AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

1. SUBJECT CLASSIFICATION
   A. PRIMARY: Agriculture
   B. SECONDARY: Fisheries

2. TITLE AND SUBTITLE
   A research program related to the development and management of small-scale fisheries in developing countries

3. AUTHOR(S)
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4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1975	14 p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
   University of Rhode Island, International Center for Marine Resource Development, Kingston, Rhode Island 02881

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
   (Presented at meeting on Small-Scale Fisheries, Paris,1975)

9. ABSTRACT

A comprehensive, formal body of knowledge on small-scale fisheries in developing countries does not currently exist. Research results that do exist relate to individual components of the fishery system, and usually cannot be effectively combined with research on another component. This is why the International Center for Marine Resource Development at the University of Rhode Island recently began a program of research designed to fill many of the gaps in our knowledge of small-scale fisheries in developing countries. The five categories of research are biological, economic, food technology, institutional, and technology transfer. The objective of the biological research is to develop a system of data collection and of stock assessment that is administratively feasible for fisheries in developing countries. The economic research focuses on the harvesting sector, marketing systems, and consumers of fish and fish products in developing countries. The objectives of the food technology research are to develop a quantitative assessment of existing food technology, determine the effects of this technology, and assess the feasibility of developing new technology and fish products in particular locations. The institutional research is designed to identify aspects of existing organizational and legal frameworks that impede fisheries development. The research on technology transfer focuses on three issues: (1) determinants of success and failure of fishermen's organizations; (2) designing messages for effective communication; and (3) the goals and methods of fishermen's training programs. The objective of this research is to determine the most effective means for carrying out a development project.

10. CONTROL NUMBER	11. PRICE OF DOCUMENT
PN-AAC-713	
12. DESCRIPTORS	**13. PROJECT NUMBER**
Economic development Research	**14. CONTRACT NUMBER** CSD-2455 211(d)
	15. TYPE OF DOCUMENT

AID 590-1 (4-74)

Paper: Presented at Meeting on Small-Scale Fisheries, Paris, France, sponsored by OECD, November 26-28, 1975.

A Research Program Related to the Development and Management of Small-Scale Fisheries in Developing Countries

by

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I. Introduction

The growing interest in assisting developing countries develop their small-scale fisheries raises some hard questions for policy-makers and researchers. Past efforts to develop the fisheries in these countries have fallen short of success. The early efforts to introduce new technology and techniques confronted large numbers of unorganized fishermen and inadequate market systems. The cooperative seemed an ideal solution to these problems. It created an institution for organizing and communicating with large numbers of fishermen, and provided a means for evading middlemen and other market inadequacies. To our regret, the cooperative has not been the answer we hoped, and successful small-scale fisheries development generally eludes us in the developing countries of the world.

Many believe the attempts at technical and institutional change have failed because our perception of the problem has been too simplistic. While technical and institutional change are still recognized as necessary ingredients, there are many other elements also necessary for successful development. Taken together, these elements, like links in a chain, form a whole, the success of which depends upon the strength of each element. At a regional seminar-workshop on small-scale fisheries development held in Costa Rica (January, 1975), the 58 participants from Latin America concluded:

"...all the links among the components of maritime artisanal fisheries development would be found to be interrelated, and failure to consider any single component could result in failure of a whole project. With such strong and multiple interrelationships, it becomes impossible to place priorities on the various components. They are all necessary" (Griffin, 1975). With this realization the next task is to identify these components or elements and to determine how they combine to form the fishery system.

II. Small-Scale Fisheries Systems in Developing Countries

An unexploited fishery obviously is a complex system, one in which several species of fish reproduce, grow, compete with and prey upon each other in a dynamic environment constantly influenced by forces of nature. As man enters the scene to exploit the fishery, the dimensions of the system are increased many fold. Just as the fishery resource is part of a larger environment which greatly influences its behavior and characteristics, man's relationship to the fishery is shaped by a set of technological, economic, social, cultural, legal and political forces which characterize his environment.

The fishery system, therefore, can be viewed as consisting of two principal sectors: the resource and its environment, and man and his environment. Man's relationship to the fishery consists of three different sets of activities: harvesting the resource, processing and marketing the resource, and consuming the resource; and finally, man's environment is shaped by what we shall call institutional factors. We now discuss these sectors separately.

A. The Resource

Most small-scale fisheries in developing countries are in tropical or subtropical waters, characterized by a large variety of species, many of which have a very bony structure. These features often create problems in both the har-

vesting (e.g., proper gear selection) and marketing (e.g., limited edible yield and substantial price variations) of the species.

Regardless of the many problems unique to these fisheries, development possibilities are most closely tied to the potential yields of the waters in or adjacent to these countries. According to Gulland (1971), the highest potential increases in sustainable yields are in the southern temperate and tropical zones (see Table 1). And it is within these zones that a number of the developing countries lie, with undernourished and underemployed populations. Therefore, it appears that fisheries development potential is the greatest in those areas of the world where development needs are most critical.

The potential yield estimates given in Table 1 are quite crude. The potential of a specific fishery in or adjacent to a specific developing country is generally not known. And, of course, a fishery's potential is a necessary piece of information for the effective development and management of the fishery.

B. Harvesting

The single-owner or single-family proprietorship is the most common form of fishing enterprise. The enterprise usually has one or more small-scale unpowered boats of indigenous materials and design (e.g., planked or dug-out canoes), and the gear and nets employed are quite simple (e.g., beach seines, gill nets, hook & line).

The proportion of fishermen employed full-time varies considerably, depending on alternative opportunities such as in agriculture. Most fishermen along the coast of East Africa, for example, work part-time at fishing whereas in the offshore islands of Reunion and Maritius most fishermen are employed full-time. Almost without exception fishermen are remunerated on the basis of a share-of-catch or share-of-revenue, rather than with a fixed wage per unit time worked.

Table 1

Potential Fish Resources
(large pelagic, demersal, shoaling pelagic)

	Recent Catches (Million Metric Tons)	Estimated Potential Yield	
		Million Metric Tons	As Percentage of Recent Catches
Northern Temperate Zone			
Northwest Atlantic	4.2(1969)	6.4	152
Northeast Atlantic	9.1(1969)	13.3	146
Mediterranean and Black Sea	0.9(1969)	1.2	133
Northwest Pacific	5.0(1964)	5.2	104
Northeast Pacific	2.1(1967)*	4.6	219
Tropical Zone			
Eastern Central Atlantic	2.0(1969)	3.4	170
Western Central Atlantic	1.5(1969)	5.5	367
Indian Ocean	2.7(1969)	14.1	522
Western Central Pacific	3.3(1968)	16.0	485
Eastern Central Pacific	1.0-1.4(1967)	6.0	1000
Southern Temperate Zone			
Southwest Pacific	0.2(1969)	2.0	1000
Southeast Pacific	10.2(1969)	12.5	122
Southwest Atlantic	0.7(1969)	7.3	1043
Southeast Atlantic	2.3(1967)	4.3	187

Source: Gulland (1971).

*Includes demersal fish, salmon, herring.

Many developing countries have developed or are developing large-scale fisheries, using vessels of modern design and gear (purse seiners and trawlers). However, small-scale fisheries continue to play important roles. The large-scale fisheries usually produce for export purposes (e.g., fish meal, shrimp), whereas the small-scale fisheries catch fish for direct human consumption. And in several countries, the small-scale fisheries continue to contribute a larger portion of total catch. For example, canoe fishermen accounted for about 60 and 80 percent of 1970 total production in Ghana and Senegal, respectively (Crutchfield & Lawson, 1974). The small-scale fishing unit probably will remain a significant force in the fisheries of developing countries for some time to come.

C. Processing and Marketing

Most fishermen sell their catch on the beach or in port for cash, often to middlemen who may also supply credit. The middlemen transport the fish from familiar landings to one or more familiar marketplaces. Market coverage is often limited by the range of the bicycle and bus routes--two common means of transport.

The greater part of the catch is consumed fresh, and the trends in many developing countries seem to be for increasing consumption of fresh fish. Factors often limiting the distribution of fresh fish are the inadequate refrigerated transport and storage facilities, and the lack of proper handling, both of which reduce the quality of the product reaching the consumer. Lower quality of the final product has two significant consequences: (1) it reduces demand and consumption levels of this form of high quality protein, and (2) reduces the ex-vessel price and, hence, slows the development of the harvesting sector.

A large portion, though less than half, of the catch undergoes some form of traditional processing before final consumption. The traditional processing methods of salting, boiling, fermenting, smoking, and drying are often carried out on a small scale by fishermen or their families. With the high price of ice and limited refrigerated transport and storage facilities, processing is generally required to preserve the fish during shipment over the considerable distance between major fishing areas and major markets. Needless to say, the quality of these processed products is quite low. As more modern communications systems are established, this traditional processing activity is expected to decline. Development of a large scale processing sector in these countries faces numerable problems. Among them are: landing locations are scattered, often along long coastlines, and not connected by all-weather roads to major market centers; and the catch, typical of tropical fisheries, is composed of several species, few of which can be caught at regular times and locations.

D. Consumption

According to Robinson (1973), average per capita consumption of fish in developing countries is less than one-third the per capita consumption level in developed countries. To merely maintain the per capita consumption levels that existed in 1970, the supply of fish for direct human consumption will have to increase by 31 percent in developing countries (in 1980) as compared to 11 percent in developed countries (Lampe, et al., 1974). These figures are significant because of the severe protein deficiency that characterizes most developing countries. Fish, being a source of high quality protein, is looked upon by many as a means for alleviating the protein deficiency in developing countries.

The extent to which fish contribute to future protein consumption in developing countries depends on (1) the demand for fish in these countries (which is determined by income levels, prices of alternative protein sources,

and dietary preferences and habits), and (2) the price at which larger quantities of fish can be delivered to consumers in the developing countries (which is determined by the cost and technical structure of the delivery and harvesting sub-sectors of the fishery). Robinson (1973) has projected an increase in per capita demand (at constant relative prices) to 8.7 kilograms in 1980 and 11.7 kilograms in 2000 for developing countries. While these projections likely will not be verified in the course of time, they do indicate a strong, growing desire by developing countries to consume more fish. Also, these projections are for large areas and, therefore, quite rough. The level of demand for fish and fish products is thought by many to vary substantially across countries and regions. Such variation, of course, likely is due to different levels of income, prices of protein substitutes, and different tastes, which are shaped by custom and familiarity with the product.

E. Institutional Factors

National fisheries policies and their concomitant government agencies in developing countries are often ill-suited to small-scale fisheries development. Private institutions that serve fishermen (e.g., banks and gear suppliers) also are rarely provided with incentives necessary to meet small-scale fishery needs. Problems for fishermen arise in a variety of ways. One of the most serious causes of difficulty has been the proliferation of government agencies, often with conflicting missions, with some interest in fisheries development. In addition to complex administrative structures, laws and regulations often are contradictory, detailed and innumerable. These patterns, of course, tend to inhibit small-scale fisheries development by confusing the fisherman who is urged to improve but finds major obstacles in his path.

III. A Program of Research for Effective Development and Management of Small-Scale Fisheries in Developing Countries

Development and management of a fishery requires directly influencing man by changing his behavior and the environment in which he functions. For example, development often requires injecting into the system new capital, training and greater economic incentives, and removing from it cultural and institutional barriers at critical points in order to encourage the growth of employment, incomes, protein consumption and other desired ends. Management may involve restricting the influx of labor and capital by, inter alia, creating legal barriers to entry into the fishery. Therefore, in addition to understanding how the system functions, effective actions require that we be able to determine with some reasonable degree of accuracy the best means of influencing the system to attain the desired ends. Since these ends involve man and his environment, the major body of information required is about man and his environment.

Information about the resource certainly is not nonessential, nor even minor. Knowledge of the resource and its environment is critical, a necessary condition for effective development and management. But a research program, designed to provide relevant information to the policy-makers, should devote most of its effort to generating information relating to the economic, technological, social, legal and political features of the system.

Rarely has it been possible to research these complex issues before a development project has commenced. The monitoring of the performance of development projects as they proceed is equally rare. In consequence, a formal, comprehensive body of knowledge on small-scale fisheries in developing countries does not currently exist. The research results that do exist relate to individual components of the fishery system and usually cannot be effectively combined with research on another component.

The International Center for Marine Resource Development at the University of Rhode Island recently initiated a program of research directed toward filling many of the gaps in our knowledge of small-scale fisheries in developing countries. The research falls into five categories: biological, economic, food technology, institutional, and technology transfer. These are described briefly below.

A. Biological Research

Tropical fisheries traditionally have been conducted with little attention to achieving or maintaining optimum yields. This has been due to difficulties in applying conventional fishery science methods to tropical fish populations (which are more complex than those in temperate waters) and to the lack of understanding of the data collection requirements.

The objective of the biological research is to develop a system of data collection and of stock assessment that is administratively feasible in the context of small-scale fisheries in developing countries. Existing systems provide rough measures of yield and some vital statistics of the resource populations, but generally they are inaccurate and unreliable. Different types of data and different analyses of the data are to be compared in terms of their value in developing a model which will evaluate existing yields viz-a-viz potential maximum yield. Biological data will be collected by direct sampling and when relevant, will include information on the performance of individual vessels (e.g., catch per unit of effort data). A major purpose of this research is to develop a data collection system that fishermen and government personnel will find comprehensible, interesting and useful (e.g., to recommend remedial action which would reduce overfishing or increase the harvest of underutilized species). The emphasis throughout will be on the transferability of methods to other tropical artisanal fisheries.

The analytical tools to be developed and used will be determined by the

nature of the fishery, and also by the feasibility of collecting data directly from fishermen. Some of these proposed procedures already have been applied to coastal species in Jamaica. While others have been discussed in the theoretical literature, there has been no attempt to unify the most preferred procedures in a single, concise methodology.

B. Economic Research

The economic research focuses on the harvesting sector and its supporting infrastructure, marketing systems, and the consumers of fish and fish products in developing countries. The ultimate objective of the research on the harvesting sector is to develop a system for collecting and analyzing data on costs and returns for a fishery's enterprises. Few small-scale fishermen in developing countries maintain financial records and as a consequence only the crudest information exists on their incomes and operating costs. Without such information, assessment of the impact of development and management efforts is virtually impossible. Information on costs and returns also can be analyzed to prescribe beneficial changes in the types of vessels, gear or techniques to be used. As should be obvious, this type of data and its use are closely related to the biological research efforts. For this reason, the two research efforts are to be conducted jointly, on the same fishery at the same time.

In addition to the research on costs and returns in the harvesting sector, we are examining the system through which fishermen purchase their nets, twine, hooks, engine parts, ice and other supplies. The objective here is to determine the extent to which fishermen's supplies are overpriced or not available, and to identify the causes of the high prices and bottlenecks that exist to a serious degree.

The purpose of the research on market systems is two-fold: (1) to evaluate the effectiveness of the functions the system perform, and (2) identify impediments to development in the marketing systems and suggest means for removing or circumventing them. The usual methods for evaluating markets likely will not apply in total due to the relative low level of commercialization that exists in these countries.

The purpose of the research on consumers is to develop practical and expeditious techniques for assessing demand in existing and new markets. There currently exist no systematic demand analyses of fish and fish products in developing countries. The analyses that do exist are usually no more than simple projections of population and per capita consumption. Income projections occasionally have played a role, but rarely have price responses been considered. More sophisticated analyses of demand will be needed to assess whether consumers will be willing to purchase fish products at a price that can support a developing fishery, and to assist decision-making in the development process.

C. Food Technology Research

A principal recommendation of most studies of small-scale fisheries in developing countries is to improve methods of fish handling, processing and preservation. However, we have few facts at hand relating to fish losses and the general quality of existing systems. The objectives of the food technology research are (1) to develop a quantitative assessment of existing food technology in selected locations, (2) to determine the effects of the status of this technology on the quality of handling, processing, preserving, and distribution of fish products, and (3) to assess the feasibility of developing new technology and fish products in this location.

D. Institutional Research

The purposes of the institutional research are to identify aspects of existing organizational and legal frameworks which impede fisheries development, and to design alternative organizational and legal frameworks which encourage development. The approach is to collect and analyze laws and regulations which relate to fisheries in selected developing countries.

E. Technology Transfer Research

The research in the area of technology transfer focuses on three issues: (1) determinants of success and failure of fishermen's organizations, (2) designing messages for effective communication, and (3) the goals and methods of fishermen's training programs. The objective of this research is to determine the most effective means for carrying out a development project. In the harvesting sector at least, any project likely will directly involve fishermen organizations (such as a cooperative). And, of course, for the project to succeed, the coop must be effective. As a designer of a development project, one should like to know the traits of effective organizations in order to select those most useful to the project.

Since a development project involves introducing new technology, the project's success depends upon whether the technology is adopted. The effectiveness of the communication between the transferors and adoptors is thought by many to be critical in determining success of the transfer. The research here is intended to ascertain the best structure of messages regarding the transfer of new fishing technology.

Much of the technology transfer involves training fishermen, but previous training programs have been replete with problems (e.g., expatriate "experts" unfamiliar with local conditions). This research effort is an attempt to

develop a method for prescribing attainable goals and effective training methods in the developing country context.

IV. Summary and Acknowledgements

This paper has described in limited detail the research program, funded by USAID, currently underway at the University of Rhode Island. While the author has benefited greatly from discussions with all participants in the research project, the views and interpretations expressed herein are the sole responsibility of the author.

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