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FISH PRODUCTION POSSIBILITIES
IN
EASTERN AND SOUTHERN AFRICA

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I. INTRODUCTION

The major purpose of this brief report is to explore areas of possible USAID assistance to the countries of Eastern and Southern Africa in marine and fresh water food production. The continuing need to find local means of providing and upgrading a proper nutritional diet should encourage exploration into any means of increasing both caloric and protein intake in those countries where malnutrition and food imports are endemic. One partial solution can be found through increased aquatic food production and distribution. Secondly this report is designed to present an overview of the major problems faced in aquatic food production and the donor efforts that have been made to date.

The report constitutes a summary effort and is not meant to be a complete nor lengthy investigation of the topic. Consequently the report does not detail specific country situations, but is more regional in scope. It is hoped, though, that it will serve Directors and other USAID personnel with background information useful in determining the possibility of providing assistance to host countries.

Included is a list of publications that might be helpful in investigating problems and potentials further. They are available through the S&T Bureau, AID/W or can be found in the REDSO/EA library, Nairobi.

II. EXECUTIVE SUMMARY

This section is included to give the casual reader a general overview of the major points included in this report.

A. Present Situation

Fish production has been fairly constant over the last decade (Fig 1), whereas world population has steadily risen. Marine fisheries have constituted the great majority of fish production, with the output being absorbed by developed countries. Fishing effort and thus exploitation generally lies in the hands of developed nations. Marine fisheries in Eastern and Southern Africa are small and poorly equipped, but there appears to be opportunity for further exploitation in the East Indian Ocean.

Inland fisheries worldwide constitute a small portion of total fishing catches. In the East African region fresh water fisheries have possibly over-exploited the natural aquatic resources. Some steps have been taken to introduce aquaculture and consequently pond culture has expanded.

Fish consumption has remained highly localized in the region and wastage of products is fairly endemic.

B. Problems in Selected Areas

Although generalizations can be locally inappropriate, for the most part statements regarding the fishing industry hold true throughout the region. Major problems are grouped under the following headings: deep sea fishing, coastal fishing, marine controlled environments, lake and river fishing, intensive freshwater aquaculture and overall marketing/organizational problems.

There is very little deep sea fishing done by local (EA or SA) fishermen. This is because of the major costs of production and marketing/storage facilities, the lack of expertise and perhaps the high risks involved in establishing deep sea fishing.

Coastal fishing (within sight of land) is fairly widespread, but the catch is quite small, the equipment used is poor, there is a decided lack of technical expertise, little is known about fish resources, the costs are high for the individual artisanal fisherman, and there is poor marketing and organizational backup for the fishermen.

Controlled marine environments are expensive to build and maintain, need a high level of initial technical assistance and demand a well-established marketing system for the products. All these factors are constraints in Eastern and Southern Africa.

Lake and river fishing is hindered by the lack of marketing organizations, lack of understanding of proper fishing methods (to lessen exploitation of immature stock and maintain stock equilibrium) and overfishing in some areas.

Pond and intensive aquaculture are faced with the problems of land and water availability, need for expert technical assistance, need for capital and the lack of a marketing infrastructure to support the fisheries industry.

In all of the areas mentioned marketing and management problems can be found. Over 10 million tons of fish are lost world-wide annually through lack of facilities and carelessness. There is a lack of adequate storage and preservation facilities, lack of proper transport, lack of consumer education and a lack of proper management (in fishermen groups and government's fisheries departments).

Donors providing assistance include USAID, FAO, Japan, ODM, NORAD, Peace Corps, FAC and some others.

C. Recommendations

The major problem areas where the authors feel that USAID can make significant, cost-effective contributions to the development of local fisheries are:

1. Fisheries management and fishermen's expertise;
2. Fisheries infrastructure in production and marketing;
3. Funding and technical support for fishermen groups; and
4. Funding and technical support for special projects.

USAID could provide funding for training programs for management personnel, both in fishing cooperatives and government employees. This could be short or long-term in nature (the latter at the University level). Training for fishermen would be most effective if done locally, using expert, professional fishermen.

USAID could assist in helping to solve production and marketing problems by funding the procurement of proper fishing equipment, storage facilities, establishing sales outlets and proper transport.

Fishing cooperatives and fishermen groups could be assisted through provision of funds for initial capital purchases and training of personnel in management and fisheries (either locally or abroad).

USAID could help with special projects (depending on their nature) through funding and/or the provision of technical assistance and expertise. Assistance to provide data and information about aquatic environments, funding to support pond culture and controlled environment projects and other special efforts would make a valuable contribution.

Any assistance by USAID must be preceded by expert analysis of the potential for success, as well as an analysis of governmental priorities and the availability of funds. Given the potential for growth in the fishing industry and economic and nutritional benefits that could be gained, it is our view that USAID should take a close look at the possibility of assisting local fisheries activities.

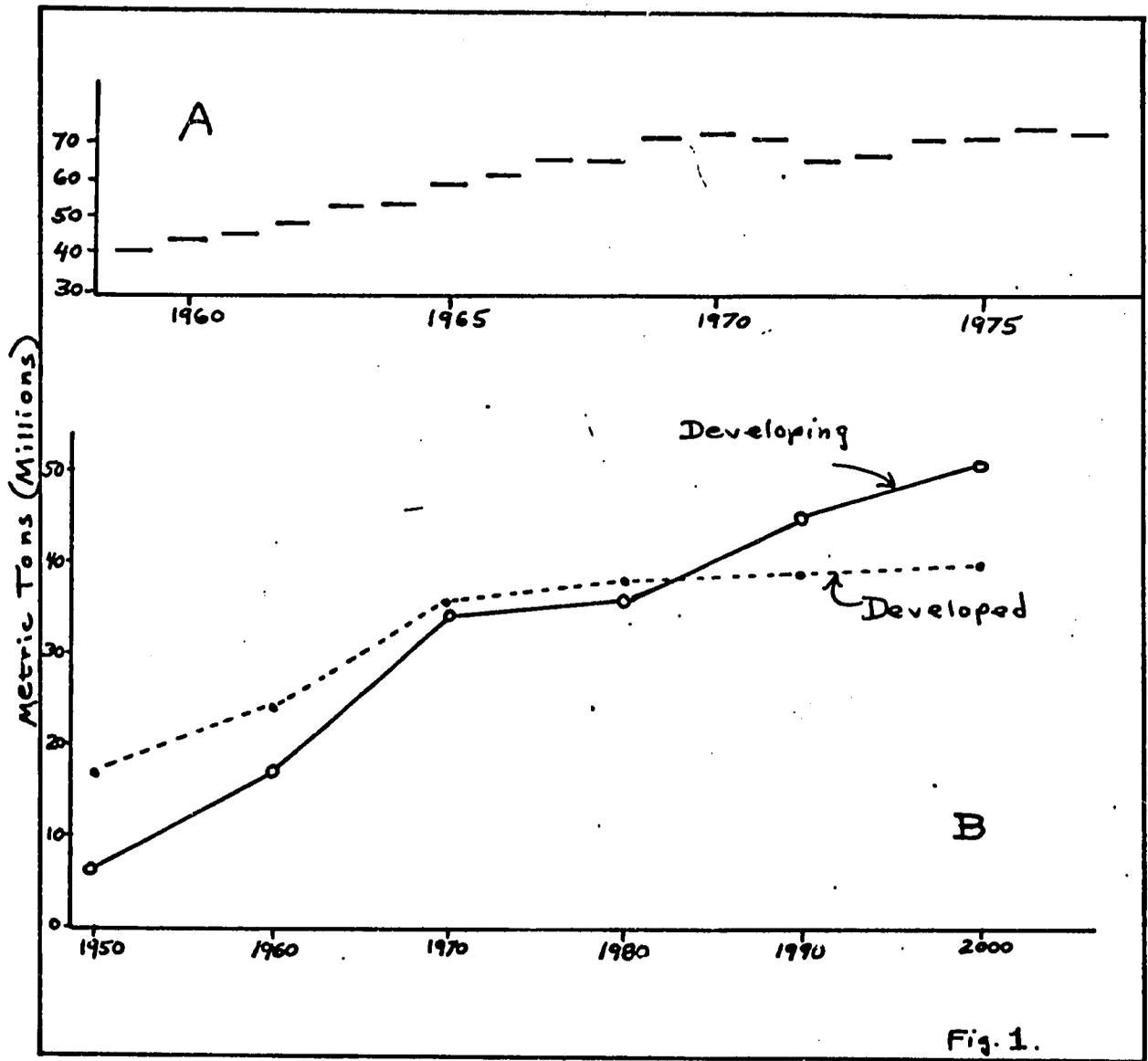


Fig. 1. A. Overall trend in fish production worldwide (1960-1978).
B. Total fish production projected to the year 2000 in developed and developing countries (FAO statistics).

III. PRESENT STATUS OF AQUATIC FOOD PRODUCTION IN EASTERN AND SOUTHERN AFRICA

World statistics from the FAO (United Nations Food and Agriculture Organization) show that there has been no significant change over the last decade in the level of fish production and total catch. Yields have averaged 78 million tons (metric) per annum. Yields of certain fish have increased over this period, while others have declined. The average net change has been an increase of only 1% per annum since 1969. In general there has been a slight decline in catches from developed countries, balanced by minor increases in yields from developing countries (Fig. 1).

A. Marine Fisheries

Salt water catches make up over 85% of the total catch. In the East Africa region (West Indian Ocean area) roughly 3% of the world's total catch of ocean fish is produced. The area is viewed by the FAO, through its surveys and research, as having a great potential for increased production. The catch of 1.8 million tons is almost totally caught by South Korean and Japanese-owned trawlers operating in open waters. The coastal catches along the East African shore are miniscule in comparison, but no concrete figures are available. Nearly one-third of the total catch consists of fish from the tuna family (0.5 million tons per annum). No East African country operates what could be labelled a modern fishing fleet of any size (although the USSR is providing assistance in Mozambique to create such a fleet). The great majority of fishing from the coastal countries is done from houris, dhows or dugout canoes within sight of the shore and simple, more traditional fishing techniques are used.

B. Inland Fisheries

In Africa, inland fishing (which entails catches from rivers and lakes) has been exploited through traditional techniques until the last three or four decades. Aquaculture, or controlled environment fisheries, is also a recent phenomenon and it is only in the last twenty years that pond culture has been introduced in Africa. Catches from rivers and lakes are obtained by using non-motorized craft, hand lines, gill nets and beach seining. The use of pond culture has seen a rapid growth in recent years, with a mixed degree of success.

There are almost no figures available on fresh water catches in Africa. World-wide, fresh water fish yield less than 15% of the total catch. Consumption of fish, for the most part, has been quite localized, with little distribution beyond the immediate sources of supply. This is due to the limited levels of production, lack of marketing infrastructure and cultural taboos and reluctance to eat fish by non-exposed tribal groups.

The concensus of expert opinion is that in East Africa most natural inland waters are over-exploited and that coastal fishing possibilities are under-exploited. However, statistical data verifying this concensus are not yet available, also there are bound to be regional and local exceptions to these opinions.

IV. PROBLEMS IN SELECTED AREAS

In any given locale the problems with fish production, storage and marketing may not be major, but regionally there are significant problems that must be viewed as constraints to efficient, economic operations. These problems are grouped under the following headings: deep sea fishing, coastal fishing, marine controlled environments, lake and river fishing, intensive fresh water aquaculture and overall marketing problems.

A. Deep Sea Fishing

Deep sea fishing involves large capital outlays, large recurrent expenditures, expertise, high technology and a major supporting infrastructure. The purchase of a medium-sized tuna trawler (60 ft. hull, steel, fully outfitted) costs roughly \$450,000.00. To operate and maintain such a vessel costs roughly \$400,000.00 per annum. The infrastructure minimally required to support such a trawler would include a processing plant (cold room, freezing room, ice machine, filleting facilities, etc.), transport vehicles and bulk marketing facilities. The level of costs, the expertise and technology requirements and the high risks involved make the attractiveness of establishing deep sea fishing quite marginal. It is felt that this type of project could only be addressed through a joint venture type of operation between USAID and a private U.S. business experienced in fishing enterprises and/or with the assistance of other donor agencies.

B. Coastal Fishing

Coastal fishing operations (carried out in sight of land) are quite different than deep sea fishing operations. They tend to be labor intensive, more "traditional" in nature and involve small (relative) capital and recurrent costs per participant. The major problems can be grouped in the following categories: output, cost and marketing.

1. Output - Output (the total catch of marine products) is usually small in terms of catch per unit effort (CPEU). This is most often due to the use of poor and inefficient equipment and the lack of expertise. The use of

poor and inefficient equipment may be a reflection of a lack of expertise, but is more often attributed to the low level of output/income generated, as fishermen are often forced to use gear that involves small capital outlays (again, relative) and gear that has passed beyond its optimum level of efficiency. The lack of expertise often arises from ignorance of marine animal habits or habitats and from maintaining inefficient (but custom-dictated) practices.

2. Cost - The costs involved in fishing, both capital and recurrent, may appear small but they are often enormous in relation to an artisanal fisherman's income. The lack of savings or credit facilities often exacerbates the situation, already made bad by a frequent non-availability of equipment. To provide examples of costs, a dugout canoe some 10 meters in length, without outrigger or sails, will probably cost around \$400 where wood is available (double this figure if wood is scarce). The fiberglass equivalent, if available, will cost between \$2,000 and \$4,000. A normal net (nine ply, five inch nylon mesh, 2 m. x 90 m.) with floats, weights and rope will generally cost a fisherman about \$30. Three such nets are normally required per fisherman and they may last one year if properly treated and repaired. The fisherman will probably share in a boat (with possibly as many as 20 other fishermen) and he will probably also have hand lines, hooks, knives, baskets and other minor paraphernalia. It is roughly estimated that an artisanal fisherman, with the equipment described, will have recurrent costs of over \$100 per year.

3. Marketing - The marketing of fish is fraught with problems. In many regions wholesalers control fish markets and thus in turn they control the prices paid to fishermen. In others, there is little demand for fish and the fisherman (or his family) is the seller. Often markets are separated by some distance from the fishing beaches and there may not be adequate transportation. The marketing may not be developed enough to have storage or transport facilities. Fishermen groups or cooperatives may be inefficient and corrupt.

In summary, the major problem areas are often a lack of expertise, lack of proper equipment and a lack of marketing facilities.

C. Controlled Marine Environments

Recently there have been many new developments in the use of controlled marine environments for production. Some efforts (such as oyster bed seeding) have been carried out for many years. The use of traps (cages) or estuary farms (where fish or shrimp are carefully bred and grown in enclosed estuaries) are more recent ventures. Both have been fairly

successful in the Far East and recently in Latin America (Colombia and Nicaragua). Incidentally, the FAO/UNDP is establishing a large pilot project using fish pens in an estuary near Malindi, Kenya.

Such projects are capital intensive and require a very high level of expertise in the initial phases. Additionally, such projects can only be established when: 1) there is a well-established market for the product; 2) a full marketing infrastructure has been established; and 3) where demand exceeds available supply of products. High price levels for end products are also essential, as capital outlays and recurrent expenditures are much greater than those of artisanal fishing.

D. Lake and River Fishing

In African inland waters commercial fishing is done most often using canoes, dhows or rafts, with gill nets, hand lines and beach seines. Fish catches are generally sold as "fresh" products locally, with sun-drying and salting of some species. Marketing in most cases is haphazard and not well organized (with some exceptions). In most lakes and rivers the sustainable yields (the equilibrium position where the stock level of fish are maintained at a constant figure) are not known. Recording of catches is seldom done (or is often inaccurate when done) and very few reliable surveys or data collections are available. Yet, informal observations in some areas (Lakes Victoria and Tanganyika) indicate that yields of certain species of fish have declined significantly in the last decade.

The lakes and rivers are probably capable of supporting larger fish populations, but certain common practices hinder stock increases. The use of small mesh nets, beach seining and non-sorting of live catches harm breeding capacities. Overfishing by expanding numbers of fisherman with more equipment has also contributed to the depopulation of fish in some local bodies of water.

Indigenous fishermen in inland areas tend to be quite knowledgeable of fish habits, yet not very understanding or concerned with the ecological impact of certain fishing practices. The lack of marketing structure lends itself to wastefulness through spoilage and pest damage.

E. Pond and Intensive Aquaculture

For the purposes of improving local diets, utilizing unused resources and perhaps producing some cash income, pond culture has been introduced into many developing countries.

Generally using varieties of tilapia fish and natural water flows, with some supplementary feeding, pond culture is being tried in nearly all of Eastern and Southern Africa, with different levels of success.

Some of the major problems that have been encountered are: 1) a need for a permanent water supply; 2) maintenance of ponds; 3) availability of fingerlings; 4) cultural resistance to fish consumption; 5) lack of access to local markets; and 6) the availability of land for pond construction.

Intensive aquaculture generally involves the use of permanent tanks and a constant waterflow, total feeding and on-site breeding of stock. Tilapia, carp and trout are the fish most commonly raised and harvested. This operation is highly commercial with fish being sold, not consumed, by the producers. The land area required can be quite small. Aquaculture is capital intensive, with high recurrent costs, and demands permanent staffing. During initial phases expertise and experience are necessary to establish operations. Except in the case of high priced, valuable fish for an elite market, aquaculture is not cost effective in poor, rural areas where it has little appeal.

F. Marketing and Management

In all of the areas mentioned, the marketing of products and management are major problems. Marketing is defined as the entire process of handling fish from the point of catch to its retail sale. Because of improper handling and storage, the FAO estimates that over 10 million tons are lost annually through spoilage and pest attack. This constitutes nearly 15% of the world's total annual catch.

The major marketing problems are:

1. The lack of adequate storage and preservation facilities, including drying, treating and freezing fish;
2. The lack of transport to move fish from the catch site to the storage facility and from there to retail outlets;
3. The lack of knowledge about how to price, present and distribute fish;
4. The inability to educate and introduce fish to groups unfamiliar with it as a source of food;
5. The dependence on middlemen for the marketing of fish, who may dominate and control the fish industry completely; and

6. The weaknesses of most cooperatives or fishermen's groups. If formed at all they are often financially and managerially weak and have a low level of expertise.

V. USAID AND OTHER DONOR ASSISTANCE

Over the years many organizations have made efforts to assist Eastern and Southern African countries with fish production. Efforts have been made with coastal and inland fish production, research and marketing. Yet these efforts have not been coordinated and often remain unknown outside the individual organization. The consequence is often a duplication of effort or even the total loss of knowledge of the work performed.

In an effort to at least inform interested people in some recent efforts made in improving fish research, production and marketing, a list of known projects is included in this report. It is by no means complete, as access and contact with many organizations is difficult. Those same organizations may be unresponsive for various reasons (the major reason being that they themselves are not aware of what work has been done).

The major groups involved in bilateral or regional assistance are USAID, FAO/UNDP, Japanese Aid, Development Division (Ministry of Overseas Development, U.K.), NORAD (Norwegian Agency for International Development), U. S. Peace Corps, FAC (French Economic Assistance Mission) and others.

A. USAID

USAID at present has four ongoing projects in Africa. They are: 1) Djibouti, fisheries Development (\$0.978 m), 2) Rwanda, Fish Culture (\$2.2 m), 3) Senegal, Marine Fisheries (\$0.15 m) and 4) Zaire, Fish Culture Expansion (\$0.2 m). Prior to these ongoing projects, USAID had supported a large variety of fishery activities. One of the major development efforts included a project on research and fish stock statistics in Lake Victoria (Kenya, Uganda and Tanzania) 1970-1977 (\$1.215 m) as well as recommendations for improving production and marketing. Other than the Djibouti Fisheries Development Project and the above, AID/Washington (S&T/DIU/DI) had very little information on hand.

B. FAO/UNDP

The FAO has been the most active organization in Eastern and Southern Africa in terms of fisheries projects.

They have done general surveys of coastal waters and have supported Fisheries Departments (usually within the Ministry of Agriculture) in most countries. They have also done basic research in fish production and have initiated major fisheries projects in many places (both coastal and inland). Because of the large number of projects carried out under FAO/UNDP, their activities will not be discussed here, but it is advisable to contact their local representative for detailed information. A number of FAO publications are listed under Section VII of this report (Resource Materials). The major FAO fisheries bodies of interest in the region are: Committee for the Inland Fisheries of Africa (CIFA), Indian Ocean Fisheries Commission (IOFC) and the umbrella program Exclusive Economic Zone Program (EEZ).

C. Japan

Assistance from Japan is given in the form of volunteers, under the organization called Japanese Overseas Cooperation Volunteers. Direct bilateral assistance is not given by Japan. The volunteers work in areas such as production research, selection of appropriate fishing gear and fisheries administration.

Japan has volunteers in Kenya, Tanzania, Malawi, Zambia and Ethiopia. In each country there are about three volunteers working in fisheries. In Kenya and Tanzania the volunteers are working in coastal (salt water) fisheries, but the bulk of support is generally with fresh water fisheries in other countries.

D. OMD (Ministry of Overseas Development, Development Division, Great Britain)

British aid in fisheries has been going on for over two decades and has taken a form similar to that of USAID, as aid is given on a project basis (using consultants principally from the Tropical Products Institute). Aid has been given in the form of trawlers, research and technical personnel. At the present time some major ODM projects are: 1) Malawi - provision and installation of 150 marine engines and a fisheries development officer; 2) Tanzania - Three trawlers and technicians (with the World Bank) to develop a prawn fishing industry, also the provision of a Fisheries Advisor in Mtwara, 3) Seychelles - provision of cold stores and facilities (lab) for the tuna fishing industry, as well as technicians. The British Development Division for Southern Africa (Lilongwe 31544) oversees additional projects, although specific details were not available.

E. NORAD (Norwegian Agency for International Development)

The Norwegian aid organization, NORAD, provides fisheries assistance in Kenya (Lake Turkana), Tanzania, Mozambique, Botswana and Zambia. In the latter two countries, technical support in fresh water fisheries is given to cooperatives. In Mozambique NORAD supports IMCO, a school of maritime (merchant marine) training and it is doing a survey of marine resources with a research vessel. In Tanzania, NORAD helps support a center for personnel training in fisheries (in Mbagani), including fishermen, marketing, etc. Support is both financial and personnel assistance. In Kenya, NORAD has been assisting the Lake Turkana cooperative with personnel and infrastructure for seven years.

F. Peace Corps (USA)

The U.S. Peace Corps has been providing fisheries support through technical volunteers for two decades. These volunteers have been working in fish culture extension (pond cultures) for the most part, although some technical assistance to marine fisheries has also been provided. At present in Eastern and Southern Africa the following assistance to pond culture is being given: 1) Kenya - ten volunteers in Western Province, 2) Tanzania - about three volunteers, 3) Zaire - about three volunteers, 4) Lesotho - three volunteers, 5) Swaziland - four or five volunteers, and 6) Botswana - about two volunteers. This level of assistance is liable to continue for some time.

G. FAC (French Economic Assistance Mission)

The French, through FAC, are providing fisheries assistance in many Francophone countries. In Djibouti, the French support marine fisheries with financial and technical assistance. In non-Francophone countries assistance is administered by the Ministry of foreign Affairs (General Direction of Cultural, Scientific and Technical Relations). The technical assistance bodies, connected with the Government are: CTFT (Centre Technique Forestrie Tropical) and France Aquaculture (Centre National pour L'Exploitation des Océanes).

H. Others (USSR, World Bank, etc.)

The USSR is assisting Mozambique in developing its marine fisheries industry with trawlers, infrastructure and technical assistance. The World Bank occasionally supports discreet projects in various countries, although the authors are unaware of any at this time, except prawn fishing (with ODM) in Tanzania. The Danish aid organization (DANIDA) is assisting the Ministry of Cooperative development Fisheries Division in Kenya through the Nordic advisors with technical assistance and may be active in other countries as well.

This is the sum total of assistance in fisheries that we have been able to identify at this time. The list is probably not complete, but does identify principal efforts and the major donor organizations now active. It is recommended that the pertinent organizations in each country be contacted to further expand our knowledge of donor efforts to assist in fisheries development.

VI. RECOMMENDATIONS FOR USAID ASSISTANCE

The major problem areas where the authors feel that USAID can make significant and cost-effective contributions to the development of local fisheries are:

1. Fisheries management and fishermen's expertise.
2. Fisheries infrastructure in production and marketing.
3. Funding and technical support for fishermen groups and cooperatives.
4. Funding and technical support for special projects (pond culture, controlled environments, surveying and research).

Deep sea fishing as a "problem" area has been categorically eliminated as a potential assistance effort because of the major risk and costs involved, as viewed against the chance of major returns or benefits. Assistance to deep sea fishing efforts should only be considered in conjunction with U.S. private enterprises as a joint venture effort.

Without reiterating the problems of fisheries management and fishermen expertise, the lack of training and government support in this area can be overcome by the provision of effective assistance. Conceivably, USAID could fund training for management personnel, both in the local government and with cooperative personnel. Training programs (usually six months to two years) of a pragmatic nature are now available in Norway, Japan, the Philippines, Taiwan and Indonesia. At the university level programs are available in the above countries as well as the USA, Canada, and Great Britain. Leading U.S. universities include Scripps, Rhode Island and Auburn. For the training of fishermen themselves, effective training can best be done in-country, using expatriate personnel for on-site, practical education.

Throughout Eastern and Southern Africa there is a lack of proper production and marketing facilities. This leads to wastage and inefficient operations. Proper fishing equipment

(appropriate boats, nets and credit facilities), storage facilities (warehouses, cold rooms, cold boxes, ice-making machinery, drying racks, etc.) sales outlets (stores, cold boxes) and transport (cold boxes, insulated or refrigerated lorries) are lacking throughout the region. USAID could possibly assist with the procurement and funding of some of these items, as part of a larger upgrading of the industry.

African fishermen groups and cooperatives have been limited in their ability to function properly because of shortage of funds and trained personnel, especially at the initial stages of their development. Certain capital expenditures, such as offices, furniture, office equipment and supplies are often lacking and thus limit the growth potential of such groups and their ability to meet recurrent costs. Untrained personnel greatly limit their effectiveness in meeting the needs of the membership. Short-term assistance in meeting training needs and establishment costs could be most helpful in establishing fishermen groups or cooperatives. By funding such needs USAID could play an important role within the industry.

The lack of data on fish yield potentials and ignorance about fish habits and the environment often limits the ability of fishermen to properly exploit aquatic food resources. Although collection and analysis of data involves a lengthy and costly exercise, by using trawlers, professional fishermen and marine biologists, the information collected can be invaluable. Such information can be used to help to determine government policies, determine seasonal patterns, locate fish concentrations and formulate theories rules of fish behavior. U.S. contractors for USAID have occasionally done this in the past (Lake Victoria, 1972-1977) and other organizations have ongoing, major activities (NORAD, ODM, Japan) in surveys and research of this type. Long-term assistance of this nature can have a lasting impact on the fisheries industry in a given country and can significantly contribute to stability and development.

Major financial constraints, lack of knowledge and/or foresight and poor focus on priorities has made it difficult for the governments of LDCs to finance special fisheries projects. Those projects which would be of great value in the long-term involve aquatic research and data collection. USAID could help long-term fisheries' potentials by funding such efforts. More immediate assistance would be AID support of pond culture and controlled environment projects. Pond culture assistance could take the form of support to ongoing Peace Corps efforts (by funding transport, breeding plant establishments, "seed" money, etc.) or establishing projects through local governments. Controlled environment projects

(intensive aquaculture, trap and estuary farming) are more costly in nature and would demand heavy technical assistance, but are also areas of potential USAID assistance.

Any assistance by USAID would be preceded by expert analyses of the potential for success, as well as a determination of local priorities and the availability of funds. Minimally though, USAID should look into the possibility of assisting local fishing activities at some time in the future. Given the potential for growth in this sector and the possible economic and nutritional benefits that could accrue, fisheries development may well be an area where USAID can offer significant help to the countries of Eastern and Southern Africa.

Resource Materials (Available at REDSO/EA)

1. Caton, Moss and Urano, 1974. Office of Agriculture, Bureau of Science and Technology, AID. Improving Food and Nutrition Through Aquaculture in the Developing Countries. (The potential for increased food production through husbandry of fresh water and marine organisms, descriptions of infrastructure and types of organisms).
2. Chakroff, M., 1976. VITA No. 36E. Freshwater Fish Pond Culture and Management. (A general description for LDC's).
3. International Center for Marine Resource Development, 1979. University of Rhode Island. Stock Assessment for Tropical Small Scale Fisheries. (Recommendations for future research of tropical small-scale fisheries, for the development of new methods for stock identification and assessment, catch and effort measurement, optional biological and economic sustainable yield estimation and overall management).
4. Lewis, William, 1981. Southern Illinois University (Bulletin no. 6). Use of Farm Ponds for the Production of Food Fish for Home Use and Specialized Marketing. (Proposed fish farm operations in ponds for farmers to produce food for home consumption and marketing).
5. Lovell, Smitherman and Shell, 1976. Auburn University. Progress and Prospects of Fish Farming. (A general overview with nutritional yields for different fish).
6. Craib and Ketler, 1977. Resource Development Assoc. Proceedings of the Fisheries Research Planning Workshop. (Determine research and development needs, recommend priority areas and identify U.S. Universities and research institutes capable of carrying out research programs).
7. Board for International Food and Agriculture Development, 1978. USAID. Fisheries and Aquaculture: A Priority Planning Approach. (Identifies development assistance needs as seen by LDC's, a list of Title XII universities that can assist and an inventory of LDC institutions active and available for collaborative research).
8. FAO/UN, 1979. World Fisheries and the Law of the Sea. (Statistics on fishing, new laws and extended zones, focus of FAO program).

9. FAO/UNDP, 1981. Draft Global Plan of Action for the Conservation, Management and Utilization of Marine Mammals.
10. FAO/UN, 1979. State of Selected Stocks of Tuna and Billfish in the Pacific and Indian Oceans. (Current research, fishery data, structure of stock, population parameters, status of stocks and recommendations for fish in the tuna family).
11. International Center for Marine Resource development, University of Rhode Island, 1981. Small Scale fisheries in Central America: Acquiring Information for Decision Making. (Shows methods of data collection, means of analysis and actual analyses of data and some overall policy implications).