 112,825 | 76 |
| <u>Australia</u> | 7,686,810 | 12,031 | 2 |
| <u>Middle East</u> | | | |
| Bahrain | 598 | 200 | 334 |
| Iraq | 434,924 | 8,634 | 20 |
| Kuwait | 16,000 | 540 | 34 |
| Muscat & Oman | 212,457 | 565 | 3 |
| Qatar | 22,014 | 80 | 4 |
| Saudi Arabia | 2,149,690 | 7,100 | 3 |
| Southern Yemen | 287,683 | 1,195 | 4 |
| Trucial Oman | 83,600 | 133 | 2 |
| Yemen | 195,000 | 5,000 | 26 |
| <u>Africa</u> | | | |
| South Africa | 1,221,037 | 19,167 | 16 |
| Mozambique | 783,030 | 7,274 | 9 |
| Tanzania | 939,703 | 12,590 | 13 |
| Kenya | 582,644 | 10,209 | 18 |
| Somalia | 637,657 | 2,745 | 4 |
| Ethiopia | 1,221,900 | 24,212 | 20 |
| Sudan | 2,505,813 | 14,770 | 6 |
| UAR | 1,001,449 | 31,693 | 32 |
| <u>Indian Ocean</u> | | | |
| Madagascar | 587,041 | 6,500 | 11 |
| Mauritius | 2,045 | 810 | 396 |
| Réunion | 2,510 | 426 | 170 |
| Seychelles | 376 | 49 | 133 |

(Source: UN Statistical Yearbook, 1969)

eight countries (Sudan, Saudi Arabia, Indonesia, Ethiopia, South Africa, UAR, Pakistan, and Tanzania) have an area of 900,000 km² and more. In terms of population, there are three giants: India with 523.89 million people and Indonesia and Pakistan with 112.83 million and 109.52 million people, respectively. Five countries (Thailand, UAR, Iran, Burma, and Ethiopia) have population sizes of between 24 and 34 million, and seven others (South Africa, Sudan, Tanzania, Australia, Ceylon, Malaysia, and Kenya) between 10 and 20 million. In addition to the disparities in geographical area and population size, there is a wide range of population densities. Among the continental countries, the highest population densities are found in Ceylon (182 people/km²), India (160/km²), Pakistan (125/km²). Singapore, which is an island city and country, stands in a class of its own with a population density of 3,422/km². Among the insular countries, Mauritius, Réunion, and Seychelles have high population densities, with 396, 170, and 133 people/km², respectively. The population densities of these countries are very much higher than those of Western Europe and North America, with the exception of the United Kingdom, Italy, Belgium, and Holland. Most countries in the Arabian peninsula have very low population densities (2-4/km²); Sudan, Somalia, Malaysia (East), Mozambique, and Madagascar have also low densities, ranging between 4 and 11/km². Countries like Indonesia, Malaysia (West) and Thailand have apparently moderate population densities comparable with those of many Western European countries, but two-thirds of the population of Indonesia is on seven per cent of the total land area, so that the de facto density is 477/km².

Figures of population density, arrived at by dividing population by area, are only broadly indicative of the relative scarcity or abundance of land resources. This is so because the "true" scarcity or abundance of land resources in relation to population size depends on a variety of factors. There may be differences between countries in the proportion of total area that is cultivated or can be cultivated. The quality of land, both cultivated and cultivable, may also vary. Moreover, there may be differences

in crop patterns and agricultural techniques employed. Finally, countries may be at different stages of industrialization, with disparities in the proportion of the population engaged in agricultural activities (Myrdal, 1965). Nevertheless, it is quite clear that several countries of the Indian Ocean region, notably India, Pakistan, and Ceylon, suffer from a heavy "pressure" of population on land resources, and this has a depressive effect on labour productivity in agriculture. In contrast, however, to some of the Asian countries, none of the East African countries seem handicapped by an over-all lack of land resources. Again, among Asian countries, Thailand, Malaysia, and Indonesia, with moderate population densities at present, have potentially fertile land capable of being brought under cultivation.

The rates of population increase in the Indian Ocean countries are much higher than those in North America and Western Europe, but are not, in general, higher than the rates in South America. Table 4 shows the rates of population increase between 1963-69 for a number of Indian Ocean countries. Comparable figures are also shown for selected countries in North America, Western Europe, and South America. Aside from Qatar and Kuwait which, primarily because of immigration, recorded abnormally high population increase rates (of 10.5 and 6.6 per cent, respectively) during the period concerned, the highest rates of population increase among Indian Ocean countries occurred in Bahrain and East Malaysia (3.3 per cent), Thailand (3.1 per cent), and Iran (3.0 per cent). Twelve countries in the region registered population increase rates of between 2.4 and 2.9 per cent; of the rest, all except three had rates of more than 2 per cent.

Population increases of 2.5 per cent and over or even two per cent per year have serious economic consequences for countries with already high population densities. They tend to drag heavily on the growth of average per capita incomes and also to aggravate the problem of unemployment and underemployment in countries where job opportunities are not created in pace with additions to the

TABLE 4. Rates of population increase (1963-69)

| <u>ASIA</u> | <u>PER CENT PER YEAR</u> | <u>AFRICA</u> | <u>PER CENT PER YEAR</u> |
|-----------------------|--------------------------|----------------------|--------------------------|
| Bahrain | 3.3 | Ethiopia | 2.1 |
| Burma | 2.2 | Kenya | 2.9 |
| Ceylon | 2.4 | Madagascar | ... |
| India | 2.5 | Mauritius | 2.2 |
| Indonesia | 2.5 | Mozambique | 1.4 |
| West Irian | 2.5 | Portuguese Guinea | 0.2 |
| Iran | 3.0 | Réunion | 2.3 |
| Iraq | 2.4 | Seychelles | 2.2 |
| Kuwait | 6.6 | Somalia | 2.7 |
| Malaysia | | South Africa | 2.4 |
| East | 3.3 | Sudan | 2.8 |
| West | 2.8 | UAR | 2.5 |
| Maldives | 2.2 | Tanzania | 2.5 |
| Pakistan | 2.1 | | |
| Qatar | 10.5 | <u>NORTH AMERICA</u> | |
| Saudi Arabia | 1.6 | Canada | 1.8 |
| Singapore | 2.1 | Mexico | 3.5 |
| Southern Yemen | 2.2 | U.S. | 1.2 |
| Thailand | 3.1 | <u>SOUTH AMERICA</u> | |
| <u>WESTERN EUROPE</u> | | Argentina | 1.5 |
| France | 0.9 | Bolivia | 2.6 |
| Fed. Rep. of Germany | 1.0 | Brazil | 3.0 |
| Italy | 0.8 | Chile | 2.4 |
| Netherlands | 1.2 | Colombia | 3.2 |
| U.K. | 0.6 | Paraguay | 3.2 |
| | | Peru | 3.1 |

(Source: UN Demographic Yearbook, 1969)

TABLE 5 Structure of the economically active population:
distribution by industry as percentage of total.

| | Year | Agriculture Forestry Hunting Fishing | Mining and Quarrying | Manufactur- ing | Construction | Other |
|------------------|------|---|-------------------------|--------------------|--------------|-------|
| <u>AUSTRALIA</u> | 1966 | 56.9 | 1.7 | 11.9 | 3.8 | 25.7 |
| <u>ASIA</u> | | | | | | |
| Ceylon | 1963 | 48.6 | 0.3 | 9.1 | 2.5 | 39.5 |
| India | 1961 | 72.9 (1) | 0.5 | 9.5 | 1.1 | 16.0 |
| Indonesia | 1965 | 67.2 | 0.2 | 5.6 | 1.3 | 25.7 |
| Iran | 1966 | 41.8 | 0.3 | 16.7 | 6.7 | 34.5 |
| Iraq | 1957 | 47.9 | 0.2 | 9.5 | 4.5 | 37.9 |
| Kuwait | 1965 | 1.1 | 3.8 | 9.7 | 15.6 | 69.8 |
| Malaysia, West | 1962 | 51.4 | 1.9 | 6.4 | 1.9 | 38.4 |
| Pakistan | 1965 | 67.6 | 0.1 | 9.6 | 2.1 | 20.6 |
| Singapore | 1957 | 8.4 | 0.3 | 13.9 | 5.1 | 72.3 |
| Southern Yemen | 1958 | - | 1.1 | 25.3 | 13.8 | 59.8 |
| Thailand | 1960 | 82.0 | 0.2 | 3.4 | 0.5 | 13.9 |
| <u>AFRICA</u> | | | | | | |
| Mauritius | 1962 | 37.9 | 0.1 | 14.6 | 10.6 | 36.8 |
| Mozambique | 1950 | 75.3 | 0.1 | 4.7 | 1.2 | 18.7 |
| South Africa | 1960 | 29.5 | 10.8 | 11.3 | 4.8 | 43.6 |
| Sudan | 1956 | 85.8 | - | 5.0 | 0.6 | 8.6 |
| UAR | 1960 | 56.6 | 0.3 | 9.0 | 2.0 | 32.1 |

(1) Agriculture, livestock, forestry, fishing and hunting

Source: International Labour Office, Yearbook of Labour Statistics, 1969

TABLE 6 Industrial origin of gross domestic product at factor cost

| Region and Country | YEAR | Percentage Distribution | | | | | |
|--------------------|----------|-------------------------|---------------------------|--------------|-----------------------------|----------------------------|-------|
| | | Agriculture | Total Industrial Activity | Construction | Transport and Communication | Wholesale and Retail Trade | Other |
| <u>AUSTRALIA</u> | 1967 (6) | 9 | 34 | 8 | 8 | 15 | 26 |
| <u>ASIA</u> | | | | | | | |
| Burma (1) | 1967 (2) | 34 | 10 | 2 | 7 | 29 | 17 |
| Ceylon | 1968 | 39 | 11 | 6 | 9 | 12 | 21 |
| India | 1967 (3) | 52 | 13 | 4 | 4 | 10 | 15 |
| Indonesia (1) | 1968 | 52 | 13 | 2 | 2 | 18 | 13 |
| Iran | 1967 (4) | 22 | 33 | 5 | 6 | 10 | 24 |
| Iraq | 1968 | 19 | 44 | 3 | 7 | 6 | 21 |
| Malaysia (West) | 1966 | 28 | 21 | 4 | 3 | 16 | 27 |
| Pakistan | 1968 | 46 | 12 | 5 | 7 | 12 | 18 |
| Singapore | 1968 | 4 | 15 | 4 | .. (5) | 33 | 44 |
| Saudi Arabia | 1966 | 8 | 57 | 4 | 7 | 7 | 18 |
| Thailand | 1968 | 30 | 16 | 6 | 7 | 20 | 21 |
| <u>AFRICA</u> | | | | | | | |
| Ethiopia | 1967 | 58 | 9 | 6 | 4 | 7 | 16 |
| Kenya | 1968 | 35 | 14 | 5 | 8 | 10 | 27 |
| Madagascar | 1955 | 53 | 13 | .. | 6 | 18 | 9 |
| Mauritius | 1968 | 23 | 19 | 6 | 12 | 11 | 29 |
| South Africa | 1968 | 10 | 36 | 4 | 9 | 14 | 27 |
| Sudan | 1964 (6) | 54 | 6 | 6 | --- | 14 | 19 |
| Tanzania | 1968 | 50 | 9 | 4 | 5 | 15 | 17 |
| UAR | 1967 (6) | 30 | 24 | 4 | 5 | 9 (7) | 28(7) |

(1) Gross domestic product at market prices, (2) Year ending 30 Sept., (3) Year beginning 1 April, (4) Year beginning 21 March, (5) Transport and Communication are included in "Other," (6) Year beginning 1 July, (7) Banking, insurance, and real estate are included in "Wholesale and Retail Trade."

(Source: UN Yearbook of National Accounts Statistics, 1969, Vol. I)

TABLE 7 Estimates of total and per capita national income expressed in U.S. dollars (1966, 1967, 1968)

| Region and Country | National Income | | | Per Capita National Income | | |
|--------------------|-----------------------|-----------|-------|----------------------------|---------|-------|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| | (millions of dollars) | | | (dollars) | | |
| <u>ASIA</u> | | | | | | |
| Burma | 1482 | 1529 | 1763 | 59 | 59 | 67 |
| Ceylon | 1537 | 1602 | 1573 | 134 | 137 | 131 |
| India | 37357 (4) | 37229 (4) | 37407 | 74 (4) | 73 (4) | 71(4) |
| Indonesia | 8542 | 8790 | 9659 | 80 | 80 | 86 |
| Iran | 5709 | 6394 | 6812 | 226 | 243 | 252 |
| Malaysia | 2475 | .. | .. | 254 | .. | .. |
| Pakistan | 11371 | 12055 | 13241 | 108 | 112 | 121 |
| Singapore | 1054 | 1136 | 1288 | 551 | 581 | 648 |
| Thailand | 3884 | 4155 | 4617 | 123 | 127 | 137 |
| <u>AUSTRALIA</u> | 20218 | 21256 | 23954 | 1743 | 1800 | 1991 |
| <u>MIDDLE EAST</u> | | | | | | |
| Iraq | 1901 | 1922 | .. | 227 | 228 | .. |
| Kuwait | 1647 | 1807 | .. | 3354 | 3474 | .. |
| Saudi Arabia | 1978 | 2176 | .. | 288 | 311 | .. |
| <u>AFRICA</u> | | | | | | |
| Ethiopia | 1307 | 1344 | .. | 56 | 57 | .. |
| Kenya | 978 | 1030 | 1097 | 101 | 104 | 107 |
| Madagascar | 588 | 614 | .. | 95 | 97 | .. |
| Mauritius | 156 | 163 | .. | 206 | 211 | .. |
| Mozambique | 434 (1) | .. | .. | 64 (1) | .. | .. |
| Réunion | 193 (2) | .. | .. | 489 (2) | .. | .. |
| Somalia | 144 (1) | .. | .. | 62 (1) | .. | .. |
| South Africa | 10102 | 11189 | 11919 | 488 | 528 | 550 |
| Tanganyika | 700 | 728 | 761 | 61 | 62 | 62 |
| UAR | 4849 (3) | 4828 (3) | .. | 161 (3) | 156 (3) | .. |

(1) For 1963

(2) For 1965

(3) Twelve months beginning 1 July of year stated

(4) Twelve months beginning 1 April of year stated

(Source: UN Yearbook of National Accounts Statistics, 1969, Vol. II.)

active labour force. Some Indian Ocean countries are at present undergoing a population explosion, with high birth rates and low and falling death rates. While several countries, notably India, are pursuing an active population-control policy, it will be several years before concrete results in the shape of an appreciable fall in the birth rate manifest themselves. Moreover, additions to the active labour force in the next 10-15 years will be persons already born, so that, in the meantime, aggravation of the unemployment problem is likely to continue.

Economic Structure

A basic characteristic of the Indian Ocean countries is that most of the economically active population gains its livelihood from agriculture and allied activities, such as animal husbandry, forestry, fishing, and hunting. The ratio of the economically active population to the total population has a fairly wide amplitude among these countries, ranging from slightly over 50 per cent in the case of Thailand and Madagascar to 25-29 per cent for Mozambique, Mauritius, and Réunion. For the bigger countries this ratio is typically between 30 and 40 per cent.

Table 5 shows the distribution of the active population by four major "industry" groups for the latest available year. Among Asian countries the dependence of the active population on agriculture and allied pursuits appears to be the highest in Thailand, with a ratio of 82 per cent in 1960. India's ratio for 1961 was also very high at 72.9 per cent. Pakistan and Indonesia come next with ratios of above 67 per cent. Among African countries for which data are available, this ratio is very high for Sudan (85.8 per cent) and Mozambique (75.3 per cent).

Another significant feature of the structure of a national economy is the percentage contribution of various sectors ("industry groups") to the Gross Domestic Product. The relevant data are given for a number of Indian Ocean countries in

Table 6. The occupational pattern of the economically active population discussed earlier naturally finds its reflection in the distribution of the gross national product by "industrial origin" as shown in Table 6. Thus, in countries like India, Pakistan, Indonesia, Thailand, and Sudan, where the great bulk of the active population is engaged in agriculture and allied activities, the contribution of these activities to the gross domestic product is also higher than that of other activities or sectors. In the countries just mentioned, the percentage share of "agriculture" in GDP is 46 per cent for Pakistan and over 50 per cent for Sudan, India, and Indonesia, and is 50 per cent or more also in the case of Ethiopia, Madagascar, and Tanzania. The weight of agriculture in GDP is 39 per cent for Ceylon and 34 per cent for Burma. For most of the other countries shown in Table 6 the share of agriculture is between 20 and 30 per cent. South Africa, Australia, and Singapore are the exceptions that prove the rule about the Indian Ocean countries, with the contribution of agriculture to GDP being 10, nine, and four per cent, respectively.

Total and Per Capita National Income

Low per capita national income is a general characteristic of the Indian Ocean countries, barring very few exceptions, such as Australia, Kuwait, Singapore, and South Africa. The concept of a "low per capita income" is a somewhat arbitrary matter of definition. Nevertheless, by common usage, countries with per capita national income or gross national product below \$500-600 (U.S.) are reckoned as "low-income," "underdeveloped," or "developing" countries. Australia, with a per capita income of nearly \$2000 in 1968, stands in a category of its own among the Indian Ocean countries (see Table 7). Singapore, whose economic structure is significantly different from the general pattern of the region, also falls outside the group of "low-income" countries, its per capita income being nearly \$650 in 1968. South Africa falls on the border between low-income and high-income countries. Kuwait, because of its oil, had a per capita income of nearly

\$3500 in 1967, however, and represents the most striking deviation from the general level of per capit incomes in the region.

Of the countries shown in Table 7, as many as 14 have per capita national incomes (for the latest year for which such data are available) of less than \$200. Again, this group contains a subset of eight countries (Ethiopia, Tanzania, Somalia, Mozambique, Burma, India, Indonesia, and Madagascar) with per capita incomes falling below \$100. Another set of six countries has per capita incomes of between \$100 and \$200; and six more countries between \$200 and \$500. There are well-known conceptual and statistical difficulties in international comparison of total and per capita national incomes, where the relevant magnitudes in the different national currencies are expressed in terms of one particular national currency, usually the U.S. dollar, by making use of the prevailing rates of exchange. This procedure naturally fails to make allowances for over- and under-valuation of national currencies. It is the view of some observers that Pakistan's and Ceylon's national currencies - to take but two examples - are at present over-valued. If appropriate adjustments are made for this, Ceylon and Pakistan may have to be moved from the category of countries having per capita national incomes of between \$100 and \$200 to the category of those with per capita incomes below \$100. Furthermore, the limitations of per capita statistics must be kept in mind in situations in which the distribution of personal means is highly skewed and where the gap between the mean (per capita) and the modal values tends to be large.

While per capita national income is a rough indicator of the stage of economic development, total national income or GDP, like total population and geographical area, is an index of the "size" of a national economy. From the economic point of view, total national income or GDP is the most significant of these three indices, since it provides a broad measure of the "size of the market." Thus, although countries like India, Pakistan, and Indonesia have low per capita incomes, their total national

incomes are sufficiently large to enable a whole range of commodities to be produced economically and with modern technological methods for the domestic market. Countries with small domestic markets as measured by aggregate national income can no doubt produce also for export markets, but export sales of, say, consumer goods encounter greater difficulties, notably in the shape of competition from sellers from other countries, than domestic sales.

Countries with the largest aggregate national incomes in the Indian Ocean region are India, Australia, Pakistan, and South Africa, in that order. They may be called the "giant economies" of the region (Table 7). Indonesia, Iran, and Thailand fall in the next category with total national incomes ranging from \$4,600 million to \$9,700 million. Four countries, viz., Burma, Ceylon, Singapore, and Kenya, have aggregate national incomes of between \$1,000 million and \$1,800 million.

The growth rates of total and per capita national income/gross domestic product are useful over-all indicators of the economic performance of an economy. Annual average rates of growth of real GDP at factor cost are shown for a number of the Indian Ocean countries in Table 8. Also shown in the table are comparative growth rates of centrally planned economies, developed market economies, and developing market economies. Most of the Indian Ocean countries, with the exception of those with relatively high per capita incomes, fall in the third category.

The growth rates of real GDP in recent years in several Indian Ocean countries have been as high or even higher than those in Western Europe and North America. The UAR, Thailand, Iran, Iraq, West Malaysia, Burma, and Ethiopia have recorded growth rates of 4.4 per cent per annum and more. The corresponding rates of Ceylon, India, and Tanzania have been lower, ranging between 3.5 and four per cent.

However, the performance of the Indian Ocean countries with respect to

TABLE 8 Average annual percentage rates of growth of real gross domestic product at factor cost

| <u>Indian Ocean countries</u> | <u>Period</u> | <u>Gross domestic product</u> | |
|-------------------------------|---------------|-------------------------------|-------------------|
| | | <u>Total</u> | <u>Per capita</u> |
| <u>ASIA</u> | | | |
| Burma (1) | 1950-57 | 5.4 | 3.5 |
| | 1950-67 | 5.0 | 3.0 |
| Ceylon | 1956-65 | 3.7 | 1.2 |
| | 1956-68 | 3.9 | 1.4 |
| India (2) | 1950-65 | 3.7 | 1.6 |
| | 1950-67 | 3.6 | 1.4 |
| Indonesia (1) | 1958-65 | 1.9 | -0.4 |
| | 1958-68 | 2.1 | -0.3 |
| Iran | 1959-65 | 6.5 | 3.8 |
| | 1959-67 | 7.4 | 4.5 |
| Iraq | 1953-65 | 6.2 | 2.9 |
| | 1953-68 | 6.3 | 3.2 |
| Malaysia, West | 1955-65 | 5.3 | 2.1 |
| | 1955-66 | 5.4 | -2.2 |
| Pakistan | 1950-65 | 3.5 | 1.4 |
| | 1950-68 | 4.0 | 1.8 |
| Thailand (1) | 1957-65 | 7.2 | 4.0 |
| | 1957-68 | 7.5 | 4.3 |
| <u>AFRICA</u> | | | |
| Ethiopia | 1961-65 | 4.4 | 2.6 |
| | 1961-67 | 4.8 | 2.9 |
| Kenya | 1964-65 | 0.6 | 2.2 |
| | 1964-68 | 6.9 | 3.8 |
| Tanzania (3) | 1960-65 | 3.7 | 1.2 |
| | 1960-67 | 4.3 | 1.8 |
| United Arab Republic | 1957-65 | 8.1 | 5.4 |
| | 1957-67 | 6.6 | 3.9 |
| <u>World Comparisons</u> | | | |
| Centrally planned economies | 1950-65 | 8.3 | 6.8 |
| | 1950-68 | 8.0 | 6.6 |
| Developed market economies | 1950-65 | 4.2 | 3.0 |
| | 1950-68 | 4.4 | 3.2 |
| Developing market economies | 1950-65 | 4.8 | 2.4 |
| | 1950-68 | 4.8 | 2.4 |

(1) Gross domestic product at constant market prices.

(2) Net domestic product at constant factor cost.

(3) Former Tanganyika only.

(Source: UN Yearbook of National Accounts Statistics, 1969, Vol. II)

TABLE 9 Consumption: Net food supplies per capita

| Region and Country | Year (1) | Calories/day | | Protein/day Grammes |
|-------------------------------|----------|--------------|-----------------|---------------------|
| | | Total | % animal origin | |
| <u>Indian Ocean Countries</u> | | | | |
| Australia | 1966/67 | 3,120 | 41 | 92 |
| Ceylon | 1967 | 2,170 | 4 | 48 |
| Ethiopia | 1961-63 | 2,040 | 13 | 69 |
| India | 1965/66 | 1,810 | 5 | 45 |
| Iran | 1966 | 1,890 | 11 | 50 |
| Iraq | 1960-62 | 2,140 | 14 | 62 |
| Kenya | 1961-63 | 2,120 | 9 | 64 |
| Madagascar | 1961-63 | 2,330 | 6 | 52 |
| Mauritius | 1967 | 2,420 | 7 | 48 |
| Mozambique | 1961-63 | 2,420 | .. | 48 |
| Pakistan | 1966/67 | 2,230 | 11 | 52 |
| Saudi Arabia | 1966 | 1,860 | 10 | 51 |
| Somalia | 1961-63 | 1,780 | 1 | 52 |
| South Africa | 1960/61 | 2,820 | 20 | 80 |
| Sudan | 1966 | 1,940 | 19 | 64 |
| Tanzania | 1961-63 | 2,080 | 6 | 58 |
| Thailand | 1963-65 | 2,140 | 6 | 46 |
| UAR | 1965/66 | 2,810 | 7 | 81 |
| <u>Other countries</u> | | | | |
| U.S. | 1967 | 3,200 | 40 | 96 |
| Canada | 1967 | 3,180 | 45 | 95 |
| U.K. | 1967/68 | 3,160 | 41 | 88 |
| Germany, Fed. Rep. of | 1967/68 | 2,960 | 37 | 81 |
| France | 1966/67 | 3,100 | 38 | 101 |
| Switzerland | 1966/67 | 3,170 | 34 | 88 |
| Japan | 1967 | 2,460 | 13 | 75 |

(1) Latest period for which data are available

(Source: UN Statistical Yearbook, 1969)

per capita GDP growth has, in general, been much less satisfactory. This has been a consequence of the relatively high population increase rates experienced by several of these countries, to which reference has been made earlier. Growth rates of per capita GDP have generally been lower than three per cent per annum -- in some cases much lower -- except in the case of Thailand, UAR, Burma, Iran, and Iraq.

Consumption and Levels of Living

Low consumption standards, low levels of education, health, and housing, and general low levels of living in the Indian Ocean countries are the resultant of low per capita incomes. However, the level of per capita income does not, in many cases, adequately convey the extent of poverty and of the overall depressed levels of living of the broad masses of the people, because of the inequalities in the distribution of income. The question of whether income distribution is more or less unevenly distributed, or skewed, in this region than in the economically advanced countries is of less significance than the fact that the generally low incomes prevailing in the former are associated with and/or are the cause of depressed levels of living.

Adequate and comparable data on the various components of consumption and of living levels are difficult to obtain for all the Indian Ocean countries. However, on one crucial component of consumption, viz. food, which accounts for about two-thirds or more of aggregate private consumption in these countries, comparable data are available for a number of countries (Table 9). The statistics of protein consumption, shown along with those of calorie consumption, are of particular significance in a study devoted to the development of fisheries, since fisheries constitute an important source of protein for human consumption.

As Table 9 shows, per capita calorie consumption per day is fairly high in Australia, South Africa, and the UAR, ranging between 2,800 and 3,100. Of the other Indian Ocean countries, 10 have daily

per capita calorie consumption of between 2,000 and 2,500, and five -- Sudan, Iran, Saudi Arabia, India, and Somalia -- below 2,000. For many of the economically advanced countries of North America and Western Europe, this figure is 3,000 and more. Japan's figure is just about 2,500. The disparity between the economically advanced countries and most Indian Ocean countries in protein consumption is even greater than in the case of calorie consumption. In most of the former group of countries, per capita daily consumption of protein is well over 80 grammes and generally ranges between 88 and 96 grammes. For Japan, the figure is 75. Among the Indian Ocean countries, only Australia, UAR, and South Africa have daily per capita protein consumption of 80 grammes and above. For the other countries of the region, this figure is below 70 and in the majority of cases below 60. Five countries, viz. Ceylon, Mauritius, Mozambique, Thailand, and India, have per capita protein consumption of less than 50 grammes per day. As various nutrition experts have pointed out, a protein deficiency in the diet is likely to have deleterious effects on the brain development of children.

Levels of literacy and educational standards vary widely in the Indian Ocean region. Table 10 shows the percentage of illiteracy for selected countries. Literacy rates are fairly high in Ceylon, Singapore, and Thailand. On the other hand, several countries, such as Ethiopia, Iran, Tanzania, Pakistan, Kenya, and India have high illiteracy rates. Despite high levels of illiteracy, some countries, such as India and Pakistan, have a sizable educated élite as well as skilled workers in a variety of activities. Ceylon has both a high level of literacy and a sizable educated cadre. The existence of an educated cadre combined with pools of skilled workers in an extended range of activities renders easier the prosecution of development programmes, including, say, fishery development. In some cases, such as, again, India, Pakistan, and Ceylon, the existence of a pool of unemployed engineers, scientists, and graduates provides a ready source of skilled people

TABLE 10 Levels of illiteracy

| Country | Per cent illiterate |
|------------|---------------------|
| Ceylon | 19 |
| Ethiopia | 95 |
| India | 72 |
| Indonesia | 54 |
| Iran | 80-85 |
| Kenya | 75-80 |
| Madagascar | 61 |
| Malaysia | 57 |
| Mauritius | 39 |
| Pakistan | 80 |
| Singapore | 25 |
| Tanzania | 80-85 |
| Thailand | 32 |

(Source: Clement, 1971)

from which the necessary personnel can be drawn for fishing and fishery activities - without pushing up prevailing rates of remuneration - although varying degrees of retraining may be needed for the different categories.

Infrastructure and Other Facilities

As seen above, Indian Ocean countries are generally characterized by low per capita national income, heavy dependence on agricultural and allied activities, low consumption standards, low levels of education and health, and low over-all levels of living. Such common features notwithstanding, there are significant differences among the countries of the region in regard to infrastructure and other facilities required for, or conducive to, the fruitful development of fisheries. These relate primarily to transport and communication systems, linking fishing ports, harbours, or villages to the cities, towns and consuming centres of the country in question; money and capital markets, including commercial banks, financial intermediaries, and stock markets; existence of a cadre of educated and skilled persons capable of being recruited, with some training, for fishery-development programmes.

Furthermore, the availability of processing facilities, in the shape of iceplants, processing factories, etc., together with the achievement of a measure of industrialization, makes for the more effective utilization in the fishing countries themselves of the marine products harvested from the sea. Judged by the availability of such infrastructure and other facilities, a number of countries in the region, although admittedly low-income ones, may be designated as "low-income countries with a developed infrastructure." These countries are India, Pakistan, Thailand, Ceylon, and Malaysia. In such countries, given the requisite marine resources, fishery-development programmes can be undertaken more easily and with less cost than in other countries which do not possess similar advantages. Moreover, the diffusion of incomes and the promotion of general economic development may be expected to occur in far greater measure in the "low-income, developed infrastructure" group of countries than in countries without such advantages, because of the multitude of "linkages" present in their economies. Countries with high per capita incomes in the region, viz. Australia and Kuwait, also have developed infrastructure facilities, and so have South Africa and Singapore, whose income levels are much lower.

All other countries of the region have rudimentary or undeveloped infrastructure and unintegrated national economies. Most of the African countries fall into this category and so do some Asian countries. Development of fisheries is more costly and presents a greater range of problems in these countries than in the former group. However, where abundant fishery resources are available in the vicinity of such countries, it is worthwhile to explore, first, the possibility of harvesting these resources profitably with only a moderate upgrading of the fishery activities and, second, to consider the feasibility of initiating fishery projects in suitable sites where almost all of the inputs, except certain categories of manpower, are obtained from outside sources.

CHAPTER V

DEVELOPMENT PROSPECTS AND BENEFITS

Objectives of Development

The exploitation of fish stocks is not a good in itself. Fishing is useful to mankind only if it results in a product which is at least as valuable as the resources, both material and human, which go into its capture, processing, and delivery. The same benefits from a fishery can be measured independently from two perspectives. From one side they are seen as net additions to the welfare of consumers through changes in the abundance, quality, or cost of foodstuffs. From the opposite side they are net additions to the incomes of producers: wages and profits; also taxes and other revenues of government. It is common to name one or more among a diverse set of objectives for fisheries development, a fact to which we have already alluded in Chapter II, which usually include protein supply, creation of employment, or the earning or saving of foreign exchange. As we have also indicated in Chapter II, we believe a more generally applicable objective to be to contribute to general economic development. The objective of providing a source of protein, providing a source of foreign exchange, or providing employment are all perfectly proper objectives of government, of course; we do not conceive of the objective of contributing to general economic development as being in opposition to such objectives, but rather that it includes them as some of a number of possible sub-objectives.

It may be useful to observe that if an objective of government is to increase the supply of protein, all possible methods of achieving this objective will presumably be considered and that the one selected (which may or may not involve fishery resources as a source of the protein) will be the one which yields the greatest rate of return.

With respect to providing foreign exchange, we may remark that "earning or saving in foreign currency" is only the net-

producer income earned by the nation as a whole, i.e., that part of the benefit which can be measured at the national frontier. Any net gain in foreign balances has a cost in terms of domestic resources; an investment in an export fishery is not justified unless the foreign-exchange earnings are worth more to the nation than the domestic resources consumed in earning them.

Some features of providing employment also require comment. Labour-intensive fisheries (and labour-intensive activities generally) do not necessarily create more employment opportunity or generate more wage income than capital-intensive fisheries. In any but a totally subsistence economy, much of the employment created by any one economic activity is created in other industries; a large part of this total is a result of the spending and re-spending of the wages and profits and taxes earned in the original activity. The size of this "multiplier" depends upon the behaviour of the economy with respect to savings and imports. Where all capital goods and supplies are not imported, the employment generated in capital-goods industries and in supplier activities, and their respective multipliers, should also be taken into account. The implication of all these indirect employment effects is that the employment opportunity and wage income created in the whole economy by a fishery depends more upon its productivity than upon the number of labourers directly engaged. Productivity is, of course, another expression for the creation of net benefits or the excess of returns over costs.

There is also a mistaken tendency to regard employment creation, and the wage income generated therefrom, as a net benefit in itself, because the existence of unemployment and underemployment suggests that the labour involved has no

alternative employment opportunities. This implication would indeed be justified if all of the labour demand generated in the fisheries were of the type which are redundant. Usually, however, a large part of the vacancies created are for workers with skills and attitudes which are scarce in low-income economies; the gross benefits from the creation of employment opportunity must be offset at least in part by the costs of training and recruitment, and the value of the alternative employment which might be available to the skilled labour force, including technicians and managers.

In any case, whatever the specific stimulus to a development project in fisheries — malnutrition, unemployment, a foreign exchange deficit, a shortage of government revenues, or low per capita incomes — and hence whatever the specific objective, the criterion on which the project must be judged is its rate of return or profitability, i.e. whether total additions to benefits equal or exceed total additions to cost. This standard is logically the same as requiring that projects initiated mainly to increase food supplies, or foreign exchange, or savings, etc., be "cost-effective," that is, that the value of the protein, etc., be greater than the value of the inputs used to produce it. It follows from this cost-benefit criterion that there are likely to be fish stocks which should not be exploited, or which should not be developed to their maximum physical yield. To develop a fishery whose product is over the long run less valuable than the materials, capital, and labour consumed in it, and which thereby requires a permanent subsidy, does not contribute to economic development but, on the contrary, is a net economic burden.

Requirements for Development

The preconditions for, and inputs to, fisheries development can be summarized as resources, labour, skills and technique, infrastructure and economic environment, capital, and markets. The low-income countries of the Indian Ocean region all suffer from a deficiency in one or more of these items; several of them have no fishery assets other than access to, or national control over promising resource

stocks, and a supply of inadequately committed, disciplined, or skilled labour. Others, even among the lowest income countries, have well-developed infrastructure facilities and internal markets, and are handicapped mainly by the lack of specific skills, financial capital, and effective linkages to international markets. These lacks on the part of the Indian Ocean countries have been responsible for the large proportion of the growth in landings accounted for by countries outside the region, and the interest in international assistance programmes and commercial joint ventures. Whether the initiatives come locally or from overseas, and whatever the form of enterprise involved, prospects for fishery development in the Indian Ocean depend heavily on inputs from high-income countries outside the region because these countries have substantial advantages as suppliers of technique, skills (including management skills), and capital; they are also the largest and potentially most lucrative markets for fishery products.

There are bound to be some genuine conflicts of interest among nations over the exploitation of high seas fisheries, but there is a broad range of opportunities for cooperation between the low-income countries of the Indian Ocean and high-income fishing and fish-consuming countries outside the region, even in their respective self-interests. In principle, at least, the lowest costs of production and the greatest return to all productive inputs in the fisheries may be achieved by combining the locational advantages and labour supplies of the Indian Ocean countries with techniques, capital, and in many cases markets, from countries such as Japan or the United States. As Myint (1970:58) has put it: "... the Southeast Asian countries can expect to enjoy a rapid rate of economic development through export expansion in the 1970's, provided that an effective link can be forged to connect their abundant natural resources with the expanding world-market demand for their exports ... the effectiveness of this link for the exports from the plantation and the

mining sectors [and, we would add, from fisheries as well] will depend on the policies to promote freer entry of private foreign investment into these sectors. Such a policy is an essential part of the economic process which adapts the productive structure of the Southeast Asian countries to the pattern of the world market demand for their exports." Thus, among the most important roles for international organizations in fishery development are their serving as a direct channel for specific inputs to the development process, and to catalyze the development of international cooperation on a commercial basis.

Growth Rates of Fisheries

Between 1964 and 1968 estimated landings of fish and shellfish from the Indian Ocean increased from 1,908 to 2,362 million tons. The growth rate of 5.95 per cent annually for landings is a respectable one, exceeding the rate of increase in either population or national product in the region. Landings of the high-valued tunas and mackerels increased at an annual rate of 15.5 and 19.5 per cent, respectively; therefore the total value of fisheries products must have grown more rapidly than the weight of fish landed. There are, however, several reasons to temper any optimism in interpretation of these figures. For many countries in the region, landings data are of doubtful quality, and some of the upward movement in growth rates may be due simply to improvement in collection of data. Even more important, however, is the exceedingly uneven distribution of the catch increase. Twenty-one per cent of the growth in landings was accounted for by non-Indian Ocean countries (Japan, Republic of Korea, Republic of China (Taiwan), and the USSR), and 39 per cent of the remainder is attributable to only one country bordering on the Indian Ocean: Thailand. Over half the population of the region lives in India, and that nation's landings grew at an annual rate of only 1.2 per cent; in Africa and the Middle East, the landings of most nations remained substantially constant or declined.

Not only was growth uneven throughout the area but, as indicated in Table 11, it

was exceedingly haphazard: neither absolute nor relative increases in landings seem regularly associated with any of the following parameters:

1. Probable abundance of fish stocks (as outlined in Chapter III).
2. Total population.
3. Gross Domestic Product per capita.
4. General level of infrastructure development.
5. Previous level of fishery development.

Another important aspect of the region is that marine catches from the Indian Ocean and its appendages make up less than half the total recorded production, the remainder coming from fresh water or from other seas. There is, however, a strong association between the increase in landings from the Indian Ocean between 1964 and 1968, and:

the growth of total landings in 1964 to 1968, or

the trend of total landings from 1955 to 1968.

The individual fisheries in which rapid growth is now occurring are exceedingly diverse. They span the entire spectrum of scale, technique, and capital intensity, from the non-mechanized local fisheries of Madagascar, to the distant-water tuna longline operations of several countries from outside the region. Thailand's fisheries, which are the most successful in the Indian Ocean region in terms of rapid growth, themselves reach from the least to the most mechanized. The same may be said for the successful sectors of the fisheries in several other countries. The wide range of growth rates among fisheries and countries, and the varied character of the growing fisheries in the Indian Ocean suggest, not that growth is entirely random, but that the opportunities for further growth are numerous and diverse, and that the necessary preconditions for development,

Table 11. Annual rates of growth, Indian Ocean landings
by Country and Region.

| | Landings for Indian Ocean (e) Increase 1964-68 | Total Finfish Landings (f) Increase Trend (g) | | Total Shellfish Landings (f) Increase Trend (g) | |
|-----------------------------------|--|---|---------|---|---------|
| | | 1964-68 | 1955-68 | 1964-68 | 1955-68 |
| Kenya | 4.7 | 11.1 | 0.2 | | |
| Madagascar | 14.6 | 5.6 | 9.0 | | |
| Mauritius | decline | 0.0 | decline | | |
| Somalia | (h) | 5.1 | 4.2 | | |
| South Africa | decline | 14.1 | 10.2 | decline | decline |
| Tanzania | decline | decline | 4.8 | | |
| <u>EAST AFRICA (a)</u> | <u>8.7</u> | | | | |
| Ethiopia | decline | 2.4 | decline | | |
| Iran | 4.6 | 7.4 | 0.6 | | |
| Iraq | 14.4 | decline | 8.3 | | |
| Israel | decline | 8.1 | 7.2 | | |
| Saudi Arabia | 8.3 | 3.6 | 3.5 | 16.7 | 10.2 |
| South Yemen | decline | decline | 7.3 | | |
| Sudan | (h) | 3.7 | 4.4 | | |
| United Arab Republic | decline | decline | 4.8 | decline | |
| <u>MIDDLE EAST (b)</u> | <u>0.0</u> | | | | |
| Ceylon, W. | 7.8 | 10.3 | 12.2 | | |
| India, W. | 0.8 | 3.9 | 4.1 | | |
| West Pakistan | 10.6 | 2.4 | 3.3 | 1.9 | 7.9 |
| <u>E. ARABIAN SEA (c)</u> | <u>2.6</u> | (i) | | | |
| Ceylon, E. | 9.3 | 10.3 | 12.2 | | |
| India, E. | 2.7 | 3.9 | 4.1 | decline | |
| East Pakistan | 2.4 | 2.4 | 3.3 | 1.9 | |
| <u>BAY OF BENGAL</u> | <u>4.2</u> | | | | |
| Burma | 2.5 | 2.8 | 0.8 | | |
| Indonesia | 5.3 | 5.1 | 5.0 | | |
| Malaysia | 11.3 | 14.4 | 5.5 | 10.8 | 13.8 |
| Thailand | 65.1 | 11.8 | 17.2 | 21.3 | 9.3 |
| <u>SOUTHEAST ASIA (d)</u> | <u>10.4</u> | | | | |
| AUSTRALIA | 7.9 | 2.2 | 3.8 | 14.4 | 8.9 |
| <u>ALL INDIAN OCEAN COUNTRIES</u> | <u>4.2</u> | | | | |
| Japan | 11.4 | | | | |
| Korea (Rep. of) | 228.2 | | | | |
| Taiwan | 42.9 | | | | |
| USSR | 18.7 | | | | |
| <u>NON INDIAN OCEAN COUNTRIES</u> | <u>18.7</u> | | | | |
| <u>TOTAL</u> | <u>5.5</u> | | | | |

- NOTES
- (a) Also includes Comoro Islands, Mozambique, Réunion, and Seychelles
 - (b) Also includes Bahrain, Jordan, Kuwait, Muscat and Oman, Qatar, Trucial Oman & Yemen
 - (c) Also includes Maldives Islands
 - (d) Also includes Singapore and Portuguese Timor
 - (e) Source, FAO (1970)
 - (f) Source, printouts for Indicative World Plan, FAO data
 - (g) Semi-logarithmic regression coefficient
 - (h) Trend not established
 - (i) Nationwide figures for Ceylon, India, Pakistan repeated for both East & West

and the specific obstacles to it, are varied and complex.

Potential Value of Fisheries

In Chapter III we have indicated the probability that the catch in the Indian Ocean may be expanded from its present level by a factor of 7-10 to 16.8-24.0 million metric tons. Estimating the value of this estimated potential yield is a compounding of uncertainties. However, we believe this can be done with sufficient confidence to provide the "order of magnitude" understanding necessary to incorporate fishery development as a part of general economic development.

The value estimates are, of course, in the form of area-wide averages, and so they may differ considerably from prices observed in different submarkets at particular times. They seem reasonable, however, since the income elasticity of demand for fish is higher than one, and since prices should respond positively to extensions in the internal markets as the region develops and as the producers in the area increase their skill in the international market place. The estimates are given in Table 12. The basic price relationship (column 4) is that the demersal fish are, on the average, twice as valuable as the pelagic fish, while the prices for tuna and crustacea are the world market prices. Around the base prices we have suggested a range of roughly 50 per cent (columns 5 and 6) to indicate what, in our opinion, is the extent of the likely possibilities.

The "most likely" estimate is that the landed value of the increase in the catch that is possible will be about 450 million dollars. When this catch is at the retail level, and value has been added by processing, transportation, etc. the value will increase by a factor of 4 to approximately 1.8 thousand million dollars. At these levels of catch and price the collective value of the fisheries is significant. But of course it should be kept in mind that, for the purposes of development, rate of return and net yield rather than gross yield are the significant figures. Gross yield data simply suggest that if other conditions are met (i.e. the fisheries rationalized, entry limited, etc.), then it is possible to have a rate of

return from fisheries that will, given the size of the potential increase, contribute significantly to development.

A final estimate is that it is not unreasonable to assume that as much as 20 per cent of the total potential catch might come from areas of high biological productivity. (Three such areas have been indicated in Chapter III.) This suggests landed values of about 90 million dollars and retail values of about 350 million for such areas. Again, values of this magnitude indicate that fishery development may make a real contribution to economic growth.

Criteria for Investment

A meaningful programme for economic development requires that scarce resources, particularly, in this instance, the money capital made available for investment, be used wisely. In economic terms this means that the money capital should be utilized where the rate of return from its application is greatest. This will result in the highest flow of material benefits (which includes improved levels of income, greatest foreign exchange earnings, employment gains, etc). More specifically, each investment project considered for Indian Ocean fisheries should earn a rate of return at least equal to the rate of return on investments elsewhere in the system. (See also Hamlich, 1970, and Theodore and Wu, 1969.)

It is important to emphasize at this point that the use of this rate-of-return criterion does not necessarily mean that certain funds acquired and utilized under the Indian Ocean Development Programme must be repaid to the supplier. Quite to the contrary, the purpose of supplying the money capital is to assist economic development, which means that the capital will remain in the recipient country. The rate-of-return criterion requires only that the project provide a sufficient net yield to meet the objective of maximizing the rate of economic growth completely independent of any condition of repayment. A project that does not meet this criterion, i.e. does not generate a sufficient net yield, should be rejected in favour of one that does.

Table 12. Estimated gross value of Indian Ocean fishery landings, of gross value at the retail level, and of the possible value of fisheries in highly productive areas.

| Category of fish | Estimated gross value of Indian Ocean fisheries | | | | | | | |
|-------------------|---|--------------------------------------|--|-----------|--|---------------|---------------|---------------|
| | Present catch (1968) 1000 MT | Estimated Potential increase 1000 MT | Estimated range of price per ton U.S. 1970 dollars | | Estimated range of value of increased landings 1000 U.S. 1970 \$ | | | |
| | | | most likely | low range | high range | most likely | low range | high range |
| Demersal | 750 | 7,500 | 40 | 32 | 50 | 270,000 | 216,000 | 337,500 |
| Schooling Pelagic | 1,150 | 6,000 | 20 | 16 | 25 | 97,000 | 77,600 | 121,250 |
| Tuna | 275 | 300 | 250 | 200 | 313 | 6,250 | 5,000 | 7,825 |
| Crustaceans | <u>175</u> | <u>250</u> | <u>1,000</u> | 800 | 1,200 | <u>75,000</u> | <u>60,000</u> | <u>90,000</u> |
| Total | 2,350 | 14,050 | 11,700 | | | 448,250 | 358,600 | 556,575 |

Estimated range of value-added in handling and processing, storage, transportation, and marketing; i.e. at the retail level. (4 times estimated increased landed value 1000 U.S. 1970 dollars)

| | | |
|---------------------|--------------|-----------|
| Price assumption I, | Col. 4 above | 1,793,000 |
| " II, | " 5 " | 1,434,400 |
| " III, | " 6 " | 2,226,300 |

Estimated range of potential value of specific highly productive areas. (.20 x estimated increased landed value 1000 U.S. 1970 dollars)

| | | | |
|---------------------|--------------|--------------|-------------|
| Price assumption I, | Col. 4 above | landed value | value added |
| " II, | " 5 " | 89,650 | 358,600 |
| " III, | " 6 " | 71,720 | 286,880 |
| | | 111,315 | 445,260 |

Sources: (1) Rounded from Column (3), Table 2, Chapter III; (2) From Shomura (in Gulland, 1970), Table H5; (3) Column 2 - Column 1; (4) Best judgement based on available data; (5) Column (4) x 0.8; (6) Column (4) x 1.25; (7) Column (3) x Column (4); (8) Column (3) x Column (5); (9) Column (3) x Column (6).

Using the rate-of-return criterion, it is possible to enumerate a number of alternative projects all of which are profitable in the sense defined above. Each country will want to select from the group of acceptable projects those that best fill its particular needs. This may mean that in certain instances countries may prefer to emphasize participation in profitable projects that will also generate significant amounts of foreign exchange, or are labour-intensive, or increase the rate of use of facilities already in place, etc. It should be emphasized that these are second-order considerations in the process of selection among alternative projects. However, given the identification of profitable projects, these second-order criteria then become central in the selection mechanism. For example: country A is interested in fisheries development both inshore along its coast line and on certain offshore fishing banks. Its government, together with UNDP, IOFC, and other interested international agencies, can develop a list of projects related to the two areas that meet the profitability test. Country A must then, using the second-order criteria, select and seek aid funds for those projects most appropriate for its own immediate development needs.

The cost of money capital, i.e., what it can earn in alternative uses, is high in all countries, both developed and developing. Circumstances throughout the world are, of course, varied and therefore it is inappropriate to be too specific about the rate of return on new investments. But, based upon numerous investigations, a range of 12 to 20 per cent seems generally applicable to investment projects. These rates are a possible guideline for decision-making; they suggest which projects are appropriate and which are not. They do not represent what a developing country has to repay when using aid funds. Any country may participate in a project that returns at this level using money capital obtained via transfers or as soft loans for which only nominal repayment may be required.

In this context, it may be pointed out that the cost of money capital may be a major

deterrent to fisheries development in many countries at the present time. In one Indian Ocean country, for example, blocked accounts currently bring 24 per cent. Thus, to attract private investment to fishery projects, the estimated rate of return would have to exceed 24 per cent (or at least 24 per cent less the rate of inflation over the period of the blocked account). This may mean in many cases that the only possibility of financing fishery-development projects is from soft loans or in any case from non-private funds.

Projects requiring massive injections of capital and a long time to complete, such as the construction of a coastal road, or a major electric plant, or a port, are to be considered as providing part of the necessary infrastructure for fishery development and therefore must be taken into account when applying the profitability criterion. However, the costs of large capital-using construction projects are generally too great to be borne by the net yield generated from increased landings of fishery products or, in fact, by any one sector of the economy. When estimating profitability under such circumstances it is appropriate to prorate the cost allocations over all possible users; e.g., in addition to its use by a fishing fleet a port installation might also be used by general cargo vessels and tankers and all three users should be taken into account in estimating profitability.

The question of the cost of money capital in fishery projects is further complicated because the fish stocks themselves are not owned. They are common property open to exploitation by the fishermen of any nation or, within territorial waters, by any number of national fishermen. In the exploitation of common property, in the long run net returns to capital tend toward zero. This follows because as long as there is a net yield, more fishermen or nations enter the fishery and drive the returns down. Therefore to insure profitability in the fisheries one of two additional conditions have to be met: (1) there must be a limitation on entry, i.e. only the

appropriate amount of labour and capital required to catch the available fish stock should be utilized; or (2) the fishery may be exploited intensively for a relatively short period — perhaps as long as five years — during which period it will be profitable. After that, others attracted by the earnings will enter and the rate of return to all will be driven down. This particular discussion relates to overcapitalization at the primary or producing level, but overcapitalization at the secondary or processing level is also a problem.

Investment in Fisheries and Economic Development

In order to illustrate the effects of fishery development in the general economic-development process, we will give hypothetical examples of a capital-intensive fishery and of a labour-intensive fishery. First, consider the introduction of a capital-intensive fishery in an area where little or no fishing activity is currently taking place, where the population density is low, where there is little economic infrastructure, but where there is a large stock of fish within the territorial sea. Let us assume that this stock is best utilized for the production of meal and oil.

After surveys of the fish stock and estimates of the cost of the project suggest that it would be profitable, funds can be sought from three sources: international agencies, a foreign partner or partners in a joint venture, and the country itself.

In Figure 1 and Table 13 are shown the money flow, sources of capital, uses of capital, sources and uses of labour, and initial economic implications for the "host" country for a capital intensive fishery, i.e. how it will affect the economy. In general, it will stimulate money flows, increase the earnings of labour, and enlarge the internal market. Some leakages will occur when spending is directed outside the area. The internal flow tends to increase the supply of savings. These increased savings may be divided between

the public and the private sectors, depending on the nature of the tax system. In any case, it is important that the flow of savings be reinvested. The effect of this process is to create in the country new demand which can be filled by increases in capacity in both the consumption and investment goods sectors. In addition, depending on the nature of the project, there may be certain external economies created which will serve as a further stimulus to growth. For example, the improvement of a harbour and the installation of better systems of material handling may reduce the cost of all imported goods, which will result in a higher level of disposable income.

This illustration is purely hypothetical, but with enlargement, more exact specification, and modification to meet various local conditions, it might be thought of as a first approximation to the type of project that would fit, say, the southeast coast of the Arabian peninsula.

For an example of labour-intensive fishery we will consider a local inshore subsistence fishery (see Table 14). Fish stocks appear to be abundant because the fishery is relatively inefficient. In the phraseology of the Indicative World Plan (FAO, 1969), the fishery has been an economic activity analogous to peasant agriculture. In these circumstances, technological change is difficult to implement because it not only raises questions about employment (in an economy where the opportunity cost of unskilled labour is close to zero) but actually threatens a historical way of life. In addition, because of the geographical spread along the coast, the low level of output in any one place, and the individual nature of the producing units, economic risks are high so that there is very little money capital available and what is available is very costly. In these circumstances the problem is to extend the market to include these scattered sources of production, a task which requires improved efficiency in the local fisheries and further reductions in costs by the creation of an infra-

Figure 1. Money-flow diagram for capital intensive fishery.

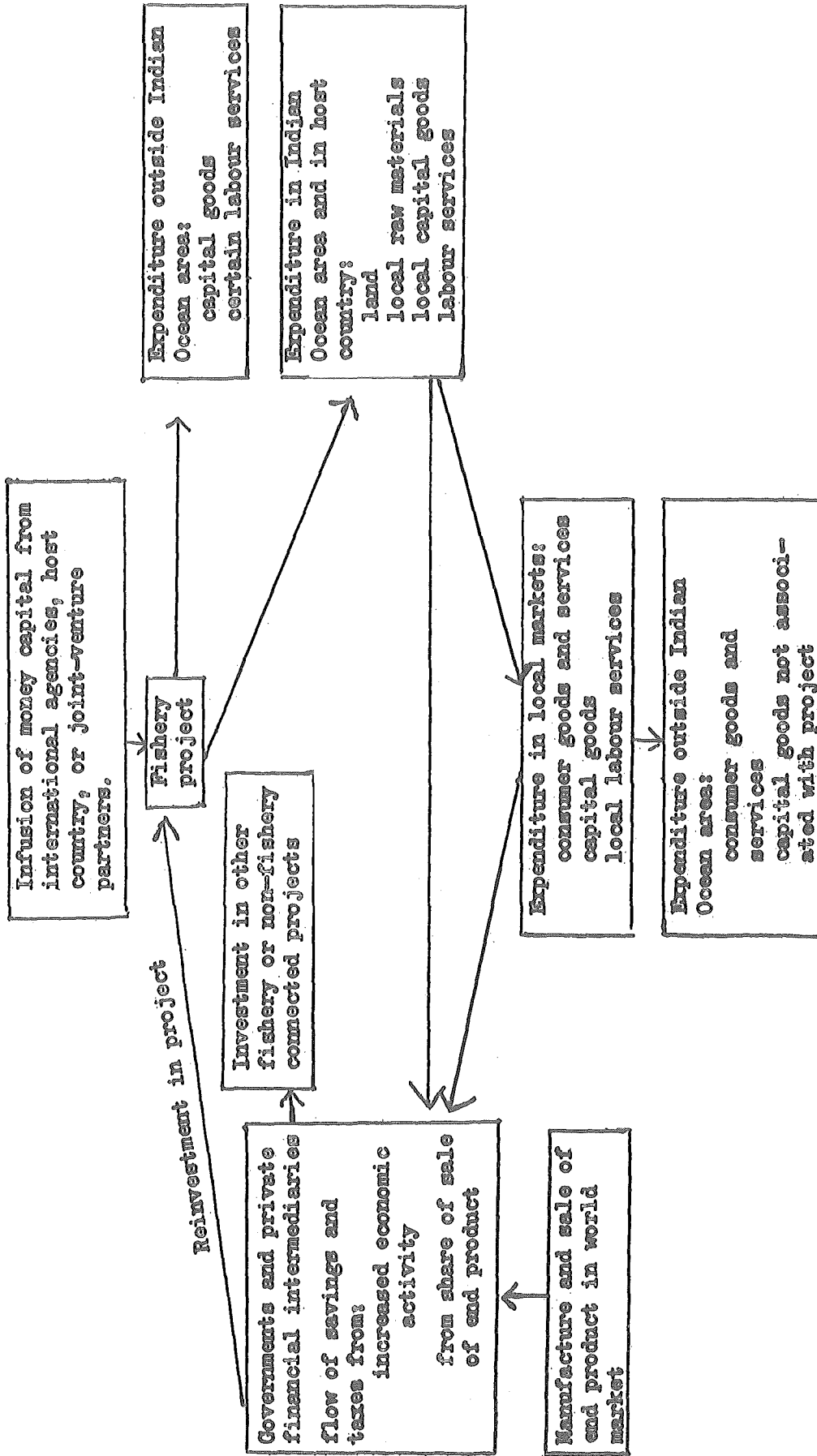


Table 13.

Hypothetical illustration of a capital intensive fishery.

| <u>Sources of capital</u> | <u>Uses of capital</u> | <u>Sources and uses of labour</u> | <u>Initial economic implications for the host country</u> |
|--|---|---|--|
| 1) International agencies | 1) Purchase of vessels, nets, and other equipment outside host country | Highly skilled and advisory services recruited from partner in joint venture and UN sources | 1) Marginal productivity of host-country workers on the project will be raised above the national average. This will result in a higher wage level for this group and tend to increase their demand for consumer goods and the flow of savings from the group. |
| 2) Joint venture negotiated with non-Indian Ocean country | 2) Construction: a. Docks, loading equipment b. Fish-meal plant c. Storage facility d. Other infrastructure as needed | Other skilled and semi-skilled workers and trainees recruited from host country | 2) This will increase the size of the domestic market for consumer goods. |
| 3) Contribution by host country of site for harbour and processing plant | - Housing - Electricity - Water - Services | Training is to be provided for upgrading of skills of host country workers as part of joint venture and possibly also with international agency support | 3) The larger flow of savings will, via direct action by individuals, and financial intermediaries and through taxes, be available for investment, |
| | | | 4) There will be continual upgrading of labour skills in fishery activities. |
| | | | 5) The supply of foreign exchange will increase as per the government's share of the end product. |
| | | | 6) Tax revenues, which may be used for a. other development projects, b. investment in management of the fish stock, c. other government purposes, may be generated by the higher level of economic activity (taxation of workers income, etc.). |
| | | | 7) A share of title to capital goods, both those installed on land and those at sea, will be acquired. |
| | | | 8) Skills and experience will be acquired, both in government and in the labour force, to permit further national development of fishery projects. |

Table 14.

Hypothetical illustration of a labour-intensive fishery

| <u>Sources of capital</u> | <u>Uses of capital</u> | <u>Sources and uses of labour</u> | <u>Initial economic implication</u> |
|--|---|---|---|
| 1) International agencies | 1) Purchase outside of country of equipment to motorize small-boat inshore fishing fleet | 1) Skills in transport, ice plant operation, and handling in central market recruited from local labour trained by mutual assistance programme | 1) Increase in marginal productivity of labour will serve to raise wages above subsistence. This will yield increased demand for consumer goods and possibly some flow of savings. |
| 2) Host country | 2) Construction: a) ice plants b) transport net c) storage and handling facilities in market centre | 2) Development of mechanical skills for repair and maintenance of motorised fleet | 2) The market for consumer goods will be extended. |
| direct allocation of internal budget funds to fishery projects, including internal currency and foreign exchange | 3) Education programme to improve handling (reduce waste), to permit repairs, and to conduct maintenance on equipment | Note that total labour force required is not large relative to that utilized in the subsistence fishing. The principal "new" labour requirement is for a slightly higher level of skills. | 3) Extension of the market area and motorization of the fishery (an increase in the wealth in each community) will require improvements in the flow of money capital and the methods and techniques of financing. |
| | | | 4) Some tax revenues may be generated by the increase in the level of activity in the central market. |

structure of transport, cold chain, credit facilities, and technical assistance.

A significant difference between our two illustrations lies in the relative ability to measure benefits. In the case of the labour-intensive fishery where we would expect growth by accretion, the marginal gains from bringing one more community into the commercial market area are low. And while these gains may be impressive as long run aggregates, they are not usually sufficient to meet the profitability test at the completion of each stage. As has earlier been suggested, the most obvious strategy is to shift some

of the development costs to alternative projects, i.e., let the cost of the development of coastal transportation be borne by several appropriate activities, utilize the cold-storage chain for agriculture as well as fisheries, etc.

However, it should be noted that in certain circumstances projects of this sort may be able to carry themselves. These instances could occur where the price of the end product is relatively high, where the productivity gains from mechanization are large, and where there is a limited number of specific bottlenecks in the institutional and economic infrastructure to be overcome.

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CHAPTER VI

REGIONAL DEVELOPMENT PROPOSALS

In this chapter we will identify many of the activities which we believe will stimulate fishery development in the Indian Ocean. We have endeavoured to do this on a regional basis, but in many cases it is difficult to draw the distinction between regional, sub-regional, and country projects. Many of the regional and sub-regional projects can best be mounted through an assemblage of country projects and, indeed, we believe one of the most important regional functions to be the establishment of a mechanism for the identification of viable projects, most of which would be, presumably, country projects. Thus, we propose a Technical Staff of the Commission, one of the main functions of which would be project identification. Other organizational suggestions are for a regional statistical centre, a Fisheries Joint Venture Advisory Board, and a Regional Fisheries Development Agency. In the following sections we will also discuss resource prospects and needs, international resource management, product acceptability and marketing, and training and the role of government in development.

IOFC Technical Staff

In the other sections of this report we have identified some of the varied actions which need to be taken to stimulate fishery development in the Indian Ocean. We have also indicated the appropriate mechanism by which such actions should be undertaken, endeavouring to use existing bodies or agencies where possible and to avoid the erection of new mechanisms. There is, however, a small group of activities which constitute the very core of fishery-development activity and which should logically be closely associated with the IOFC. We therefore recommend that there be created a Technical Staff of the Commission, charged with carrying out these activities which include (1) project identification, (2) coordination of existing projects, (3) investment opportunity

identification, (4) resource management, (5) advisory services, (6) facilitation of communications, (7) review and accountability mechanism, (8) supervisory and liaison capacity for activities carried out elsewhere under the aegis of the Commission, and (9) support for the Fisheries Joint Venture Advisory Board. In addition to amplifying this somewhat cryptic characterization of proposed Technical Staff activities, we will also comment on possible Technical Staff structures, staffing, criteria for the selection of the physical location of the Technical Staff, and a mechanism for review and accountability of the work of the Technical Staff.

(1) Project identification includes the identification of any kind of action relating to fishery development, whether such action be appropriate for action by governments, for bilateral or multilateral agencies, or world or regional banks. Projects so identified would, of course, be specified in adequate detail for the appropriate agency or body. The rate-of-return criterion and second-order criteria with respect to project identification and selection have been discussed in an earlier section. Obviously, the skill with which the Technical Staff, on behalf of the Commission, can identify fruitful projects, can stimulate whatever action is necessary to bring them into being, and can encourage their successful completion will determine in large measure the effect of the Commission on the course of fishery development in the Indian Ocean.

(2) Coordination of existing projects is obviously related both to project identification and to project review, but, in addition, would permit broader implications to come from the results of some projects by providing a regional or sub-regional aspect and, in the case of other projects, might make them more effective simply by facilitating the flow of information.

(3) Investment-opportunity identification is obviously an extension of project identification and coordination. It is hoped that investment opportunities will arise out of completed projects. In other cases there may be investment opportunities apparent even though there has been no pre-investment project. The Technical Staff should have as one of its key functions the identification of investment opportunities and the communication of such information to governments, banks, and the private sector.

(4) Resource management of both national and international fisheries is necessary to prevent over-capitalization of both the processing and producing sectors of the industries as well as the possibility of reduced total yields, as is discussed in a subsequent section. The Technical Staff would obviously not be able to follow all Indian Ocean fisheries in sufficient detail to make meaningful recommendations about their management. Yet it should be able to follow key fisheries, important because of foreign-currency-earning ability, capital-intensive investments, etc., at least in sufficient detail to know when more detailed studies were needed and, if unable to carry out such studies itself, to arrange for their completion by FAO, national institutions, or other appropriate body.

(5) Advisory services would provide Governments with a mechanism for obtaining a fresh view in whole or in part of the spectrum of their fishery development problems and activities. Those of us who have travelled in the Indian Ocean countries have invariably been astonished by a number of features (which generally vary from country to country) which were obviously inhibiting fishery development. (Further investigation has sometimes, but by no means always, revealed the existence of other conditions accounting for the feature initially noticed.)

(6) The facilitation of communication between industry and government and, indeed, between different sectors of government is a striking need in virtually every country

visited. Industry is not well informed of the results of government activities designed to facilitate fishery development, government is not always aware of industry needs, and one part of government may proceed without taking account of the activities of another part. A relatively small amount of time and effort invested in ameliorating these conditions could be very profitable.

(7) A review and accountability mechanism is a logical outgrowth or extension of the profitability criterion already described. Essential to the mechanism is careful project planning and specification fitted to a time scale. Periodic reviews will permit the decision to continue or to terminate the project. The feature of accountability permits the identification of reasons for successes and failures. We are aware, of course, that various review and accountability mechanisms already exist, depending upon the nature of the project. Care should be taken that any additional mechanism neither duplicates those in existence nor imposes unduly upon the time of those concerned. An extremely useful study, which could be performed by some independent body under contract, would be the careful analysis of a set of projects, carefully selected to include both successful and unsuccessful projects, with the objective of determining the reasons for successes and failures. If these reasons could be generalized, they would be very useful tools with respect to the initiation and conduct of future projects. Even if they could not be generalized, they would still provide useful guidelines. We recommend that the Commission arrange for such a study.

(8) The need for supervisory and liaison capacity for activities carried out elsewhere under the aegis of the Commission is apparent. As we have both implied and made explicit elsewhere in this report, we do not believe that the Technical Staff should be large nor that it should get involved in continuing, operational activities if a logical home for them can be found elsewhere; nor will

it be able to undertake many of the special studies for which there is a need. Thus, there will be need for the services of consultants, involvement of FAO regular staff, and involvement of national fishery staffs. Still, with respect to such activities, the Commission will want to be kept informed and will want to be satisfied that adequate direction and review are available.

(9) Support for the Fisheries Joint Venture Advisory Board (described elsewhere in more detail) will need to be supplied. The kinds of support needed are such that they might be included under several of the activities of the Technical Staff listed above. In any case, the Technical Staff will either need to provide them directly or make arrangements for their provision by FAO or other appropriate body.

Discussion of the possible structure or organization of the Technical Staff is in one sense pointless, for, to repeat a truism, no particular organization will be effective if the staff is inadequate. On the other hand, a highly effective staff may function reasonably well regardless of the structure (although it is also true that an obviously difficult organization may militate against the recruitment of an adequate staff). The organizational forms we have discussed included (a) one structured by activities, (b) one structured by problems, and (c) one with rather less structure in which the staff would tend to work as a group or at least interchangeably across problem boundaries or whatever structural lines might exist. The quality of staff hoped for would probably operate best under the condition of (c), but some useful purposes may be served by a structure of the type (b). Perhaps a structure of type (b) could be specified with the expectation that, in fact, much of the operational reality will conform to (c). In any case, we have made the assumption that the Technical Staff would, for payroll and other administrative functions, be lodged within the FAO structure.

As we have already stated, we believe that the Technical Staff should not be large; it should consist of five professional members in addition to a director,

plus secretarial and other support staff.

There should, of course, be some mechanism for the periodic review of the progress and technical competence of the Technical Staff members. We recommend that a Review Board be constituted of the Commission Chairman, the FAO Assistant-Director General, Department of Fisheries, the Director for Operations, FAO Department of Fisheries, and the Fisheries Officer, Animal and Fish Resources Programme, UNDP. This Review Board might meet with the Technical Staff to review its work, say, every two years. It might be convenient to do this just prior to the Sessions of the IOFC.

We have given some thought to specific sites for the location of the Technical Staff and we have discussed some of the criteria of desirable sites. These criteria include, not listed in any particular order, (a) international transportation (air) centre to facilitate access to different parts of the region; (b) good medical facilities, schools, cultural facilities, etc., in order to encourage the recruitment and retention of high-quality staff; (c) professional community of similar interests in order to provide stimulation and prevent insularity; (d) signatory of Convention on the Privileges and Immunities of the United Nations and Specialized Agencies and the Agreement between the United Nations Special Fund and Individual Governments concerning Assistance from the Special Fund; (e) staff income should not be reduced by artificially maintained rates of exchange, and (f) close access to FAO HQ staff, not only for facilitating professional work, but also (and this is most important from the standpoint of staff morale and efficiency) for facilitating the day-to-day administrative aspects of the operation which are inherent to association with any large organization. On balance, we believe that the advantages of being located with close access to FAO HQ staff, i.e. in Rome, outweigh the advantages of any other single location. In any case, regardless of where the Technical Staff is located, its members will need to spend a very substantial part of their time in travel within the region.

In the following sections where we have used the phrase, "We recommend that the Commission arrange for...." or similar wording, it is our intent that such work either would be carried out by the Technical Staff or that the Technical Staff would arrange to have it done by the FAO regular staff or by an appropriate national institution or firm.

Statistics

An essential requisite for the development and maintenance of viable fishery activities is an adequate and continuous flow of statistical information. Successive sessions of the Commission, as well as of the Indo-Pacific Fisheries Council, have stressed the importance of this aspect of the problem. The need for a continuous flow of the relevant statistical information arises from the fact that such information is required for rational decision-making, both at the national level by government and private industry and at the regional level by multinational agencies or bodies, such as the Commission itself.

Relational decision-making calls for a certain minimum flow of statistical information on a continuous basis. An important and common decision is whether, in particular fishing activities, it is rational to limit further fishing effort because of overcapitalization, or to intensify effort in order to utilize the fishery resources which are still largely unexploited. For this kind of decision-making the statistical data required are those which relate, by species and, if possible, by gear, to (1) catch, (2) catch per unit effort, (3) effort, and (4) size/age composition of the catch.

Theoretically, it is possible to build up a statistical system under which these biological/physical data are collected by a regional statistical centre through the instrumentality of its own apparatus. But such a system would, however, be unnecessarily costly, since it would not make use of the national statistical systems already existing in the region. The best course is, therefore, to take cognizance of, and make effective use of, the existing national

systems and bring out the requisite improvements, since undoubtedly the national systems differ widely in regard to their ability to produce on a current basis the information necessary for management decisions (Banerji, 1971), through advice, assistance, coordination, etc., so that the various national systems serve as effective and mutually-supporting mechanisms.

We are, however, of the view that, in addition to measures relating to the improvement and, in some cases, even to the erection ab ovo, of national statistical systems, there is need to establish a regional statistical centre which alone can perform certain essential services, in the form of supplying of specific categories of statistical information, of rendering guidance, etc. to national statistical organizations, and of bringing about the necessary coordination between the activities of the national systems. To say this is not, it must be stressed, to underplay in any way the urgent necessity for upgrading and improving national statistical systems in a number of cases.

A regional statistical centre should have the following functions:

(1) to serve as an agency for providing advice and guidance to national governments for effectuating the necessary improvements in the national fishery statistical systems;

(2) to act as a central repository of statistical data on fishery activities in the region and to provide read-outs of such data on demand, and to play the role of a catalytic agent in the adoption of uniform concepts and methodology in statistical data-collection, and thus contribute to the maximum comparability of data assembled by different national systems;

(3) to develop rough and ready, as well as expeditious, methods of supplying data on vital current problems of fishery development, particularly those which affect several or all countries of the region;

(4) to undertake special studies, on its own initiative or at the request of member governments or the Commission, relating to various aspects of fishery

development.

Effective discharge of these functions would require the use of an electronic computer.

In addition to the "biological-physical" data base, there is also need, for use by industry, of up-to-date and continuous information on prices, supplies, etc., of fishery articles in international trade. Because these data are of a different nature, arise from different sources, and would have a specialized set of users, we think that this function should not be undertaken by a regional statistical data centre, but rather by other bodies such as trade associations.

There is no compelling logical necessity for the specific site for a regional statistical centre to coincide with that for the location of a Technical Staff of the Commission. We have already discussed some of the criteria for selecting a desirable site for the location of a Technical Staff and have included among them close access to FAO HQ staff, for, inter alia, facilitating professional work. Should it be decided to locate a Technical Staff at or close to FAO HQ, the balance of advantage would, in view of the statistical facilities and services already developed in FAO, lie in also locating the regional statistical centre at or close to FAO HQ. (In view of the special nature of the relationship between the proposed output of a regional data centre and many of the proposed functions of the Technical Staff, the Commission may wish to consider inclusion of the regional data centre within the responsibilities of the Technical Staff. In general, however, we have tried to keep the functions of the Technical Staff distinct from those of an on-going operational nature.)

Joint Ventures

We have suggested elsewhere in this report that many opportunities for fishery development in the Indian Ocean region will be exploited most effectively by an enterprise which can combine inputs from the low-income countries of the region with

those from outside, highly developed countries. There is a wide variety of forms which such cooperation can take, from "concession arrangements," in which a wholly foreign-owned firm is licensed by an Indian Ocean country to fish in its territorial waters and/or to use its ports, to a completely domestically-owned enterprise using outside technical and other assistance on a contract basis for a limited term. Between these extremes, there is a range of provisions for the sharing of ownership, management, and profits. The most common arrangement, however, is likely to be a joint venture in which ownership is divided between a government or private firm in the Indian Ocean host country, and an international corporation based in one of the high-income countries. While ownership may be held on the basis of 49 per cent by the Indian Ocean country and 51 per cent by the "outside" firm, in general it is becoming more common to find the majority ownership in such ventures resting with the developing country. It is also becoming more common for the entire ownership to rest with the developing country, with management services (or marketing services) provided under contract by an outside firm. In any case, whatever the nature of the arrangement, it will typically involve the training of labour from the host country for progressively more skilled and responsible positions in the enterprise.

Despite the economic logic favouring the joint-venture approach in fisheries, the existing record of success is spotty. Hamlisch (1970) has enumerated several common reasons for failure. In many cases, the terms of joint-venture concession agreements have been subject to conflicting interpretations, or one or another party has been unable to carry out some of the provisions of the agreement. In other instances an agreement was executed with insufficient knowledge of resources, markets, or probable production costs. Some friction in administration of international joint ventures is inescapable. Fisheries enterprises generally, and fisheries in low-income countries particularly, are surrounded

by considerable uncertainty, and it is difficult for any participant to know with confidence the probable future distribution of gains or losses from such an enterprise. The bargaining which takes place at the beginning involves some gambling on each side, and when the business is in operation and real profits or real problems actually appear, it is understandable that one or more of the parties may have misgivings. This process, and the mutual suspicion which accompanies it, often leads one party to suspend the agreement long before the initial investment can be recouped.

Nevertheless, we believe there are some steps which can be taken to reduce the frequency of misunderstanding, friction, and premature abandonment of joint-venture or concession arrangements. The Commission can assist in identifying exceptional opportunities for fishery development on the basis of joint ventures and can provide the required information on resource productivity, costs, and technical factors. In addition, we recommend that the Commission arrange for a review of joint ventures which would include: (1) a survey of previously attempted or existing concession and joint-venture agreements in the region and a systematic assessment of the reason for their success or failure, and (2), on the basis of such a survey, the drafting of an annotated model joint-venture agreement and joint-venture law.

We also recommend the establishment (by the UNDP, IBRD, or perhaps regional banks), independent of the Commission, of a Fisheries Joint Venture Advisory Board to provide financial, legal, and political counsel to prospective and actual participants in international joint ventures. The Board would have a panel of 12 to 18 members, chosen mainly for their experience and ability in international business matters, but including some persons who have a direct connection with the fisheries. These members would be chosen from executive level personnel of IBRD, Asian Development Bank, African Development Bank, private international banks, large fisheries firms in the developed countries, UN agencies (FAO-UNDP), and the financial and fisheries

agencies of the Indian Ocean countries. This Board could, upon request and through a small sub-panel of its members, provide counsel to prospective participants in joint ventures during the investigation and negotiation phases, give guidance on administrative and financial problems during its operation, and serve as a panel from which mediators might be drawn, or which might nominate mediators or arbitrators, where disagreements occur in the interpretation or execution of an agreement. The Board should be composed of persons of stature sufficient to give it substantial persuasive authority with governments, corporations, and financial authorities. Because of the way in which it is envisaged that the Board would operate and because staff support would be supplied by the Commission's Technical Staff, it is anticipated that the services of a secretariat could be supplied by whatever organization to which the Board was attached (say, for example, the Asian Development Bank) without undue difficulty and that the necessary but relatively minor costs of the time and travel of the Board members would be borne by their own organizations.

Regional Fishery Development Agency

Problems connected with fishery development in the Indian Ocean include:

- (1) provision of capital,
- (2) provision of technical and managerial skill, and
- (3) accommodation of the interests of Indian Ocean countries and non-Indian Ocean countries.

A possible mechanism for dealing with these problems is a Regional Fishery Development Agency. The concept is admittedly nebulous at present, and the various possibilities for the organization and operation of an RFDA need to be explored and clarified. It could be a consortium of governments participating on the basis of shares purchased. An initial infusion of capital might be sought in the form of a loan from IBRD or from a Regional Bank. Actual fishing operations could be arranged with

existing, highly-skilled companies under some form of agreement. The RFDA might well also act as an international marketing organization for the products of its operations, although this might be less fruitful than the production-processing side of the business. The activities of an RFDA would be particularly suited for international resources and, indeed, might constitute a mechanism which could contribute to the management of such resources (in the case in which the RFDA included all interested parties and was itself carrying out the entire fishing operation on the resource).

We recommend that the Commission arrange for a study of an RFDA, particularly with respect to whether such an organization could perform a useful function and what form its structure and operation might take. Advantage should be taken of any analogous experience in related fields, as, for example, perhaps the West Africa Rice Development Association.

Resource Prospects and Needs

We will review the resource prospects and needs by geographic areas: (1) East Africa, including Tanzania, Kenya, and southern Somalia; (2) Gulf of Aden, including northeast Somalia, Gulf of Aden, and the Red Sea; (3) Gulf of Oman, including the southeast coast of the Arabian Peninsula, Gulf of Oman, and the Gulf between Iran and the Arabian Peninsula; (4) Eastern Arabian Sea, including the coasts of West Pakistan and west India; (5) Western Bay of Bengal, including the coasts of east India and East Pakistan; (6) Eastern Bay of Bengal, including the coasts of Burma, Thailand, and West Malaysia; (7) Indonesia and (8) Madagascar and Mauritius, including Madagascar, Mauritius, and adjacent oceanic islands. In addition, we have commented on (9) shrimp and (10) tuna.

East Africa

In Tanzania, Kenya, and southern Somalia, the coastal areas are characterized by a narrow shelf, which is generally thought to be unproductive relative to many other regions in the Indian Ocean region. It is

not clear, however, that the nature of the fishery productivity in the area has been sufficiently assessed to evaluate accurately the cost-effectiveness of fishery programmes which would, although modest, make, at least initially, important contributions to the development of the region. The basic method of fishing in this region is by small, unmotorized craft. Roads, storage, and other infrastructure are limited, and so it is difficult to develop markets for products. Tanzania is attempting to solve this problem by the creation of fishing villages. In addition to the more or less demersal types of fish which are caught by local fishermen, there are the high-value shrimp and lobster resources. Although these are caught in relatively small quantities, both by traditional fishermen and by some more advanced but in some instances not clearly successful operations, and although there have been some studies on these species, the potential of the region for shrimp and lobster is not clear. The pelagic resources are likewise thought to be rather limited, although some clupeoid catches have been made in the Zanzibar Channel. The offshore tuna resources of the region are quite large, but do not, for the most part, enter the economy of the region even though there is at least one port in the region which is used as a transshipment base.

We recommend a resource survey to establish particularly the distribution, abundance, and potential yields of shrimp and lobster. Such a survey could also be designed to yield similar information on the stocks of demersal fishes. It could be carried out by the coordinated efforts of the R/V Shakwe operated by the Kenya Fisheries Department; the 90-foot stern trawler scheduled to be delivered to the Marine Fisheries Research and Training Institute, Kunduchi, Tanzania in 1971; the R/V Manihine of the East African Marine Fisheries Research Organization; and possibly other vessels in Tanzania. The staffs and other facilities of these organizations should be involved as appropriate. UNDP or other participation should provide for the coordination-

guidance of the project and such operational support as may be required. There appear to be likely opportunities for bilateral participation. It hardly need be stated that the project will be most likely of success if (1) it utilizes the previous work in the area (by HAMPRO, FAO Technical Assistance Programme,^{*} and others) as a base for its own operational plan, (2) it is carried out with the objective of fishery (economic) development so that its progress is constantly appraised in this light, and (3) there is provision for adequate communication between projects, governments, and industry.

Another development prospect appropriate to this area (as well as to other areas located near the best longline tuna-fishing grounds) is an economic feasibility trial of small (four- or five-man crew) longline boats of the size, for example, of those used in the vicinity of the Hawaiian Islands. Even though the yield of the Indian Ocean longline tuna fishery is approaching, at, or beyond the level of the maximum sustained yield (depending upon the species in question) and, thus, even though it may be over-capitalized at the producer level with resultant low marginal yields for additional producing units, such smaller, "local" longline boats may be economically viable because, (1) the much smaller capital investment, (2) the much lower operating costs, and (3) the much lower labour costs. Since the tuna catch rates and ex-vessel prices are known, and since vessel construction and operating costs can be approximated rather closely, a paper feasibility study of the operation of such boats can fairly readily be made. We recommend that as a first step the Commission arrange to have such a feasibility study made. If the results of this study are positive, we recommend that feasibility fishing trials be carried out. In addition to East Africa, other appropriate sites

(on the basis of known tuna catch rates) include Madagascar, Mauritius, Indonesia, Ceylon, and India. In selecting the specific locality for the feasibility trials, wind and sea conditions, catch rates of tuna throughout the year, and marketing facilities should be taken into account. (If there is a strong seasonal component in the tuna catch rates in some localities, alternative fisheries such as shrimp should be considered for the tuna off-season.)

Although this area is close to productive longline tuna grounds as we have already indicated, although substantial catches are made on these grounds, and although at least some of these catches are transshipped through at least one local port, very little is added to the economy of East African countries by these operations. These resources could, however, contribute to the economy if one or both of the following situations obtained: first, that domestic fisheries were developed (see above) to provide a source of raw material (frozen) for export or, second, that value was added to the fish, however they might be caught, in the form of processing (canning) for export. In view of increasing demand for tuna in the world market and the levelling-off of some sources of supply, we recommend that the governments concerned investigate, utilizing the services of the Commission as appropriate, the practicability of either or both of these possibilities, possibly in the form of joint ventures.

Finally, we recommend that the arrangements for the shrimp-demersal fish resources survey be left open-ended so that upon the completion of this work there may be carried out a pelagic resource survey.

Gulf of Aden

The northeast Somalia, Gulf of Aden,

^{*} No attempts has been made to refer specifically to the work of each FAO/UNDP Project, etc., in this region, even though use has been made of their results. All such projects and related activities are listed in a subsequent report in this series.

and Red Sea areas are much richer than the area immediately to the south. The resources of the Gulf of Aden include, tuna, oil-sardine, anchovy, and chub mackerel, as well as a variety of demersal species. There are presently two FAO/UNDP and one bilateral-aid exploratory fishing-resource survey vessels operating in the Gulf of Aden. We recommend that some coordinating mechanism be established, making use of the Commission if this is appropriate, to ensure that duplication of effort is avoided and that combined operations be carried out where this is desirable. Provision should also be made, presumably by the Somalia FAO/UNDP project vessel, to assess the oil-sardine resource off the northeast coast of Somalia.

The known distribution of the adult oil-sardine around the border of the Arabian Sea and the much more restricted distribution (at least as presently known) of oil-sardine larvae suggest that there is an important stock-identity problem. If, for example, the oil-sardine stocks off the west coast of India and in the Gulf of Aden are completely independent, then an oil-sardine fishery in one of these localities will have no effect upon oil-sardine abundance in the other. If, on the other hand, the oil-sardine in these two localities constitute a single migratory stock, then obviously a fishery in one locality will have an effect on abundance in the other. We recommend that the Commission arrange to have made a review of the available information to the end of (a) defining the stock-identity problem, if any, and (b) suggesting the most appropriate way to attack the problem in view of the nature of the fisheries and handling procedures (and keeping in mind that this is a problem in the context of fishery development and management, perhaps international management).

The Red Sea has anchovy and sardine resources and, in the southern half, important demersal resources. One of the main problems in connection with the further development of the demersal resources appears to be marketing, particularly with respect to those resources in the

territorial waters of Ethiopia (which claims a 12-mile territorial sea and "In the case of pearl and other sedentary fisheries the seaward limit of the territorial sea extends to the limit of the said fisheries." FAO, 1969). Another problem is the presence in the catch of species of no market value locally, such as Leiognathus and Trichiurus, which, however, are marketed in other countries of the region, especially on the eastern side of the Indian Ocean. Building markets within Ethiopia, where the annual per capita fish consumption is low, will take some time, but ready markets may already exist in other countries. We recommend that the Commission arrange for a paper feasibility study of marketing the demersal fishes of the Red Sea. If the results are encouraging, they should be brought to the attention of governments and industry in the expectation that the fishery will develop without further stimulation.

Development efforts for the pelagic species might well be left in abeyance pending the investigations now in progress along the southeast coast of the Arabian peninsula (see below). In any case, the potential stock-identity problem should be kept in mind.

Gulf of Oman

Along the southeast coast of the Arabian Peninsula and in the Gulf of Oman there are important stocks of sardine and tuna. There are sardines in the Gulf between Iran and the Arabian Peninsula, anchovy in the southern part of the Gulf, and demersal resources, including shrimp. Fisheries for the shrimp are already highly developed.

We understand that a private firm is presently investigating the feasibility of a fish-meal and -oil operation based on the sardine. Whether or not this particular investigation results in a commercial operation, such operations seem inevitable sooner or later. As an aid to planning such operations and to resource management, an assessment of the magnitude of the

resources, perhaps using acoustic techniques, would be valuable. We recommend that such an assessment survey be made and understand that it is quite likely that an appropriately equipped and staffed vessel will be made available for this purpose by a non-Indian Ocean country. If so, this work should be integrated with other work in the area by the Commission, as well as any relevant national or bilateral programmes.

Within the Gulf proper there is a problem with respect to the international management of the shrimp resource and we will comment on this subsequently. Shrimp aside, there is need for an assessment survey of the other resources in the Gulf. This could be carried out by coordinated work of the vessels of the Kuwait Government Fisheries Division and of the Trucial States Council. We recommend that such a survey be carried out. UNDP or other participation should provide for the guidance-coordination of the project and for such other support as may be necessary. In addition, concurrently with this survey, or with only a slight time lag, there is already enough known about the demersal resources of the Gulf to rationalize the development of a trawl fishery, which could be financed with a development loan or with private capital. We recommend that the Commission arrange to have the relevant information summarized for use by governments, banks, and the private sector.

Eastern Arabian Sea

This is one of the best known and most heavily-fished areas in the Indian Ocean, particularly in the area around Karachi and along the west coast of India from Bombay south. Similarly, in India there is a large number of state, national, bilateral, and FAO/UNDP programmes all relevant to fishery development. We recommend that a coordinating mechanism be established, through the Commission if appropriate, to ensure coordination and cooperation.

In the area northwest of Bombay to the offing of the Rann of Kutch, there is a fairly extensive shelf area which is known to be a productive ground for trawling.

We recommend that the Commission arrange to have the relevant information summarized in the form of a paper feasibility study, with the view that the development of this fishery might best be stimulated by a broad development-loan project.

We understand that there may be a bilateral project involving a vertically-integrated fishery for tuna off the Makran Coast of West Pakistan. The Commission should determine if it can be helpful in stimulating this project and in any case should follow its development closely and coordinate other fishery surveys in the Gulf of Oman area with it in order to obtain the maximum results from vessel operations.

Western Bay of Bengal

There is presently a fishery-development (exploratory-fishing) FAO/UNDP project in East Pakistan concerned with demersal resources. We understand that a similar project for the demersal and pelagic resources of the east coast of India is under consideration. Beyond these two, no additional exploratory-fishing surveys appear to be needed at this time. There is at present an Asian Development Bank Mission looking into fishery-development problems in Ceylon. The Commission should defer consideration of any action relating to the area around Ceylon pending the report of the ADB Mission.

Eastern Bay of Bengal

Although the fisheries off the west coasts of (especially) Thailand and West Malaysia have grown rapidly in recent years, there still remains a large undeveloped and largely unexplored area along the coast of Burma. We recommend that there be established an exploratory-fishing survey of this productive area. There has been a draft FAO/UNDP project along these lines in existence for some time which has never been formally proposed. If there is an exploratory-fishing survey of this area, it should

be designed specifically around the objective of fishery development.

It may be possible to involve the Southeast Asian Fisheries Development (SEAFDEC) vessel Paknam and, if the survey were also to relate to the area off Thailand and Malaysia, the fishing-research vessels of those countries. If these vessels were involved, other support should provide for guidance-coordination and as much operational support as may be appropriate. There may be a stock-identity problem with respect to the chub mackerel of this area, which may (or may not) migrate over areas off all three countries. Thailand and Malaysia have already established a mechanism to facilitate examination of this problem. Burma should be included, and we recommend that the Commissions arrange for a review of the available information to the end of (a) defining the stock-identity problem, if any, and (b) suggesting the most appropriate way to attack the problem in view of the nature of the fisheries and handling procedures.

Indonesia

The area south of Indonesia, particularly off Sumatra, is one of high productivity. Although the shelf area off Sumatra is not large compared, say, with that of the Bay of Bengal, the average density of demersal fish is higher there than anywhere else in the eastern half of the Indian Ocean and is matched by only a few localities in the western Indian Ocean. There is reason to expect that the offshore pelagic resources may also be abundant, not only off Sumatra, but south of the Lesser Sunda Islands as well. In addition, the Java Sea (lying, of course, north of Indonesia and not part of the Indian Ocean) is known to be a productive area for both demersal and pelagic fishes. From the standpoint of the development of the fisheries (and the economy) of Indonesia, both areas must obviously be taken into account. Thus, any broad development projects would necessarily involve both sides of the archipelago. We therefore recommend that there be established two fishery-development projects in the area: one for demersal fishes and one for pelagic fishes. We understand the fishery-research vessel R. I. Jalanidhi

of Indonesia would be available to participate in such surveys. There is also the likelihood of bilateral assistance, and the possibilities for such assistance should be explored and taken into account in designing the survey. Infrastructure and marketing problems should also be identified and taken into account.

Both the demersal project and the pelagic project will be closer to pre-investment development work than they will be to exploratory fishing. The demersal project might well be modelled on the highly successful Thai-German project in the Gulf of Thailand which rapidly led to commercial development. Similarly, the pelagic project could be based upon the introduction of Philippine-style purse-seining with light attraction. Both projects could be expected to advance rapidly to the stage of commercial operation, perhaps with the assistance of a development loan.

Madagascar and Mauritius

The potential demersal catches in the vicinity of Madagascar, Mauritius, and other oceanic islands is quite large. However, there are FAO/UNDP fishery-development/exploratory-fishing projects in both Madagascar and Mauritius and there is no need for additional work of this nature at the present.

These islands are situated adjacent to productive tuna longline grounds, and our earlier remarks concerning a smaller longline boat apply here as well.

Shrimp

Because shrimp resources tend to be fairly localized, their fisheries initially are highly profitable, and they earn foreign currency, there is a tendency for them to be easily overcapitalized. In fact, we will in a subsequent section make recommendations relating to shrimp management in a specific geographic area. But there is a general need for management strategy by both industry and government, frequently in the face of inadequate or at

least scanty information on which to base management decisions. We recommend that the Commission arrange for a paper review of shrimp fisheries in general to see if it is possible to develop a set of what might be called "rule-of-thumb guidelines" which will be helpful in the management of shrimp fisheries: i.e., are there general features of the growth and development of shrimp fisheries which (a) can be predicted or at least recognized as they occur, and (b) are useful to both industry and government in the efficient utilization and management of the fishery?

The value of the existing catches could be increased considerably -- perhaps even doubled in some cases -- if better handling and quality standards were practised. We will make a specific recommendation on this subject in a subsequent section.

Recent work on a sorting trawl in the fishery for a pandalid shrimp off the northwest coast of North America has shown that such a trawl can reduce the catch of trash fish from 80 per cent to one per cent. The catch rate for shrimp was reduced slightly, but the sorting time on deck was so greatly reduced that crew size could be reduced from four to three. While these results probably cannot be transferred directly to other species in other areas, we recommend that the Commission make this information generally available in the Indian Ocean.

Finally, shrimp resources may exist in depths greater than those in which shrimp are presently fished and we suggest that those designing exploratory-fishing surveys keep this possibility in mind.

Tuna

There is, as we have indicated in several places, an international management problem with respect to the longline tuna fishery. We will discuss this specifically and in more detail in a subsequent section.

We may note again our earlier recommendation for a paper feasibility study of the operation of a smaller longline boat and, if the results are positive, an actual

feasibility trial.

The potential for a large yield of skipjack tunas has been mentioned. Aside from possibilities in the northwest Arabian Sea which we have already specified, the most likely areas for the development of skipjack fisheries are in such island groups as the Laccadives, Maldives, Andamans, Nicobars, those off the southwest coast of Sumatra, and the area around Ceylon. Bringing the skipjack resource into fuller production and at greater value levels involves a number of technological, as well as other, problems. What kinds of live-bait species are available? What is their distribution and abundance? Are they appropriate only for day bait or are they hardy enough to be carried for days or even weeks in live wells? Is purse-seining effective for skipjack fishing in the Indian Ocean and, if so, at what places and seasons? In view of increasing world demand for tuna, and, apparently, especially for skipjack, can value-added be increased? We recommend that the Commission arrange an examination of the skipjack fisheries in Ceylon, the Maldives, and the Laccadives, to see if these operations can be (a) made more efficient, (b) expanded, and (c) can increases be made in value-added. This examination should take the form of a relatively brief field and desk study which would result in the preparation of a specific proposal for an investment project or for a pre-investment project, depending upon the results of the study.

There may also be potential in the stock of the lesser-known tunas or tuna-like fishes including the black skipjack or little tunny, frigate mackerels, and bonito. We make no specific recommendation about these except to remark that those involved in exploratory-fishing surveys should be alert to the possibilities of these species.

International Resource Management

Where a fishery is exploited by more than one enterprise or more than one nation, excessive commitment of capital and labor is the general fate of that fishery unless management measures are taken specifically

to prevent this overcommitment. There is now a substantial literature (Christy, 1969; Gulland, 1968a, 1968b, 1971) demonstrating that high expected rates of profit to individual fishing enterprises tend to draw more investment into the same fishery long after the returns to this investment, for the fishery as a whole, are negative. Except where port markets are highly competitive, this tendency toward overinvestment appears powerfully in the processing sector as well as in fishing. In exceptional instances, these tendencies lead to an overfishing which threatens the short- and long-term physical productivity of the fish resource itself, but the more general objection to overinvestment is that it squanders scarce capital resources which might be productive in some other fishery or in some other economic sector.

There are wholly national fisheries in the Indian Ocean region in which the economically or physically optimum level of fishing activity or of processing capacity may already have been exceeded. Yet, to our knowledge, none of the countries of the region now has the machinery to determine and enforce a limit on the amount of effort committed to specific fisheries. Moreover, there is at least one important international fishery in which fishing effort has clearly exceeded the optimum. No international management machinery of any kind has yet been established within the region, but special committees to consider the longline tuna fisheries have been established by the Commission and by the Indo-Pacific Fisheries Council.

Management policies for fisheries entirely within one nation are inseparable from the broader questions of national fisheries administration and development. The appropriate management techniques will vary according to the kind of resources and the structure of the industry in question, but proper implementation of any of them requires a knowledge of the fishery stock and its dynamics, and the regular collection of information on landings and on economic conditions. International organizations and bilateral-aid programmes on a country basis may assist in building up the institutions of

fisheries administration, statistical services, and resource analysis, but establishment of the scope and manner of regulation is a national problem reflecting national assessments of development priorities. (For instance, the effective fishing pressure on a particular stock might be limited to a specified level either by the sale of a concession to a single, highly capitalized enterprise, or by restriction of fishing rights to boats of a very small maximum size. The first alternative would probably be more profitable and might yield the government substantial revenue; the second might create more employment.) However, requests for grants or credits for specific fisheries operations should include -- and granting or lending agencies ought to demand -- an assessment of the dangers of excessive effort in the particular fishery, and a specification of the measures to be taken to meet this danger. In some instances, grants or loans should not be made without a commitment on the part of the recipient nation to limit further entry into the fishery in order to protect the profitability of the investment in question.

Two investment principles should be especially emphasized: one regarding commercial profitability, the other in respect to economic development policy:

(1) Where access to a fishery is unlimited, the economic life of capital committed to it -- the period over which the investment must be amortized -- is greatly shortened. In some cases it will be in order for granting or lending agencies to calculate depreciation over a period as short as three to five years in evaluating project profit expectations.

(2) Some fisheries ventures will have good commercial profit expectations, considered by themselves, but will waste capital and contribute nothing to economic development because they are additions of capacity to an already fully exploited resource. Generally speaking, grants or loans whose objective is economic development should be confined to projects which

will not result in, or contribute to, excess capacity.

The exploitation of fish stocks in international waters is subject to the same tendency toward excessive fishing effort as are open-access fisheries under a single jurisdiction. Management of international stocks, however, is far more difficult because it presupposes agreement among sovereign states who have different objectives, different price and cost situations, and different institutions in their own fisheries. Two important fisheries of the Indian Ocean region have been identified by the Commission as presenting immediate management problems, and evidence presented to the Commission has established a strong case that total fishing effort in each of these cases is already excessive.

Agreement on international management measures in a particular fishery requires an implicit agreement on the allocation of benefits from that fishery among its participants. Even where it is conceded on all sides that additional fishing effort will not result in a substantial increase in landings, or may indeed decrease them, it will often be difficult to persuade a party whose share of the fishery is increasing rapidly that it will gain more by limitation of effort than by the existing uncontrolled regime.

The tuna longline fishery of the Indian Ocean is a particularly thorny and challenging problem in international management. The fishery is now almost entirely conducted by three nations from outside the region: Japan, Republic of China (Taiwan), and Republic of Korea. The relative shares of these three in the catch have been changing very rapidly, and a number of other nations are considering entering the fishery despite evidence that additional effort will result mainly in a further redistribution of a limited catch at higher costs of harvesting. Potential expansion in worldwide supplies of large tunas is limited, yet demand is expected to continue its rapid growth (Broadhead, 1971). The result will be a continuation of the long-term increase in world tuna prices, and this increase is certain to attract new entrants to the fishery, both from within and outside

the Indian Ocean region. Any management regime for the resources must take into account the desire of additional nations to enter the fishery and must provide for a continuous readjustment of shares to reflect approximately the reallocation which would occur in the absence of regulation. Otherwise, management will be impossible, because some nations may regard it as in their interest to remain outside any agreement. The importance of including all potential participants is intensified by the fact that successful management will assure high catch-to-effort ratios and high profitability, and thereby make entry into the fishery even more attractive than it is now. Moreover, management objectives may be frustrated if fishing interests in presently participating nations attempt to preserve or increase their shares of the catch by transferring existing capacity to "flags of convenience" or to bases in non-participating countries.

The immediate objective of tuna management in the Indian Ocean would be an agreement among the three nations now comprising the bulk of the fishery on means of limiting effort. Three possible mechanisms for obtaining such an agreement are the Indian Ocean Fishery Commission, a body dealing with the world tuna problem as a whole, and negotiations directly among those countries. Over a longer period, any stable management regime must include those three nations and all the potential entrants, both inside and outside the Indian Ocean region. The Commission, of course, is attempting a constructive start on this problem through its Committee on Management of Indian Ocean Tuna.

The shrimp fisheries of the Gulf between Iran and the Arabian Peninsula present a lesser order of difficulties. Here, also, there is evidence that some parts of these stocks are already over-exploited and that a further increase in total capacity is not warranted. In contrast to the Indian Ocean tuna fisheries, however, these stocks exist within an almost wholly enclosed body of water. The probable participants in the fishery are known with a reasonable degree of

confidence, and are confined to the countries bordering the Gulf, since most of the shrimp stocks occur within territorial waters. These countries have moreover made considerable progress in dividing the potential undersea resources of the Gulf. The prospects for agreement on a management regime for these fisheries seem reasonably good, and we recommend that the Commission initiate a conference of the Gulf countries with the objective of arriving at a draft management Convention on shrimp, and perhaps on other marine resources of the Gulf.

Further development of the fisheries of the Indian Ocean will almost certainly bring new issues of international rivalry and over-commitment of fishing effort. Potential problem areas are both demersal and pelagic stocks of the Straits of Mozambique (note here an overlap with the area of the International Commission for the Southeast Atlantic Fisheries which, in the Indian Ocean, includes the area north of 50°S and west of 40°E because of the distribution of the fishes with which it is concerned); the Gulf of Aden and the Coast of Oman; the upper Arabian Sea; the South India-Ceylon area; the Bay of Bengal; and the sea south of Indonesia. Proposals for further resource assessment or for development projects in these areas should take into account these management issues; funding of such operations might be conditioned upon the contending nations' taking steps toward resolving these issues.

The Commission will, of course, be kept informed of the activities of its Committee on Management of Indian Ocean Tuna, as well as of the activities of the Indo-Pacific Fisheries Council's Committee on Management of Tuna in the Indo-Pacific Region (which will, in fact, meet jointly with the Commission's Committee). We recommend that the Commission also keep itself informed concerning the activities of (1) the Indo-Pacific Fisheries Council's Working Party on Economic and Social Aspects of National Fisheries Planning and Development (which is to arrange a symposium on this subject for the Council's 16th Session in 1974) and (2) the Working Party on Scientific Advice to Fishery Management and Development Bodies which may be established by the Advisory Committee on Marine Resources Research.

Product Acceptability and Marketing

Product acceptability, of which quality control is one aspect, is a continuous problem in all food-processing industries. In fisheries these difficulties are exacerbated by the very perishable nature of the raw material. For a variety of reasons, fish are difficult to process well, and, furthermore, the requirements for acceptable processing are constantly being upgraded. For example, the elimination of biological contamination has long been recognized as a key difficulty in the processing of fishery products. Recent developments indicating the presence of chemical contamination (such as mercury content) may force radical changes in processing methods and may even prevent certain products from reaching important markets. Finally, consumer tastes and preferences are continually shifting, requiring the development of new products and the modification of old ones.

We have been particularly impressed by the opportunities for increasing value-added in the shrimp industry at very little additional cost, relative to the existing production and processing costs. We have also been impressed by the need for information about marketing procedures and outlets, particularly with respect to items of international trade.

As a first step to grappling with this diversity of problems, we recommend that the commission arrange an Indian Ocean Fishery "Conference on Product Acceptability and Marketing Problems." Topics that should be covered by such a Conference include:

- (1) Methods and techniques for handling raw fish of various kinds, both at sea and ashore.
- (2) Appropriate standards in relation to biological and chemical contamination. In many instances these standards are relative to the preferences and levels of acceptability standards in the markets for the end product.
- (3) Quality control in processing.
 - (a) Quality requirements for products appropriate for different markets

(b) Evaluation of the costs of quality control in manufacture and the implication of these costs for the choice of alternative markets for end products.

(c) The possibilities of increasing the value-added in manufacturing by improved handling, additional processing, and the development of new end products.

(4) Marketing

(a) Evaluation of the markets within the Indian Ocean area and the standards and preferences within those markets. Analysis of other barriers to product acceptability and use, such as specific handling problems, duties, and tariffs.

(b) Markets outside the Indian Ocean area. This should include analysis of relevant dimensions of important markets for principal products.

(5) Producers associations

The possibilities for, and desirability of, establishing area-wide associations of producers organized along lines of common interest, such as by Commodity Groups, should be explored. Associations of this type exist in many parts of the world and when they are effective they can make an important contribution. They can assist individual producers (countries or firms) with production problems, in finding new markets or expanding old ones, and with new product development. On an area-wide basis, they can develop marketing programmes, conduct institutional advertising campaigns, etc.

Finally, the Conference should be organized in such a way that the topics listed here, and others if appropriate, are considered in a realistic way and that the recommendations arising from it are stated in terms of specific, practical steps that may be taken in solution of the problems identified during the course of the Conference. The Conference should be designed primarily for the benefit of industry (and, to a lesser extent, of governments) and industry should be involved in the planning and organization of the Conference.

Training and the Role of Government in Development

These two topics are considered jointly because they have certain elements in common. One of the philosophical positions underlying this entire report is a recognition of the importance of building institutions: institutions that will be the basis for a pattern of fishery development, that will maximize the gains from these resources to the peoples who live on the margins of the Indian Ocean. The way in which men are encouraged and prepared to follow a career in fishing and the way in which the fisheries are regarded by governments are at the heart of such an institutional framework. The manpower and the skills required in the development and operation of Indian Ocean fisheries run the gamut, from government administrators and lending officers in financial institutions, to the operator of the smallest unit in the inshore fleet. Fortunately, in almost all instances the tasks do not require a level of skills that cannot be acquired relatively quickly by those already trained in other fields. On-the-job training is one of the most effective ways of rapidly developing a manpower pool of skilled operators in any area of enterprise. The types of fishery projects proposed above should, where appropriate, provide for manpower training as part of the project cost. The planning of, for example, a joint venture should include a program for training the nationals of the host country for all operations. The individuals trained in this fashion "on the job" have employment at the tasks for which they were trained, a condition that may not be and, in the past often has not been, fulfilled by broad general training programmes.

Labour mobility may be improved, and hence the supply of trained manpower in the fisheries increased, by removing or reducing institutional barriers to entry and by retraining programmes. Institutional barriers to the entry of individuals with skills should be reduced or eliminated. A thorough re-examination of standards and

requirements should be undertaken by each government to see if they are preventing qualified individuals from entering the fisheries and exercising the skills, initiative, and determination which play such a crucial role in the growth process. For example, the governments should evaluate the requirements for captain of a fishing vessel. Does being the captain of a fishing vessel require, in order to provide for the safety of the crew, the same extensive training required for the captain of a merchant-marine vessel which may operate in any ocean? Any easing of requirements that can be accomplished will contribute to a reduction in the cost of manpower training as well as speed-up the course of fishery development. Retraining programmes are very efficient. The process of economic development is always somewhat uneven, so that certain sectors of any economy may be constrained from rapid growth by a manpower shortage while others are experiencing unemployment. The exploration of this kind of paradox involves both economics and sociology. Individuals may not know about conditions in the labour market elsewhere and therefore may be unable to take advantage of the alternatives potentially available to them. Or for reasons of family, social custom and attitude, or other personal reasons, they may be unwilling to change their life styles. No one should underestimate the reality of these barriers to labour mobility. But at the same time they are amenable to modifications. If a country has a pool of skilled individuals -- for example, engineers with university degrees -- who are underemployed or unemployed, a well-designed retraining programme can quickly and relatively cheaply shift a number to alternative occupations. It is important that such programmes should stress the advantages of the shift, make clear the nature of working conditions in the new occupation, and, to the extent possible, finance the transition.

Special manpower training programmes are also very useful. On-the-job training and improvements in labour mobility will not solve all the manpower needs of the fisheries. They will, however, make a significant contribution to those needs. They have the

great advantage of integrating manpower resources and employment opportunities and of being less costly than special training programmes. Our emphasis on these two aspects of the manpower training should not be taken, however, as a negative view of the many training schools and educational activities in the area. These institutions should be encouraged by their governments, their quality improved, and their activities directly involved in the growth of the fisheries in each country. The firms or governmental units operating the fishing activities, the processors, and the marketing people should all participate in the activities of these schools. Visiting lectures, seminars, and visits to plants and vessels should all be part of a continuing interaction between activities in the industry and the educational mechanism. This will help integrate the two activities and gain additional support for the schools.

Updating the training of the existing staff of fisheries administrators and managers in private firms is also essential. There is already a large pool of individuals in key positions in all aspects of fisheries activities. These include the staffs of governmental agencies, schools and departments of universities involved in training people for fisheries work, and individuals in the private sector. It is vitally important that the level of skills in this crucial group be kept "up to date". Ocean activities are changing rapidly; biological, technological, legal, and economic developments are constantly forcing new approaches and new ways of thinking about problems of fisheries administration. We therefore recommend that the Commission, together with FAO, work jointly on the problem of continually revitalizing the administrators through the use of regional seminars, short (say, for a month) "refresher" experiences, and the opportunity to move between organizations (say, for three-to-six-month periods).

Regional training programmes may be advantageous for certain types of fisheries education. This would assist those countries whose resources do not permit them to provide adequate schools and, by the

elimination of duplication, reduce the cost of training to the area. It is important, however, before undertaking a regional training programme, to ascertain what kinds of training are required to meet the specific demands for skilled manpower and whether they can best be supplied in this manner.

Governments tend to look at different kinds of activities in terms of their relative importance. It is always difficult to change the traditional order and structure. Yet if fisheries are to develop, they will require, in certain countries, greater consideration than they have thus far received. Consideration means, of course, greater budget allocations, but it also means changes in status and attitudes. Part of this can come from the sort of activity described with respect to training schools, a higher level of inter-relationship between those actually engaged in operations and those responsible for planning or managing projects, as well as the regulation of fisheries. The Commission can also have

a salutary effect. By its presence as a high-level intergovernmental body it can indicate the importance of rational development of the Indian Ocean fishery. And in so doing it can encourage governments and individuals to look upon the fisheries as an important element in the national economy, an element worthy of the same consideration and status as other sectors of the economy.

To sum up, we believe there are pressing training or educational needs at the managerial level. But in general we believe that institutional training is justified only when the rapid growth of a particular fishery (industry) strains the supply of needed manpower. (A good example is the FAO/UNDP Deep Sea Fishing Training Centre in Pusan which supplied the personnel for the rapidly expanding Korean tuna longline fleet.) Otherwise, we believe that training needs can best be met by on-the-job training. Therefore, we recommend that all development projects include provision for on-the-job training, not only through association with the project, but by working with appropriate organizations elsewhere.

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CHAPTER VII

OTHER PROPOSALS AND CONSIDERATIONS

Proposals From Consultants' Reports

The reports from the several consultants, which follow in this series, contain a number of recommendations in addition to information reviews. Many of these recommendations and much of the information have been embodied in one form or another in the preceding chapters. Those points which were not thus included and which we believe require special mention follow here.

Mangrove Swamps

In discussions of aquaculture in general, or coastal aquaculture, or of country fishery-development plans, the statement "We have x-thousand hectares of mangrove swamps available for conversion to coastal aquaculture facilities" is frequently encountered, as though these areas were the same as money in the bank. It is true that, if these mangrove swamps are to be converted to other use, the most appropriate use probably is coastal aquaculture. But we do not believe that the ecology of these areas is sufficiently well-known so that even the practical ecological cost of destroying the swamps — i.e., the loss of the areas as a nursery ground for shrimp and fish — can be included in the cost-benefit estimates. It may be that their value in this regard is negligible, or it may be that their value in this regard is so great that any coastal aquaculture scheme based on converting mangrove swamps could only result in a net economic loss, or it may be that under judicious management they may be used for both natural production and aquaculture. The point is that there simply is not enough known to make an intelligent choice from among these alternatives. What is needed, as a first step, is a summary of the existing

ecological information on mangrove swamps, particularly with respect to their importance as nursery grounds of commercially important fishery resources or their importance to commercial fisheries in any other way. We recommend that the Commission arrange to have such a summary made. Following the completion of the summary, the Commission can then decide what additional work, if any, needs to be undertaken.

Coral Areas

The productivity (of fish) of coral areas and the behaviour of the fish as this relates to the ease or difficulty with which they may be captured in commercial quantities are very little known. There are extensive coral areas in the Indian Ocean in the form of oceanic banks, atolls, and fringing reefs. How best to harvest and manage these is not known, but, owing to the numbers and diversity of species present, it is certain that this will have to be done on some general, simplifying basis rather than on a species-by-species basis. As in the case of the mangrove areas, the first step is the preparation of a summary of the existing ecological knowledge of coral areas, particularly as related to fish productivity, harvesting, and management of fishery resources. We recommend that the Commission arrange for such a summary. Decision about additional action should be deferred until completion of the summary.

Fish Eggs and Larvae

Collections of fish eggs and larvae can be very useful in determining the abundance and distribution of fishery resources, as well as their very presence or absence. If, however, the means of

making the collections, sorting the samples, and identifying the fish eggs and larvae, which are all very costly, has to be charged completely against fishery development, then this is an investment which would rarely, if ever, be made. On the other hand, if most or all of these components are already charged against other undertakings and can be made available at little or no cost, then full use should be made of such opportunity. Fortunately, such an opportunity exists in the Indian Ocean region. There is at Cochin, in south India, the Indian Ocean Biological Centre, started under the aegis of UNESCO and now included in the structure of the National Institute of Oceanography. The IOBC is fully staffed for plankton work and, in fact, has already examined many of the collections resulting from the International Indian Ocean Expedition. We understand that the IOBC would be willing to continue work on Indian Ocean plankton samples, particularly with respect to fish eggs and larvae, provided that the samples could be made available. Samples could be collected at very little additional cost by FAO/UNDP and national vessels operating in the Indian Ocean. We recommend that the Commission verify this interest on the part of the IOBC and make arrangements to have the collections made. Particular attention should be paid to (a) the design of the sampling programme, (b) the kind of net used and the method of hauling, (c) preservation, storage, and handling techniques, and (d) identification.

Resource Information From Exploratory-Fishing Fishery-Development Projects

During the course of the projects which involve fishing, a great deal of information is accumulated on the identity, distribution, and abundance of fishery resources. Aside from any publications which may result from such projects, there is apparently no organized way in which all of this accumulated information is presently stored and no way in which it can be readily retrieved and recombined in various ways. This situation could be obviated if a standard form were available on which the pertinent information (including certain environmental data) could be recorded and if such forms, after being completed aboard

project vessels, were deposited in the regional statistical centre (proposed earlier). We recommend that the Commission arrange: (a) to have an appropriate form designed, (b) to have all projects in the Indian Ocean cooperate in supplying the desired information, and (c) to have these data generally available through the regional statistical centre (or otherwise if such a centre is not established). While we recognize possible advantages in considering this problem together with similar problems from other geographic areas, we recommend that this action for the Indian Ocean proceed without being linked, and thus made time-dependent, with similar problems elsewhere.

It is also appropriate to mention here the desirability of making the necessary arrangements to insure comparability of data from area to area. Such inter-area comparability will enable comparisons of the resource base and facilitate economic-feasibility projections. Comparability can be ensured through the use of standard gear and techniques or, if, as is likely, this is not feasible, through the inter-calibration of the different brands of gear used. Neither of these alternatives will be costly; they probably could be covered by normal operating costs. This procedure is particularly important in the case of trawling, since there is already a large body of "standardized" data for the Indo-Malay regions.

Contracts and Charters

We believe that it may sometimes, perhaps frequently, be advantageous to operate projects through contracts with appropriately specialized institutions or firms rather than by recruiting a full project staff. We realize that this is already done occasionally but believe that it might profitably be done more frequently. We recommend that this possibility be seriously considered for each new Indian Ocean project. Similarly, we believe that it may frequently be more efficient to charter vessels than go

through the delay and operational problems of building and operating vessels. We realize, of course, that there are advantages and disadvantages to both alternatives. We recommend that the possibility of charter be seriously considered for each new Indian Ocean project requiring vessels.

Information Transfer

There are apparently many gaps or breaks in the nexus of information transfer within and between countries in the Indian Ocean region and between countries within and without the region. While the Commission can be useful in facilitating the flow of information at some levels and while it might be easy to make a general recommendation concerning the enlargement of extension service activities, we recognize that this is a complex problem not likely to be easily or fully solved. We do believe, however, that most of the actions we have recommended elsewhere in this report will have, as one of their important effects, the facilitation of the transfer of information on matters critical to development. It is obvious that the testing and demonstration of new gear developments is a very effective form of extension work. We recommend that this be included as an integral part of all FAO/UNDP fishery-development projects involving the use of vessels, with the understanding that this would be clearly distinct from feasibility-type fishing trials.

Vessels and Equipment

The design of vessels and equipment in use in the region has come about either through pragmatic endemic development or the transfer of designs developed outside the region. The result of the combination of these two processes has not always produced the most efficient fishing units, taking into account local conditions of sea and wind and the behaviour of the fishes involved. We recommend that the Commission arrange for a marine architect to provide an inventory of the kinds of vessels and equipment in use in the region and, especially, to

identify potential improvements in the light of local sea, wind, and resource conditions.

Shipyards

With some few specific local exceptions, the shipyard facilities for construction and repair are generally inadequate throughout the Indian Ocean region. We recommend that provision be made for such facilities, including boat lifts and slipways, in or adjacent to fishing harbours as these are developed in the region.

Harbours

As in the case of shipyards, fishing harbours are generally inadequate. We recommend that the Commission arrange for an engineer to provide an inventory, by countries, of the harbour needs and the potential sites for expansions or development. We also recommend that all FAO/UNDP fishery-development projects should automatically include provision for a more detailed assessment of the harbour requirements, potential sites, and approximate development costs. We expect that countries would, of course, include consideration of harbour requirements as part of their general fishery-development plans. The inclusion of fishery harbours within regular commercial harbours almost always results in unsatisfactory conditions for the fishing interests. We recommend that, in harbour-development plans, provision be made for fishing harbours distinct from the general commercial harbours.

General Economic-Development Policies

While it is beyond the scope of this report to consider in detail the general economic-development policies of the Indian Ocean countries (but see Clement, 1971), it is still necessary to touch on them because of their effects on fishery development. In several countries the overvaluation of currency and chronic balance of payments problems lead to stringent controls over foreign transactions.

These conditions militate against the development of industries, such as the fishing industry, which may still be dependent upon imports (e.g., engines, electronic equipment, spare parts, synthetic nets, diesel fuel, etc.) or which may produce for the export market. While we are not the group to do so and this is not the forum in which to recommend currency devaluation, still we may note these effects and hope that governments as well are aware of them. Furthermore, because of the apparent rather general lack of appreciation of the difficulties by overvaluation of currency on that part of the fishing industry engaged in exporting, we recommend that the Commission arrange for (a) a tabulation of the possible mechanisms to ameliorate these difficulties (e.g., export vouchers allowing conversion of foreign-currency earnings at free rates, opportunity to use foreign currency earnings for the purchase of needed imports, etc.) and (b) an inventory of the mechanisms actually in use in Indian Ocean countries.

Demand Projections

Demand projections have been supplied (Broadhead, 1971; Peckham, 1971; Alverson, 1971; Lanier, 1971; Alverson and Broadhead, 1971) for five important items of international trade: tuna, shrimp, crab, groundfish, and fish meal. All of these are in the position of continuing growth in demand which will require bringing into production additional sources of supply. The constraints associated with these fisheries are examined and, where they exist, the special advantages of the Indian Ocean region are brought out. We have no special recommendations relating to these fisheries that have not already been made in the earlier sections, but we do especially call these demand studies to the attention of all interested in these fisheries.

Government Enterprises

There are in the region a number of government-operated cooperatives and fishing enterprises. Government accounting procedures are well-known to be such

(and not just in the Indian Ocean region) as to make it extremely difficult to judge whether these enterprises have been successful in the sense that a privately operated venture would be judged (i.e., do earnings exceed costs?). In any case, since there are a number of planned economies in the region, it would be very useful to make a comparative study of such enterprises toward the end of identifying those features which tend to make for a successful operation and those features which tend to make for an unsuccessful operation. We recommend that the Commission arrange for such a study.

Business Management

While we were impressed by the dedication and professional competence in their own specialities of both government and business personnel in managerial positions, we were equally impressed by the lack of managerial knowledge and skill and the fact that apparently none of the training schemes takes account of these lacks. We regard this as one of the major problems in fishery development and, in fact, many of the other problems we have identified can, we believe, trace their origins to this problem. We recommend that governments review their educational programmes and make such changes as may be appropriate to meet this need. It would also be useful to establish some kind of contact between fisheries and such more sophisticated Management Institutes as may exist in the region in the hopes of attracting some of the graduates of such institutes into both government and industry.

Some Policy Proposals

There have been made a number of policy or guideline proposals in the other sections of this report. A few more are presented here. Some of them may appear to be so obvious as to constitute truisms; still, it seems worthwhile to state them.

We recommend, as we have done in specific instances throughout the report, that use be made of existing facilities where possible, as opposed to the constitution of duplicating or overlapping

facilities. This will have the advantage, just mentioned, of avoiding duplication. It may have the advantage of making fuller use of a physical facility, such as a ship or of increasing the capacity of a physical facility ashore by building on it as a nucleus. The greater use of an institution, in the sense of a group of people, should act to strengthen it in the community.

We think that, clearly, no one country will wish or be able to afford all of the possible kinds of fishery-development activities. Thus, choices will have to be made. Some of these will clearly be determined by the distribution of resources, others by cultural characteristics, and still others, perhaps, by a process of accommodation with other countries.

Quite frequently, if not invariably, exploratory-fishing/fishery-development projects have as their objectives: (1) the conduct of exploratory fishing in the sense of examining the economic feasibility of a fishery, and (2) the training of vessel crew-fishermen, both to be carried out simultaneously (in the course of the same operation). It seems quite clear, particularly in the case of highly sophisticated gear, that these two objectives are mutually exclusive and that to attempt them simultaneously is to invite failure. If economic feasibility is to be examined, it should be done in the best possible circumstances (with an experienced crew). If done otherwise, a potentially valuable fishery may appear wrongly to be economically infeasible. Once the feasibility has been established, then the training objective can take precedence. (And if the fishery is not economically feasible, why train fishermen?). We do not wish to overstate the problem, of course, and there are obviously instances in which the exploratory fishing can be interrupted for a day or two from time to time to allow for training demonstrations for fishermen of the area where the feasibility trials have been taking place. But we do recommend that in further projects the distinction between these two functions be clearly appreciated and that they be separated operationally. The same general comment

may also be made about experimental fishing: i.e., it should not be confused with exploratory fishing or with training.

It is anticipated that, as many of the projects develop, IERD or the regional banks will become involved either in making loans or providing technical assistance. Such institutions should be involved very early in the development process, not only so that they may more effectively carry out their work, but so that the Commission may have the benefit of their fields of competence.

Mariculture

We have not, perhaps erroneously, included mariculture in our proposals (except as this possibly relates to mangrove swamps as nursery grounds of shrimp and fish), in part because of some uncertainty concerning the interest of the Commission in this subject. Although mariculture is not specifically mentioned in the Commission's Terms of Reference, it clearly is not excluded. The Commission, however, during the course of its two sessions has not considered the subject. We recommend that the Commission confirm its intent to include mariculture in the concept of fishery development and thus in the process of project identification proposed to be carried out by the Technical Staff. We assume the Commission will wish to extend its cooperation with the Indo-Pacific Fisheries Council to include mariculture, particularly with respect to the activities of the Council's Working Party on the Economics of Aquaculture which might be made a Joint Working Party.

Fish Protein Concentrate

We have not included fish protein concentrate (FPC) in our proposals for a variety of reasons. The processing technology is still new and complex. Marketing is difficult in view of the quality and packaging standards established by the U.S., for example. Desirable characteristics of FPC may vary widely in different parts of the world. Markets and demand are uncertain. FPC manufacturing requires large, continuing supplies of low-cost raw material, as does the manufacturing

of fish meal and oil. The latter is a well-established process, with well-established markets and growing demand and would seem much the wiser course to take at the present time. The Commission may wish to keep itself informed on the status of FPC manufacturing processes, markets, and demand, and we recommend that it do so.

Contamination

The previously known problem of the accumulation, in areas where there is exposure, of DDT (or chlorinated hydrocarbons in general) in body fat is well known and does not appear to be a serious impediment to the utilization of marine fishes. The more recent alarms over mercury in tuna and swordfish are, in fact, so recent that it is as yet impossible to appraise realistically their implications vis-à-vis product standards and demand. It seems certain that this particular problem will be extensively investigated in Japan and the U.S., if not elsewhere. It also seems quite likely that a whole new broad line of enquiry will have been stimulated by this finding, and reports of other contaminants, as well as improved understanding of fish physiology and marine ecology, can be anticipated.

Because of the obvious implications in fishery development, the Commission may wish to keep itself informed of developments in this general area and we recommend that it do so.

Suez Canal

The reopening of the Suez Canal, whenever that may occur, will have at least two obvious effects on Indian Ocean fisheries. It will provide a shorter route to European and eastern North American markets for fishery products and a more direct source of supplies (e.g., spare parts, electronic equipment, etc.). At the same time it will supply a shorter route to Indian Ocean fishing grounds to vessels from such countries, for example, as Greece and the USSR, so that the amount of fishing by non-Indian Ocean countries could be expected to increase appreciably. We mention these two classes of effects in passing, since they must be taken into the planning process at some point. The reopening would also result in an increase in the activities in the Indian Ocean of research vessels from some European countries.

CHAPTER VIII

COSTS, FUNDING, SCHEDULING, AND PRIORITIES

The essence of this chapter is contained in the lengthy tabulation which makes up most of the chapter. In this tabulation the recommendations or proposals are grouped in five categories. The proposals are ranked by priorities (A, B, C, or D) within each category; the categories themselves are not ordered by priority. Also shown are the year in which the project should begin, its duration, cost, number of vessels involved, possible sources of support, explanatory comments, and a reference to the page on which the recommendation is discussed in the report.

All of this is reasonably straightforward except the assignment of priority. It is not possible to make a meaningful priority assignment without knowing what funds are available, since the significance attached to different proposals will vary according to whether the funds available are X, 10X or 100X. Furthermore, with respect to country proposals, there will obviously be some variation in the vigour

with which individual countries support the proposals, so that a project of first priority may not be vigorously promoted while one of second or third priority is. There may be a tendency to support inexpensive projects before expensive ones or easy projects before difficult ones, regardless of priority, and so on.

Some statistics on existing projects in the region may provide useful terms of reference in which to consider the proposals. There are presently nine projects whose total costs are \$17,307,237. Individual project costs range from \$656,900 to \$3,047,778, with an average of \$1,923,026; the UNDP contributions range from \$360,600 to \$1,898,700, with an average of \$1,062,844. The durations range from two to five years, with an average of 4.2 years. The proposed east coast of India project will have a total cost of about \$3,500,000, a UNDP contribution of \$2,400,000, and a duration of six years.

The tabulation follows:

| | PROJECT | PRIORITY | BEGIN IN YEAR | DURATION | COST | NUMBER OF VESSELS |
|-----|---|----------|---------------------|----------|---------------------|-------------------------|
| I. | <u>Investment Projects</u> | | | | | |
| | 1. Trawl fishery feasibility, Gulf between Iran and Arabian Peninsula | A | 1 | 3 months | \$ 8,500 | - |
| | 2. Trawl fishery feasibility, NE Arabian Sea | A | 1 | 3 months | \$ 8,500 | - |
| | 3. Skipjack tuna fishery feasa- bility, Indian Ocean | A | 1 | 6 months | \$ 18,000 | - |
| | 4. Small-boat tuna longline fishery feasibility, Indian Ocean | A | 1 | 3 months | \$ 8,500 | - |
| | 5. Small-boat tuna longline fishery trials, Indian Ocean | B | 2 | 2 years | <u>\$ 270,000</u> | 1 |
| | | | | | \$ 313,500 | |
| II. | <u>Pre-investment Fishery-Development Surveys</u> | | | | | |
| | 1. Pelagic fish-assessment sur- vey, NW Arabian Sea | A | 1 | 1 year | \$ 430,000 | (1) |
| | 2. Demersal fish-assessment survey, Gulf between Iran and Arabian Peninsula | A | 1 | 2 years | \$ 320,000 | (2) |
| | 3. Demersal fishery development; introduction of trawling, Indonesia | B | 2 | 3 years | \$ 470,000 | (1) |
| | 4. Pelagic fishery development; introduction of purse-seining with light, Indonesia | B | 2 | 2 years | \$ 505,000 | 1 |
| | 5. Shrimp, lobster, and demersal fish-assessment survey, East Africa | C | 2 | 2 years | \$ 260,000 | (2) |
| | 6. Exploratory fishing-fishery development survey, Burma | C | 3 | 3 years | \$ 895,000 | 1 |
| | 7. Resource-assessment informa- tion from fish eggs and larvae | D | 1 | 5 years | <u>\$ 50,000</u> | - |
| | | | | | <u>\$ 2,930,000</u> | |

| POSSIBLE SOURCE OF SUPPORT | C O M M E N T S | PAGE REFERENCE |
|--|--|----------------|
| IBRD, UNDP, bilateral, country | | 49 |
| IBRD, Asian DB, UNDP, bilateral, country | | 49 |
| IBRD, Asian DB, UNDP, bilateral | | 51 |
| IBRD, African DB, UNDP, bilateral | | 47 |
| IBRD, African DB, Asian DB, UNDP, bilateral, country | | 47 |
| UNDP, bilateral | Number of vessels shown in parentheses indicates vessel costs are not included in cost figures; in this case it is assumed that vessel will be provided under a bilateral programme. | 49 |
| UNDP, bilateral | Plus country contributions of two vessels, local crew, operating costs, counterpart staff; local facilities | 49 |
| UNDP, bilateral | Plus country contribution of vessel, local crew, operating costs, local facilities. | 50 |
| UNDP, bilateral | Plus country contributions of operating costs, counterpart staff, local facilities (could be combined administratively with preceding project). | 50 |
| UNDP, bilateral | Plus country contributions of two vessels, local facilities. | 46 |
| UNDP, bilateral | Plus country contribution of operating costs, local crew, counterpart staff, local facilities. | 49 |
| UNDP, bilateral | Most costs can be borne by existing projects and institutions. | 58 |

| PROJECT | PRIORITY | BEGIN IN YEAR | DURATION | COST | NUMBER OF VESSELS |
|---|----------|---------------------|-----------|------------|-------------------------|
| III. <u>Feasibility and other studies</u> | | | | | |
| 1. Feasibility of marketing Red Sea demersal fishes | A | 1 | 3 months | \$ 8,500 | - |
| 2. Joint-venture review and drafting of agreement and law | A | 1 | 1 year | \$ 28,000 | - |
| 3. Shrimp fisheries review for management guidelines | A | 1 | 6 months | \$ 16,000 | - |
| 4. Currency-valuation problems review | A | 1 | 3 months | \$ 8,500 | - |
| 5. Increased value of tuna fisheries, East Africa | B | 1 | 12 months | - | - |
| 6. Oil-sardine stock identity, Arabian Sea | B | 1 | 3 months | \$ 8,500 | - |
| 7. Chub mackerel stock identity, eastern Bay of Bengal | B | 1 | 3 months | \$ 8,500 | - |
| 8. Function and form of Regional Fishery Development Agency | C | 2 | 6 months | \$ 16,000 | - |
| 9. Vessel and equipment improvements | C | 2 | 2 years | \$ 56,000 | - |
| 10. Inventory of harbour needs and sites | C | 2 | 2 years | \$ 56,000 | - |
| 11. Government cooperatives and enterprises | C | 3 | 1 year | \$ 28,000 | - |
| 12. Importance of mangrove swamps to shrimp and fish production | D | 3 | 3 months | \$ 8,500 | - |
| 13. Coral-area fish production, harvesting, and management | D | 3 | 3 months | \$ 8,500 | - |
| | | | | \$ 251,000 | |

| POSSIBLE SOURCE OF SUPPORT | C O M M E N T S | PAGE REFERENCE |
|--|---|-------------------|
| UNDP, IBRD, African DB, bilateral | | 48 |
| UNDP, IBRD, African DB, Asian DB, bilateral | | 45 |
| UNDP, IBRD, African DB, Asian DB, bilateral | | 51 |
| UNDP, IBRD, African DB, Asian DB, bilateral | | 60 |
| | Activity would be carried out by countries and presumably small costs would be borne by them | 47 |
| UNDP, bilateral | | 48 |
| UNDP, bilateral | | 50 |
| UNDP, bilateral | | 45 |
| UNDP, IBRD, African DB, Asian DB, bilateral | | 60 |
| UNDP, IBRD, African DB, Asian DB, bilateral | | 60 |
| UNDP, IBRD, African DB, Asian DB, bilateral | | 61 |
| UNDP, bilateral | | 58 |
| UNDP, bilateral | | 58 |

| PROJECT | PRIORITY | BEGIN IN YEAR | DURATION | COST | NUMBER OF VESSELS |
|---|----------|---------------------|----------|---------------------------|-------------------------|
| IV. <u>Institutional and management arrangements</u> | | | | | |
| 1. Commission Technical Staff | A | 1 | 5 years | \$1,070,000 | - |
| 2. Regional statistical centre | A | 1 | 5 years | \$ 275,000 | - |
| 3. Fisheries Joint Venture Advisory Board | A | 1 | 5 years | - | - |
| 4. Coordination Gulf of Aden activities | B | 1 | 5 years | - | - |
| 5. Coordination E. Arabian Sea activities | B | 1 | 5 years | - | - |
| 6. Storage-retrieval project resource information | B | 1 | 5 years | - | - |
| 7. Meeting on Management Shrimp Fisheries, Gulf between Iran and Arabian Peninsula | C | 2 | 1 week | - | - |
| 8. Information on shrimp trawls | C | 1 | 1 week | - | - |
| | | | | <u>\$1,345,000</u> | |
| V. <u>Conference and training</u> | | | | | |
| 1. Management fellowships and seminars | A | 1 | 5 years | \$ 100,000 | - |
| 2. On-the-job training | A | 1 | 5 years | - | - |
| 3. Conference on Product Acceptability and Marketing | A | 2 | 1 week | \$ 30,000 | - |
| | | | | <u>\$ 130,000</u> | |
| | | | | <u><u>\$4,969,500</u></u> | |

| POSSIBLE SOURCE OF SUPPORT | C O M M E N T S | PAGE REFERENCE |
|--|--|-------------------|
| UNDP | Presumably most of the feasibility studies, etc. would be arranged by the Technical Staff; if funds for these are included here the total should be increased by \$374,500 | 40 |
| UNDP, bilateral | | 43 |
| - | Small costs presumably will be borne by participating organizations | 45 |
| - | Small costs can be borne by organizations involved | 48 |
| - | Small costs can be borne by organizations involved | 49 |
| - | Small costs can be borne by organizations involved, including regional statistical centre | 59 |
| - | If arranged through Commission, FAO would provide meeting costs | 53 |
| - | Small costs can be borne by Technical Staff | 51 |
| UNDP, bilateral | | 57 |
| - | Costs to be included in project proposals | 57 |
| UNDP, IBRD, African DB, Asian DB, bilateral | | 54 |

CHAPTER IX

SCHEDULE OF EVENTS RELATING
TO INDIAN OCEAN PROGRAMME

The following schedule of events relating to the Indian Ocean Programme will serve as an outline of activities through January 1972 and will also call attention to the Commission's Executive Committee Meeting (26 - 30 April 1971 in Rome), the Meeting of Programme Consultants (8 - 10 September 1971 in Rome), and the deadline (January 1972) for country submission to be considered at the June 1972 session of the UNDP Governing Council.

4 - 29 January 1971

Draft "Plan for Fishery Development in the Indian Ocean" prepared by Marr et al.

February 1971

In-house review of draft Plan by FAO Department of Fisheries Division Directors and their colleagues.

10 - 12 March 1971

Review of draft Plan by FAO advisory group, the Economic Advisory Committee.

10 - 17 March 1971

Review of draft Plan by FAO advisory group, the Advisory Committee for Marine Resource Research.

15 - 19 March 1971

Review draft Plan on basis of comments and suggestions received.

4 January - 26 March 1971

Prepare (edit, print) consultants' reports for Commission Executive Committee Meeting to meet 5 April 1971 mailing deadline

31 March - 6 April 1971

International Indian Ocean Expedition Symposium in Kiel; paper on Indian Ocean fisheries by Marr

15 - 21 April 1971

FAO advisory group, the Committee on Fisheries meets, progress report on Indian Ocean Programme

22 - 24 April 1971

Joint meeting of the Commission's Committee on Management of Indian Ocean Tuna and the Indo-Pacific Fisheries Council's Committee on Management of Tuna in the Indo-Pacific Region.

26 - 30 April 1971

First meeting of the Indian Ocean Fishery Commission's Executive Committee; presentation of the "Plan for Fishery Development in the Indian Ocean" and background papers to the Commission through the Executive Committee.

May 1971

Transmit Plan to Commission Member Governments, other interested Governments, UNDP, IBRD, and Regional Banks.

May - July 1971

Visits to economically developed countries interested in the Plan by the Programme Leader.

June - December 1971

Preparation of country proposals to UNDP.

8 - 10 September 1971

Meeting of Programme Consultants from economically developed countries to discuss Plan and what role each country might play in its implementation.

October - November 1971

Visits to Indian Ocean countries by the Programme Leader.

January 1972

Deadline for submission of country proposals to UNDP for consideration at June 1972 meeting of Governing Council.

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CHAPTER X

ACKNOWLEDGMENTS

The reader will know that it has been necessary for us to depend on and perhaps in many cases to impose on, a large number of people in order to be able to complete this report. The reader, as well as those to whom we are indebted, will also realize that it is impossible for us to acknowledge all of these obligations individually. We do, however, take pleasure in being able to acknowledge the following.

The people contacted in government and industry in the Indian Ocean countries were extremely generous with their time and knowledge to those of us writers who travelled in the region, as well as to those Programme consultants who also travelled in the region and whose reports follow in this series. Their help was literally indispensable and the information

they imparted was illuminating. The assistance of the UN Resident Representatives, and their colleagues, and the FAO Senior Agricultural Advisor were equally invaluable for their funds of knowledge and insights which they gladly shared, not to mention the myriad of more mundane matters such as local transportation, hotel accommodations, etc., which they arranged.

This report has been widely reviewed in draft, with resulting suggestions leading not only to improved clarity of expression but also to improved clarity of thought. Detailed reviews were received in writing, with also an opportunity to discuss them, from a number of people (and their colleagues) in the FAO Department of Fisheries, including:

| | |
|----------------|--|
| Roy I. Jackson | Assistant Director-General |
| H.C. Winsor | Director for Operations, Office of AD-G |
| V. Shah | Technical Officer, Office of AD-G |
| M. Ruivo | Director, Fishery Resources Division |
| J.A. Storer | Director, Fishery Economics and Institutions Division |
| H. Watzinger | Director, Fishery Industries Division |

The report was reviewed by two FAO advisory groups: The Advisory Committee on Marine Resource Research, which is an advisory group to both FAO and UNESCO, and the Economics Advisory Committee, an advisory group to the Division of Fishery Economics and Institutions. The meetings of these two groups came at a time when

this report was still in draft and it was, fortunately, possible to include the reviews in their already full agendas.

The report was also reviewed in considerable detail by a small group, convened especially for that purpose, consisting of:

W.P. Appleyard

Project Director
 Proyecto UNDP/FAO 449 Peru
 Apartado 97 Miraflores
 Lima
 Peru

A. Morgan

Angel Flores 108 PTE
 Mazatlán
 Sinaloa
 Mexico

L.I.J. Silva

General Manager
 Ceylon Fisheries Corporation
 Columbo
 Ceylon

In addition to his FAO/UNDP experiences in Peru and Korea, Appleyard was formerly Managing Director of the International Division of Ross Group Ltd. Morgan has had fishing experiences as well as a substantial number of years in bilateral aid programme in Korea (primarily), Pakistan, and elsewhere. Silva has a formal background in economics and progressively responsible experience in government. This group, perhaps more than any of the other groups or individuals, had adequate time to go over the report in great detail and their highly competent and incisive comments were of great assistance.

The cost estimates were kindly supplied

by N. Kajima, Senior Officer, Project Operations, to whom we are indebted.

Finally, we wish to thank Kellogg Smith who has served as editor and, if you will, production manager by overseeing manuscript typing, making sure that illustrations were prepared at the appropriate times, seeing that manuscripts got to the printer on schedule, etc., all to the end of meeting a mailing deadline in advance of the Commissions Executive Committee Meeting, 26-30 April 1971. He did this, not only for this document, but for the 21 which follow it in this series and which constitute the documentation for the Executive Committee Meeting.

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