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Approaches to Development and Extension of Capture Technologies for Developing Small Scale Fisheries

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OF CAPTURE TECHNOLOGIES

FOR DEVELOPING SMALL SCALE FISHERIES

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PREFACE

A number of experienced development workers contributed information and ideas for this discourse. Particular thanks are due to Dr. Richard Pollnac of the University of Rhode Island, and to my wife, Margaret, for her suggestions, editing, and critique of the text.

It must be clarified that any opinions or errors in the text are the sole responsibility of the author, and do not necessarily represent views of other individuals or organizations, unless stated otherwise.

It is difficult to obtain reliable, detailed, and current printed information about fisheries development activities, and there is no substitute for first hand observation. Many of the observations which are not footnoted in this text are the products of the author's experience working with fisheries in developing countries. The following is a list of places and dates from which the observations were drawn. It is likely that some activities and conditions have changed during intervening years.

El Salvador	1976-80	Honduras	1977-80
Belize	1980	Guatemala	1979
Mexico	1979,1980	Guyana	1983
Sierra Leone	1984	Tunisia	1985
Morocco	1985	Ecuador	1985
Netherlands Antilles	1984		

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1. INTRODUCTION

Over half the world's supply of fish for human consumption is produced by small scale fisheries.[1] Numbers of artisanal fishermen world-wide are estimated by tens of millions, and uncounted persons are engaged in shoreside activities supporting these fisheries. The income and production generated by this sector support and nourish a significant portion of the population in many parts of the world.

In recent years, increasing attention has been focused on improvement of small scale fisheries in developing countries. In spite of substantial investments, and the arduous labor of many competent, well-intentioned people, the success rates of small scale fisheries development projects have not been encouraging. Some organizations and individuals are attempting to learn from past failures, and develop more effective approaches to the challenges of fisheries development.

Many development organizations have stated objectives which include or imply the goal of improving the quality of life of people in developing countries. A desire for lasting development with which target populations can sustain development and progress independently of outside help is

often stated. There is a growing awareness that a purely technical or scientific approach to fisheries development is rarely effective in approaching these goals. Development efforts must also respond to a host of economic, social, political, and cultural issues. Some organizations have begun to address these issues with integrated programs involving significant participation of local target populations, as well as long term commitments to particular projects.

Careful attention to a wide variety of issues in fisheries development is indispensable for a project, and in many situations, concentration on improving fish capture effectiveness would not be appropriate (for example, where fish populations or markets are limiting factors). However, in other situations, many projects have as one important and appropriate component the improvement of fishing methods, vessels, and gear; in other words, fish capture technologies. Many projects have focused on this area, but relatively few have done so with success.

It may be said that virtually every different project adapts an approach which differs, at least slightly, from any other project. However, for discussion purposes, this discourse will identify three general types of project approaches for small scale fisheries development. An Appendix to this text presents simplified flowcharts for the approaches discussed.

One approach for developing fish capture methods might be called the "throw boats" philosophy (variations include "throw motors" and "throw gear"). In many projects using this

approach, varying degrees of planning, done chiefly by expatriate or host country officials outside the fishing communities, precede the delivery of significant quantities of vessels, fishing gear, or other fisheries-related equipment. Sunken motors, beached hulks, and many unpaid loans are testimony to the ineffectiveness of this approach.

The integrated approach, and concentration on Community Fishery Centers described by Ben-Yami[2], appear much more promising. A pillar of this system is intensive community participation in project planning and implementation. However, as projects begin to apply this approach to small scale fisheries, they are likely to find a number of problems which require the participatory approach plus something more.

"Something more" in this case may be a pilot project for adaptive research, development and extension of locally appropriate fishing technology. After a reasonable period of information gathering and planning, using participation of local community people, such a project would concentrate on on-site development of fishing technology which can be demonstrated to be effective and appropriate under local conditions, considering technical, biological, social, cultural, and economic factors. Extension of this technology can be based on demonstration of systems that work. Motivation for local people to participate and adapt new methods would come from their actually seeing the technology used effectively in the local setting.

This paper will discuss two types of project approaches

which have been used in small scale fisheries development, with examples of the challenges and problems they have encountered. A discussion will be presented of the advantages and disadvantages which each approach brings to the different parties involved in the development process. A description of the Appropriate Technology Adaptive Research, Development, and Extension (ATARDE) approach for small scale fisheries will follow, with comments on its potential, and challenges it will have to address.

2. CLARIFICATION OF TERMS

At the start of this discussion, it is necessary to clarify a few terms commonly used with regard to small scale fisheries. There is endless debate over the meaning of small scale fisheries and artisanal fisheries. In reality, there is no clear division between small scale and industrial fisheries; from the smallest canoe to the largest factory trawler, there is a continuum of vessels of all sizes and shapes. This discussion will follow the arbitrary definition proposed by Acosta et al.: small scale fisheries are those "involving vessels of less than 15 meters in length, generally operating within 20 miles off the coast".[3] It can be argued that some small scale fisheries are quite technically advanced, and therefore not properly called artisanal fisheries. Likewise, some coastal fisheries include the participation of large, advanced vessels. However, in order to avoid excessive repetition of one expression, the terms artisanal and coastal fisheries will be assumed to share the same definition with small scale fisheries in this discussion.

The term "project" is commonly applied to a very wide range of activities, and there are all kinds of development projects. In this discourse, project will generally refer to the type of program in which a donor organization attempts to improve a fishery in part through the introduction, improvement, or extension of technology.

It is necessary to clarify the use of the expression "appropriate technology". The concept of appropriate

technology presented here draws heavily from E. F. Schumacher's "intermediate technology"[4], and from the works of David Thomson[5]. Generally, it implies low-cost, labor intensive technology which "considers people before profits"[6]. The emphasis for small scale fisheries must also consider technology to which artisanal fishing communities can gain reasonably easy access, and technology which fishing communities can continue to use and benefit from for an indefinite period of time (after the expatriate project personnel leave).

Another major factor for defining appropriate capture technology for small scale fisheries is that what is appropriate for one area may be totally inappropriate for a different fishing community a short distance away. The physical, oceanographic, ecological, and socio-economic diversity in small scale fisheries is such that the expression "appropriate technology" must have very local connotations in a geographic sense.

3. APPROACHES TO SMALL SCALE FISHERIES DEVELOPMENT

3.1. Focus on Provision of Vessels and Equipment

The productivity of small scale fisheries is often constrained by the fishermen's inability to obtain more effective vessels and fishing gear. In response to this situation, many development projects have focused on the introduction of more "advanced" boats and equipment.

This approach has typically involved a period of information-gathering and planning, by short-term consultants, in-country officials of international organizations, and host country fisheries officers. In many cases, the short-term consultants and donor agency personnel who have the greatest input into project planning, spend no more than a few weeks (often less) in the communities where the project is to be implemented. Usually the planners talk with local fishermen to try to get some ideas about what their needs are. In some cases, fishermen's meetings are convened to discuss these needs, and the directions which a project should take.

When a technologist from an industrialized country visits an artisanal fishing community, he may see technology such as non-motorized dugout canoes, using trot lines or gillnets with rocks for anchors and sticks for floats. Without further study, it is easy to draw the conclusion that as a top priority the fishery needs larger, motorized vessels, and more advanced, imported fishing gear. A longer term, in-depth

study of the situation, considering technical efficiency of the current methods, as well as economic, biological, and socio-cultural factors, may or may not lead to the same conclusion. However, planning time is short, consultants are expensive, and governmental donor agencies from industrialized countries often have plenty of advanced boats, motors, and gear available.

Bilateral and multilateral governmental donor agencies usually have other priorities which enter into planning decisions. (The means and priorities of Private Voluntary Organizations, PVO's, often differ substantially from those of governmental agencies. However, the vast majority of fisheries projects have been conducted by government-related organizations, so this portion of the discourse will focus on governmental donor agencies.) International political relations are, understandably, near the top of the priority list. Government officials who measure the worth of development projects often consider first the amount of funds dispersed, and this produces a bias toward rapid, capital-intensive projects. Virtually all government officials, of donor and recipient nations, like highly visible projects, designed to show many people that they are taking major steps in helping the people to progress. There is pressure for instant, visible progress, and there are often incentives for spending project funds or dispersing loans in relatively short time periods.

Sponsors of bilateral projects, and some multilateral projects, usually specify that equipment and materials to be provided must be manufactured in the donor country. This

boosts their industry and avoids burdening their balance of payments.

Fishermen who work in small boats are often more than ready to agree to receiving larger, more advanced vessels. Although they are often unfamiliar with all the technical and economic ramifications and requirements of larger vessels, they feel confident that they can use the new vessels to make substantially greater profits, and improve their situations.

A net result of these interests is often the provision to artisanal fishermen or fishing cooperatives, through gifts or bank loans, of numbers of larger vessels, motors, and equipment. In some projects, the quantity of materials and funds dispersed in this fashion are quite amazing; thus, the appellation "throw boats". The items provided are generally manufactured in industrialized countries, and appropriate for the markets of those industrialized countries. There is no guarantee that the technologies will be effective or appropriate for the developing fishing community.

It should be no surprise if some aspects of the imported technologies turn out to be inappropriate for the local fishery. Any boatowner-captain knows that a new vessel requires a shakedown period with minor or major adjustments in order to become effective in a new fishery. The throw boats approach usually leaves very little room for such adjustments. It is a package deal, and if the package is not effective immediately, many fishermen are likely to reject it, since they can ill afford additional risks, and since they had

little input into the choice of package.

Technical support for the introduction of new technology is often inadequate. Local fishermen may be given courses of a few weeks' duration in the operation and maintenance of new equipment. Levels of mechanization vary greatly among developing countries. In the more rural, non-mechanized areas, the introduction of machinery will encounter special problems, described very aptly by Ben-Yami.

> "Only rarely will a first-generation trainee from a rural, non-mechanized society acquire the same sense of responsibility, technical know-how and intuitive feeling for machinery as will a person born and brought up among the machines and disciplines of a modern industrial society. Yet many development projects insist on giving rural, not very mechanically-minded people quick and intensive training to enable them to operate and maintain imported technology. The chance of success is very low indeed."[7]

It is not unusual to see one expatriate master fisherman with three or four host country fisheries officers, responsible for the introduction of many thousands of dollars worth of new boats and gear, in a half dozen fishing communities involving scores of fishermen. The master fisherman, who may or may not have intimate knowledge of the local fishery, may be stationed in the country for two or three years, a relatively short time to alter long-standing traditions in fishing technology.

Even where new technology is technically and biologically sound, human factors such as traditions and interpersonal interactions may obstruct the productive use of unfamiliar types of vessels and gear. Fisheries technologists often see cases where relatively inefficient technology persists, and

more productive innovations are rejected. This is often due to human factors, whose importance cannot be overemphasized. Richard Pollnac has documented a number of failed projects in which organizations threw boats or gear, or formed fishermen's cooperatives, while neglecting essential local socio-cultural factors.[8]

With all these factors combined, it is unusual to see a "throw boats" type of project where most of the vessels are operating profitably four years after their introduction, and where development loans have been repaid.

Even if the "throw boats" approach could be used effectively in the more advanced of the developing countries, there are technical needs in the least developed areas which are completely incompatible with this approach. For example, in most West African countries, over 50% of the fishing vessels are non-motorized canoes.[9] In some countries of the region, fossil fuels and imported manufactured goods are either prohibitively expensive or completely unavailable. Even if massive development efforts were implemented, it would be many years before the majority of the region's fishermen had physical and financial access to reasonable quantities of motors, fossil fuel, and synthetic nets and lines. The real and immediate need in this situation is for improved, effective fishing technologies using, as exclusively as possible, inputs locally available from within rural fishing villages. At this level, it seems that development organizations have very little to offer for this situation, and the throw boats approach obviously has no validity.

It is quite difficult to find accurate, reliable information about the results of fisheries development projects. Project evaluations are usually conducted or sponsored by the implementing organizations, and results are often not publicized. In some cases, consultants are prohibited by contract from publishing project information without permission of the contracting organization. A few site visits to reportedly successful projects can make the observer very skeptical of written and oral accounts. On the other hand, some observers seem so anxious to criticize international aid that they sometimes overlook real benefits which resulted from projects. Unfortunately, many experienced development workers have concluded that anything short of direct observation, or the reports of a few trusted and well-known experts, constitutes inadequate information.

In 1984, Pollnac observed the results of a government fisheries development project carried out in Oman a few years previously. The fishermen of the area traditionally used boats made of reeds, and in recent years these boats had been modified to accept outboard motors. Project planners felt that open five meter aluminum boats would be far better than reed boats, so the government conducted a project in which hundreds of these aluminum skiffs were introduced. An unforseen problem was encountered; the boats were regularly run over reefs or pushed up on beaches, and after a very short time, metal fatigue caused sufficient deterioration to render the craft unseaworthy. In this case, the traditional reed

craft were clearly more appropriate. [10]

In a development project involving distribution of boats and gear conducted in Morocco in the early eighties, a number of problems arose. Through an international agreement, the government of Morocco received over one hundred fiberglass vessels of about eight meters in length, with inboard diesel motors and hydraulic fishing gear haulers. A large quantity of gillnets and lobster traps accompanied the vessels. the vessels were built in Europe, and technically they would appear to the visiting fisheries specialist to be a reasonable improvement for many small scale fishermen in the area. However, many local fishermen, who are accustomed to wooden planked boats, say that the fiberglass boats are too light and unstable. The fishermen also complain that the lobster traps and some unfamiliar types of gillnets delivered are not effective in Morocco. In this case it appears that much of the technology delivered could be effective in Moroccan fisheries. However, the vessels were distributed to at least eight different newly formed cooperatives scattered along several hundred miles of coastline. Reports indicate that only one or two technical experts were present during the introduction of the vessels, and they did not stay long enough to make any impact. This technology was unfamiliar to the recipients, and it was not used efficiently.

Compounding the technical problems were very serious socio-cultural and administrative problems. The cooperative concept was completely new to most fishermen, and it was generally not accepted nor executed well. Virtually all

decision-making authority was concentrated in the central bureau of the Office National des Peches, so local groups of fishermen could not legally make significant changes in their operating methods. In early 1985, a very small minority of the vessels were operating regularly and profitably, and none of the loan repayments for their purchase were up to date.

It must be pointed out that, although many of the projects involving boat and equipment dispersion appear to have failed, even the failures can produce some positive results. Production was sometimes raised, although some raises were temporary, and some fishermen earned increased incomes. It can be argued that people learned from exposure to new technology, and there may be some long range, less tangible benefits which are difficult to identify and measure.

However, the observable and lasting benefits from projects using this approach are generally very low, relative to their costs, in funds, time, and effort.

3.2 Approaches Emphasizing Fishing Community Participation

3.2.1. The Integrated Approach and Community Fishery Centers

In recent years, the United Nations Food and Agriculture Organization has been attempting to promote an alternative approach for small scale fisheries development. The need for, and concepts of, this approach were described by Ben-Yami in a 1980 Symposium of the Indo-Pacific Fishery Commission.[11] Subsequent works by Johnson[12] and the FAO Fisheries Department have covered the strategy in more detail. This approach has been called integrated development, and its main objective, as stated by Ben-Yami, is "improving the lot of fishing folk and their communities".[13] An FAO West African regional small scale fisheries project, based in Benin, is implementing the approach, and it was approved as part of a Programme of Action of the FAO World Conference on Fisheries Management and Development.[14]

This approach emphasizes the fact that a small scale fishery is composed of multiple factors and issues. In addition to fish capture technology, fisheries development must address landing facilities, processing, transportation, markets, supply of boats and equipment. The socio-cultural and economic aspects of a fishing community must also be considered in development; for example, family and community structure, tradition, education and basic health needs.

Strictly technical or scientific approaches to the development of such complex systems as small scale fisheries

have proven to be generally ineffective. Integrated development strategies seek to address a wide variety of economic, social, and cultural issues which are essential components of coastal fishing communities.

While integrated development may be applied on a national or regional basis, a fundamental component of this approach is development through village-based entities which are sometimes called Community Fishery Centers. Planning and implementation must be conducted while acknowledging that the conditions and needs in different communities may differ significantly. Johnson summarizes this project component by saying "the fundamental units of the Programme strategy are individual fishing communities working on their own self-development projects".[15]

There is a growing awareness that expatriate "experts" cannot hope to have sufficient knowledge and capability for planning the details of an integrated program to address all the necessary issues in a particular fishing community. In the past, development projects have often been rejected by villagers, because project planning did not give adequate consideration to traditional community structure and authority, or because the villagers themselves had no active input into the formulation of project plans.

In order to avoid these problems, FAO's integrated approach seeks to include community members in active participation in projects, from preliminary planning through implementation. Traditional community authority structure is to be respected, and community leaders will help determine the

directions taken by the project. This obviously requires that the specific goals and activities of the project be flexible, to address the interests of the community, and to change as the project acquires experience through the trial and error process which is an inevitable part of implementation. Active community participation should help to ensure that the project is aimed at the real needs of the community, and that the community feels an interest and commitment to work toward achievement of the goals which it has set.

This integrated approach will involve much longer term commitment to individual communities than has been the norm in government development projects. Some outlines describe a beginning program of five years' duration, with options for extension in order to continue the development process. Long term technical support will be conducted by a multidisciplinary team of experts, sometimes referred to as a Fisheries Development Unit, with needed specialties, such as economics, fish processing and marketing, fish capture technology, and sociology or community development. This system is intended to thoroughly train community members in the operation and maintenance of new technology, as well as to help them become adept in the management skills which will enable the community to continue promoting its own development independent of outside assistance.

The physical facilities and activities of Community Fishery Centres (CFC's) will be determined by community priorities. FAO documents mention facilities such as improved

landing areas, refrigeration installations, stores for the sale of fishing gear and household items, wells or pumps for provision of clean drinking water, and social gathering centers.

The integrated, community-based development approach for small scale fisheries has only recently begun to see widespread application, and since it is a long term approach, evaluation of results at this point may be premature. This approach represents a significant step in the process whereby development organizations learn to work effectively in an extremely difficult field. It should enable organizations to avoid many of the pitfalls encountered by projects which focus primarily on the dispersion of vessels and gear.

3.2.2. Difficulties Anticipated with the Participatory Approach

In spite of the advantages of the integrated, community-based development approach, the system should not be expected to succeed without some difficulties. Past projects which have incorporated a significant component of community participation have sometimes found that this component may bring its own set of obstacles. Such obstacles are illustrated by the case of the Interamerican Development Bank (IDB) fisheries project which was active in El Salvador during 1979-1981. While that project did not attempt the broad, integrated approach now promoted by FAO, it did incorporate significant inputs from local fishermen, and it found that local participation may not be the cure for all the problems

of fisheries development.

Salvadoran fisheries in the late seventies were characterized by about seventy double-rigged shrimp trawlers averaging 20 meters in length, and a few hundred open skiffs and dugout canoes, many of which used outboard motors. Almost all the fishing effort of the different vessels was concentrated in a belt extending from the beach seaward for about 20 miles. The major small scale fishing gears were hook and line, and gillnets, with some additional use of demersal longlines, crab pots, cast nets, oyster diving, etc. Some small boats made a business of buying the discarded by-catch from shrimp trawlers and selling it to buyers on the beach. As in many developing countries, costs of fuel and outboard motors had become the major expenses of the artisanal fishermen. In 1980, gasoline cost approximately US$ 2 per gallon, and the expensive, imported outboard motors generally lasted only two or three years.

The IDB project proposed to use a development loan totalling approximately US$ 4 million for construction of landing facilities, introduction of improved small scale vessels and equipment, and improved fish marketing. The project faced a variety of obstacles which do not appear to have been given adequate consideration in the planning process, including uncertainty about the resources, suspicion of overfishing fish stocks by the shrimp fleet, and destruction of resources by pesticide runoff. However, since the focus of this discourse is the introduction of appropriate

capture technologies, we will concentrate for the moment on the problems which were encountered in this area of the project.

Work with the fishing communities was concentrated on ten fishermen's cooperatives scattered along the coast. Project personnel felt that the most appropriate innovations in capture technologies would involve the introduction of efficient vessels in the 7-12 meter size range, equipped with sail or diesel engines for fuel economy in propulsion. (At the time, diesel fuel was about half the price of gasoline.) This type of vessel had never been used in El Salvador, and was not available for purchase in the country. The most promising, energy-efficient fishing gears were expected to be stationary gears such as gillnets and longlines.

The first assignment of the consultant in fishing operations was to collaborate with the fishing cooperatives to clarify their needs, and determine what kinds of boats and gear they wanted to buy with loans from the project. It was no great surprise when the majority of fishermen expressed the desire to buy 20 meter shrimp trawlers with the loans. Project staff showed drawings of the proposed intermediate-sized craft, and presented slide shows of these vessels working successfully in the fisheries of other countries. Understandably, the fishermen still refused to commit themselves to purchasing vessels which they had never seen first hand or worked on.

The project contained no provisions for obtaining intermediate-sized boats for demonstration, without purchase

agreements from fishermen's cooperatives. However, a national development bank realized the need for positive action to overcome this obstacle, so it financed the construction of a 12 meter prototype fishing catamaran, in the hope that demonstration of this vessel would stimulate purchase agreements from the cooperatives. During the first half of 1980, this catamaran spent about three months making fishing trips intended to explore new fishing grounds and demonstrate the vessel's effectiveness to fishermen who participated in the trips.

From the start, there was a great deal of opposition from the fishermen, because the vessel was not a shrimp trawler, and because the multihull concept is completely foreign to Central America. Results of the fishing trials were mixed, for a number of reasons. First, the new fishing grounds were not so productive as expected. Only in the last trips did production begin to approach profitable levels. A second problem was that the vessel was intended to use sail propulsion, with two auxiliary outboard motors, in order to avoid the expense of diesel motors for the prototype. Construction delays prevented the builder from installing the sailing rig for trial operations, and operating costs under outboard motor power were very high.

On the positive side, some technical aspects of the vessel were demonstrated to be very effective. Its substantial deck space and mechanical winch allowed it to handle quantities of gillnets and longlines substantially

greater than those fished by vessels of comparable length which were operating profitably in Mexican waters 300 kilometers to the West. The stability afforded by its 5.5 meter beam allowed it to fish easily in seas up to two meters, and some local fishermen said its motion was more stable and comfortable than that of the larger shrimp trawlers. Indeed, the dozen or so local fishermen who made trips on the catamaran were all favorably impressed.

Unfortunately, increasing political violence motivated several project staff members to leave El Salvador in July 1980. With the most enthusiastic supporters of the prototype gone, the level of interest and activity waned rapidly. Although the long-awaited installation of a sailing rig resulted in fuel savings on the order of 80%, the skepticism of most fishermen and the lack of enthusiasm of some project staff contributed to the vessel's falling into disuse. For a time it joined the world-wide fleet of beached hulks chalked up to experience for development methods. Recently, the builder purchased it and is reportedly planning to prepare it to fish once again.

While the catamaran was under construction, project staff realized that it would be best to show the fishermen a second, less radical alternative for an improved boat type. The fishing operations consultant proposed the purchase for demonstration of a seven meter diesel-powered monohull vessel made in Mexico. However, since IDB had no provision for vessels for demonstration, and since the national bank was already risking substantial funds in the catamaran, funds were

not available for this purchase. It seems ironic that a $4 million project could not invest $15,000 for trial and demonstration of the appropriate technology which it was attempting to introduce. This planning error is indicative of a lack of consideration for some fundamental issues in small scale fisheries development.

As IDB's allotted time period for the project neared completion, and the fishermen accepted the fact that the project would not finance new shrimp trawlers, the project agreed to the purchase of the only other technology which the fishermen were willing to accept: the familiar open skiffs with outboard motors. Considering the technical and economic constraints of this technology mentioned earlier, it is uncertain whether these boats are now operating profitably, and up-to-date information on the project is hard to find. It is clear that the project did not succeed in its objective of introducing new, more efficient capture technology.

A few of the lessons to be learned from this project have significance for project approaches which stress community participation. First, local fishermen and project staff, exchanging ideas in good faith, may find it extremely difficult to agree on what constitutes appropriate technology. A very awkward situation could result if project staff spent a great deal of time expounding the importance of community participation, and then refused to aid in the procurement of locally desired technology which staff felt was inappropriate. A great many canoe fishermen want 20 meter shrimp trawlers.

Many development projects seek to introduce more efficient technologies which have not previously been used in the project areas. Local fishermen may be reluctant to participate in such innovation, if they have never seen the strange new boats and gear in action. They may be understandably reluctant to invest their limited resources in technology which has not been proven locally. More cautious, responsible fishermen may hesitate to accept the burden of loans to acquire unfamiliar technology.

Another important lesson seen in the Salvadoran project and in many others is that it generally takes time to make newly introduced technology effective under the local conditions of a small scale fishery. Time constraints during trial and development of the catamaran did not allow project staff to find productive fishing grounds, work technical bugs out of the system, and demonstrate a technology which was clearly effective. These factors hindered the acceptance of a technology which had a number of advantages, and which might have been shown to be locally effective and acceptable, given sufficient time for development and demonstration.

The demonstration time necessary to promote local acceptance increases with the degree of dissimilarity between the new technology and local traditional technology. With the exception of the Southeast Asian and Pacific regions, the multihull concept is radically different from traditional vessel types, and requires a great deal of demonstration before local acceptance may be achieved.

Fraser has documented a case in which a technical change planned and implemented by village fishermen turned out to be totally unacceptable in the technical and socio-cultural contexts, and may indeed have left the village worse off than before.[16] In the late fifties, Malay fishermen in the town of Rusembilan wanted to motorize their boats, to become less dependent on propulsion by sail and oar. After a series of discussions among fishermen, the town leaders acquired a few inboard motor launches, and initiated a system of towing groups of smaller craft to and from the fishing grounds every day. In this process, individual boats lost a great deal of independence about where they could fish and when they could return to port. Disputes over distribution of the catch, and payment of towing fees, caused a great deal of acrimony, sometimes leading to physical violence, especially among wives of fishermen. Most fishermen abandoned the new system after less than one year. The town leaders, who had been major participants, lost stature, and decreased social harmony within the town was apparent.

FAO's integrated approach for village-based fisheries development suggests very extensive participation of community members. After site selection, there is a proposed six month period of planning, to be carried out by host country officials, an expert planning team or Fishery Development Unit, and representatives of particular fishing communities. With many communities, it may be very difficult to achieve

this level of participation prior to the demonstration of concrete action.

In many villages, the level of organization for purposes such as joint planning or consensus could be an impediment to community participation. One Peace Corps Volunteer in Sierra Leone related a story of how she tried in vain for three weeks to promote a meeting of a significant number of community members to make them aware of and to discuss a local development plan. Finally she found that the only way to gather a significant number of community adults was to have the village chief help her to physically herd the people from the mosque directly into the chief's yard immediately after a weekly religious service. It is doubtful whether this strategy would be effective on a regular basis; in the case of this community, regular community meetings were not held.

In cases such as these, where it is impractical to attempt to periodically assemble significant numbers of community adults, a necessary alternative may be to concentrate planning activities with a smaller number of community leaders such as village chiefs. However, most communities contain a variety of socio-economic levels, and there is no guarantee that community leaders will accurately represent the interests of the majority of community members at the different levels. In addition, it may be difficult to achieve agreement between leaders who may represent diverse interests or ethnic groups within a community. The establishment of a decision-making procedure may be a long,

arduous process.

Many community members, especially successful fishermen and fish dealers, are very busy with their normal activities. It may be extremely difficult for the more capable community members to invest the necessary time for the extended planning period proposed by the FAO plan. It is unclear from available documents what will be the incentives for community participation, besides the promise of a development project in the future.

This "promise of a development project" may be another highly sensitive issue. Many fishing communities have already seen a number of failed development projects. For example, one of the most successful and prosperous small scale fishermen in eastern El Salvador refused to become involved with the local fishermen's cooperative, which was participating in the IDB fisheries project. When questioned why, one of the chief reasons he gave was previous involvement with a failed cooperative: "I practically lost my youth in a fishermen's cooperative. For years, we members worked hard and invested in that cooperative, then the president ran away with the funds".[17]

In some cases, government agencies whose good intentions exceed their means, have repeatedly spread propaganda about coming projects which never materialized. A long series of events which raised expectations and then dashed hopes have left a great many fishermen very skeptical of announcements of government development projects.

The combination of these factors may make it very

difficult for project planners to obtain the substantial investments of time and effort for preliminary planning requested from community leaders.

Some concerned government representatives may also have reservations about requesting such investments from the community during preliminary planning. If the planning team is composed of different individuals from those who will implement the project, are there enough capable specialists and extensionists available so that the planners can guarantee for the community the top quality project staff necessary for technical support? Can the government planners be confident that their organizations can help to obtain appropriate technologies to meet the real needs of the village? Honest assessment of the records of past projects may make government planners reluctant to make grand promises about project results, and to request significant investments of time and effort by community members.

In spite of these potential obstacles, community participation is still an invaluable project component, and may be considered a significant step forward in development methods. This discourse is intended not to derogate the approach, but rather to point out some potential problems, and reinforce the approach by suggesting ways to deal constructively with these problems.

4. BASIC TENETS FOR INTRODUCING SMALL SCALE FISHING TECHNOLOGY

At this point it is helpful to review some basic tenets of introducing appropriate small scale fish capture technologies, in consideration of previous discussion and field experience.

Prior to any planning of a project for capture technology improvement, it is essential to determine whether or not local fishery resources are sufficient to warrant expansion in this sector. If the current level of effort is near or beyond Maximum Sustainable Yield, then development should focus on rational resource management, and not on improving capture technologies. In virtually all the industrialized countries which have viable small scale fisheries, careful management practices help to maintain those fisheries, and avoid overfishing on the same resources by larger vessels. Fisheries management is often less efficient in developing countries, and danger of overfishing may exist from both small scale and industrial scale craft.

In areas with abundant resources, fishermen are sometimes constrained by the inability to gain access to more effective capture technologies. The desirable technologies may be unknown in the area, unavailable due to commercial and trade factors, or too expensive to be affordable for small scale fishermen whose sources of credit are often limited.

Among coastal fisheries, there is tremendous diversity in physical, oceanographic, biological, technical, economic, and

socio-cultural factors. Even technologies which appear primitive can, in fact, be quite diverse and complex, having evolved over many years to the specific conditions of the area. In this setting, there may be a real need for technology improvement. However, the term technology transfer may be inappropriate, since experience has shown that the transfer of small scale fishing technology unchanged from one place to another is often unsuccessful. Any technology which is transferred unchanged should not be expected to be effective on an immediate and long-term basis. It will almost certainly need modification for local conditions, and such modifications may require time and extended sea trials. In this context it is more appropriate to talk about technology development, rather than technology transfer.

Even where innovations have been shown to be technically effective, a broad range of issues must be addressed in extension of the innovation to fishermen. Fishermen's willingness to accept the change is one of many socio-cultural, economic, and resource management issues which must be dealt with.

For technologies which are most appropriate, in terms of the broad range of issues mentioned above, the level of extension and promotion effort by development organizations need not be so intense. The most appropriate technologies generally sell themselves. The harvesting of post-larval shrimp for mariculture in Ecuador, and the spread of Ghanaian outboard fishing canoes along the West African coast, are interesting illustrations of this concept. In Ecuador, a man

can enter the fishery for post-larval shrimp with a total investment of approximately US $15. All of the required materials are readily available in Ecuador. In this fishery, an individual fisherman pushes his net through shallow water, while one or two family members tend the captured larvae in tubs on the beach. Trucks carrying tanks and compressed air buy the catch on the beach, and transport it to shrimp ponds. There are no reports of development organizations promoting this fishery, and it has grown in recent years to become the most significant small scale fishery on the coast of Ecuador.[18]

A better-known example of technology spread without intentional outside promotion occurred in West Africa circa 1955-1965. Fishermen of the Fanti tribe from Ghana had developed an effective fishing technology using large planked canoes with outboard motors and surrounding nets to capture schools of small pelagic fish. These fishermen were highly migratory, and they spread to many coastal communities of other West African nations. Over a period of years, local fishermen who were using smaller, non-motorized canoes and less effective gear, learned and adapted this technology, and in some cases improved fish processing technologies. The improved technologies remained after several states forced the Ghanaians to leave, and it remains the most effective small scale fishing technology along much of the West African coast. Hendrix relates an interesting account of this extension process in Sierra Leone.[19]

Admittedly, the biological consequences and long term viability of the Ecuadorean post-larval shrimp fishery are uncertain. Its rapid spread is probably due more to low initial investment and relatively high returns than to other factors. In the West African example, increasing costs, and shortages of imported motors, spare parts, and fuel, are starting to hinder the viability of the outboard canoe fisheries. However, these cases do show that technologies which are relatively low cost, labor intensive, and profitable, involving locally available materials, can spread like wildfire without promotion by any outside organization. The fact that changing economic and biological conditions may in time render these technologies inappropriate, highlights the need for ongoing evolution and development of appropriate technology.

The participation of the fishing community in project planning and implementation can be helpful in ensuring that innovations are appropriate for addressing real needs, and in stimulating the community to work actively in its own development.

At every stage of the project, it is essential to consider the incentives of local individuals to work with the project and contribute to its success. What are the incentives for this fisherman to help plan? What would motivate him to help build facilities for a Community Fishery Center? When the project asks him to adopt a new fishing method, what's in it for him? Many villagers have

seen failed projects in the past. They have limited financial resources, and in some cases, limited time. Their participation in a project often represents significant investment and risk, of a personal if not a financial nature. Project design should, at every stage, honestly address the question, "what's in it for them?".

Organizations must avoid the common mistake of modeling fisheries development projects after agricultural projects. The biological, technical, economic, and socio-cultural issues regarding these two fields contrast markedly. Johnson[20] and Pollnac[21] have discussed these contrasts, and described problems which have arisen from treating fisheries development like agricultural development.

A final tenet for small scale fisheries development is that it takes time. Virtually all development workers and organizations would like to see immediate impacts. The push for immediate impacts has contributed to designing most projects for fixed durations of one to four years. Whether or not the project has accomplished its stated objectives, it ends at most within a year or two from the planned date of completion. If the initial efforts were not successful, then termination of the project may result not only in the loss of its expenses, but also in the effective loss of the knowledge and experience gained from the project's mistakes. On the other hand, a project which makes a minimum commitment of five years, with options for extension, can afford to spend its resources cautiously during the first years, learn from its

mistakes, and still have time for introduction and extension of technologies evolved through the inevitable process of trial and error.

Fixed duration projects which focus on the dispersion of numbers of vessels and gear whose type are determined at the start of the projects, clearly do not adequately address the issues outlined above, and the low success rates of such projects reflect this fact. The integrated approach, incorporating Community Fishery Centers, is a significant step forward. However, FAO documents describing the integrated approach leave some gaps in the areas of capture technology and extension, as well as doubts about practical implementation of community participation. The next section of this discourse describes an approach intended to fill those gaps, while outlining a development strategy which could be implemented with resources less extensive than those required by FAO's integrated approach.

5. THE APPROPRIATE TECHNOLOGY ADAPTIVE RESEARCH, DEVELOPMENT, AND EXTENSION (ATARDE) PROJECT FOR SMALL SCALE FISHERIES

If this project approach had a motto, it might be, "walk softly and carry something that works". It is based on the premise that people will, in time, adapt technologies which they perceive to be effective, appropriate in a broad sense, advantageous to them, and available.

Successful businesses generally do not market new products until they are confident that those products will prove effective under expected user conditions, and attractive to the targeted consumers. They spend millions of dollars on research and development, as well as market testing of consumer acceptance. The companies know that if they flood the market with ineffective products, their reputations are likely to suffer.

If development organizations want to spread appropriate fishing technology, they must stop flooding developing countries with boats and gear that are not effective and appropriate, considering the broad range of technical, economic, and socio-cultural issues. They need to establish operations in developing countries for ongoing research, development, and extension of small scale fishing technology. Extension work before adequate, on-site research and development, is not effective. Instead, projects should gather as much relevant information as possible, invest the time necessary to develop technology which works in the local

setting, evaluate whether it is appropriate in a broad sense, and then help it to spread by demonstrating it and making it accessible.

5.1 Project Background

A project using the ATARDE approach could form a major technical component of an integrated, village-based project incorporating Community Fishery Centers. On the other hand, general principles of the approach may be applied in less ambitious projects by organizations with more limited resources.

The broad objective of the project is to develop and spread technology which local people can use to improve their quality of life. The technology should be such that it allows the local people to sustain progress and improvements on a long term basis, with eventual independence from outside assistance.

The approach described here may not be useful in all situations. There is at least one prerequisite: local fishery resources must be sufficient to warrant improving or expanding fishing technology. This is not the case in a number of developing areas which would like to expand their fisheries. Some local tradition of small scale fishing would also be very helpful. However, in response to changes such as coastal infrastructure development, there have been cases of fisheries expanding very rapidly and attracting people from other occupations. As an example, Pollnac cites the expansion of

fisheries in some parts of Costa Rica, after local construction of improved roads.[22]

The ATARDE approach should facilitate community participation while avoiding some of its difficulties. Project staff must solicit information and opinions from community members starting in the planning phase, and continuing through implementation and extension. However, the project does not depend on community members to make investments of a personal or financial nature before the demonstration of appropriate innovations which are beneficial to the community.

5.2 Personnel

The ATARDE project will require a full time master fisherman and major effort of a specialist in economic and social issues relating to community development. The master fisherman must have international experience with a wide variety of small scale fishing technologies, and an open mind about experimenting with different fishing methods which might be expected to be effective and appropriate. The socio-economic specialist must deal with the questions of determining which innovations might be locally appropriate, considering the range of socio-cultural and economic factors. Both experts must have a sensitivity for monitoring the social and economic effects of innovations as they are developed and introduced.

A competent business manager will be needed to ensure efficient support in logistics and materials, as well as to keep careful records of project monies and financial analysis of fishing operations.

Some crew members for the fishing vessel or vessels should be taken from the local community. They can provide essential local knowledge for fishing operations, and should also serve a valuable liaison function between the project and the community.

If members of the local fisheries service are interested in improving their fishing and extension skills, they should also participate in the fishing operations, and be assigned to the project on a continuing basis. Between fisheries officers and local fishermen, the project must have enough fisheries technologists to have some on land making or mending gear while the others are fishing at sea.

Although vessel and gear trials are aimed at achieving commercial levels of production, there is a strong research component in the fishing operations. Therefore, it would not be realistic to pay crew members according to a share of the catch. Crew members must have a guarantee of some steady earnings. On the other hand, the work will sometimes be very strenuous, and require long, uncomfortable days at sea. The project must develop locally appropriate pay arrangements which will provide adequate incentives for crew members to perform well in this skilled and demanding work.

5.3 Project Components and Activities

5.3.1 Information Gathering

An essential first step for any development activity is the gathering of as much information as possible about the local fisheries. A great deal of information is needed, not only about technology, but also about the biological, economic, and socio-cultural aspects of the fisheries. The importance of, and methodologies for this process are covered by Stevenson, Logan, and Pollnac.[23] The immediate goals of this phase are to determine if technical innovations might be appropriate, which types of innovations can be expected to be beneficial, and which sites appear most promising for a project.

Dialogue with local community members must begin at this point, to determine their interests and needs, as well as their willingness to work with a development project and consider technical changes. The establishment of good personal relations with community members, especially the more influential ones, is an indispensable part of the project right from the start. In order to gain the confidence of community members, it is important to present realistic accounts of the proposed project's goals, potential, and limitations. In many communities, people have heard a great deal of propaganda, whose promises were not realized. They often appreciate frankness about limited possibilities more than vague promises of great possibilities.

During the information-gathering process, and at times during subsequent project phases, the master fisherman will certainly want to make fishing trips with local fishermen on their boats. This will enable him to learn about local fishing technology and conditions, while building friendships with local fishermen.

The following criteria for site selection were proposed by Drew and Pollnac.[24]

- The Project should be based in a community where artisanal fishing is a major activity.
- The site should have abundant and diverse fishery resources within operating range of small craft.
- The site should be within a convenient distance from a commercial center for provision of logistic, material, and administrative support.
- A preliminary socio-economic analysis of the community is essential. It is important that local people be interested in artisanal fisheries development, open to possible innovations and changes, and not distrustful of the development organization.

After the project begins actual fishing operations, the information gathering component can expand to focus on the information yielded by these operations. Careful accounts should be kept in all relevant areas, including: fixed and variable costs, income, areas fished, possible effects of environmental factors on production, and species and quantities fished. Such records should enable the project to analyse and show which operations are profitable, to

demonstrate the economic benefits of sound practices such as motor maintenance, and to learn more about the local fisheries.

5.3.2. Equipment Selection and Acquisition

After the selection of a site, the project must select and obtain the boat or boats and fishing gear which it intends to test. In cases where the traditional boats are felt to be appropriate, and innovations are intended to concentrate on methods and gear or other aspects of the fishery, the next step may simply be to purchase local boats. In cases where the introduction of modified boats to be built locally is the goal, an expert project boatbuilder may begin to train and work with local boatbuilders, hired by the project, to construct the new craft.

In the selection of vessels to test, a project might consider both ends of the spectrum in artisanal fishing. On the one hand, the more prosperous artisanal fishermen may be using motorized vessels and significant quantities of fishing gear, which represent substantial investments. An ATARDE project might test vessels of similar size and cost, with fuel-saving innovations such as auxiliary sails and inboard diesel motors. Insulated ice boxes for improving product quality, locally unknown types of fishing gear, or mechanical net haulers, are other examples of new technologies which might be tested. In some cases, a project may want to test vessels made with new materials, such as fiberglass or

wood-epoxy. In any case, the most expensive new technologies should not be far beyond the financial means of the more prosperous fishermen, under existing financial constraints.

At the other end of the spectrum, most fisheries also have very small craft, often canoes, of less than six meters in length, without motors. An appropriate technology project should address the issue of improving technology which is accessible to fishermen at this level, whose financial means are extremely limited. For instance, in Sierra Leone, many fishermen use 5-meter dugout canoes with paddle or square sail for propulsion. Some development workers have voiced the possibility of improving this level of technology with improved sailing rigs or leeboards which might allow the canoes to sail to windward. The traditional use of handlines or very small demersal longlines might be improved by the introduction of longer, more effective longlines coiled in baskets or boxes.

Following adaptation to local conditions, such innovations would involve little additional investment for fishermen, and could be made with local materials. As small as these changes may appear, they could bring real benefits to thousands of West African fishermen, enabling them to increase their earnings without increasing dependence on imports. In recent years, FAO has published several catalogs of small scale and traditional fishing gear, which could be good sources of ideas for such innovations.

The ATARDE project may want to acquire one vessel in the financial range of the poorest fishermen, and one in the range

of interest of more prosperous fishermen. The master fisherman may want to test gear which is used effectively in other regions. In addition, it must be remembered that other communities not far from the project site may be using technologies which could be of benefit if introduced to the project's community.

5.3.3. Adaptive Research and Development Phase

After the project has obtained the first boats and gear, it must concentrate on operating the new technologies profitably under local conditions. This might be considered the adaptive research phase of the project. Technology which is effective in site A is often assumed to be effective in site B, and this is a serious mistake. Anyone who has visited a number of projects a few years after development organizations have completed their work and left, knows that many innovations were not profitable in the long run under local conditions.

In fact, even innovations which have proven effective in other small scale fisheries may require significant modifications for application in a new site. Small scale fisheries often require high skill levels and extensive local knowledge, so it may take an expatriate master fisherman and mixed crew some time to achieve the necessary skill and coordination. Training of the project crewmen is an essential part of the adaptive research and development phase. All

crewmen must become as competent as possible with the new technology, because they will later be the extension agents responsible for demonstration and training for other fishermen.

If the first innovations attempted do not produce positive results within a reasonable trial period of, say, a few months, project staff must begin to try technical modifications. This modification and trial process must continue until effective technology is developed. It is likely that effective technology will be developed and extended in small measures during this phase. For example, a project which is attempting to introduce inboard diesel boats which can be beached easily may also demonstrate a new, improved method for using traditional nets or longlines. Local fishermen who may not be interested in buying boats may want to learn the new method of using nets and longlines. Project operations must be flexible enough to work with interested fishermen when opportunities arise for formal or informal training and extension.

Indeed, there may be many opportunities for demonstration of small, but important changes which can be of benefit to fishermen. Project staff should continually practice and demonstrate proper maintenance of boats and motors, which is lacking in many developing areas. Local fishermen should be able to see that practices such as proper maintenance, and careful safety procedures, bring benefits of a concrete, demonstrable nature.

Effective innovations involving minor changes may be achieved in a relatively short time. However, for major changes, such as the introduction of new types of vessels, the development of technically effective adaptations which are economically and socially appropriate may take a few years.

During this phase, input from local fishermen employed in the project, as well as from other community members, should be solicited, in order to develop technology which is acceptable and appropriate in the social and economic contexts.

5.3.4. The Extension Phase

After innovations have been proven effective in fishing operations and judged to have a strong likelihood of being appropriate in the broad sense, the project can move into the extension phase. Extension activities should focus first on demonstration, then on training local fishermen who are interested in the innovations. Through observation and informal interactions with project staff, many local fishermen will have heard that the project is having some success with new technology. Interested fishermen can be encouraged to go fishing on project vessels to see the new technologies in action.

Demonstration and training with technology which is really appropriate should, in a relatively short time, stimulate some fishermen to attempt to acquire or use the

innovations. As fishermen begin to acquire new equipment, thorough and careful training by project staff will be essential. In addition to group training, individual training and hands-on methods will be important for preparing fishermen to use new equipment. If significant numbers of fishermen begin to adapt new technologies, it may be necessary to expand project staff in order to provide adequate training.

At this point we encounter the crucial question of how to help fishermen to gain access to new technology. This question has two facets. First, is the required equipment available locally? Ideally, if the technology is really appropriate, a fisherman should be able to gather, build, or purchase all required equipment from local sources. However, experience and demand from fishermen has shown that some equipment, such as motors and synthetic nets, are valuable enough to warrant importation from industrialized nations. In some cases, foreign exchange shortages and a number of other factors make the acquisition of imported manufactured goods extremely difficult for fishermen. The ATARDE project must start to consider this problem before the adaptive research phase, and plan to work only with equipment which will be available to fishermen.

A second constructive approach is to start early on to work with government officials to establish customs exemptions and special consideration for artisanal fishermen in matters relating to foreign exhange and importation of equipment. Such special consideration often exists officially, but the procedures and paperwork required for implementation put it

effectively beyond the reach of rural artisanal fishermen. Thus, this approach is generally not so effective as working with materials already available locally.

Commercial dealers of fishing gear are sometimes helpful in obtaining new types of gear, and the project should investigate their willingness to deal fairly with fishermen and cooperate with the project.

If the needed equipment is physically available for the artisanal fisherman, and not free to be gathered or built by his own efforts, then the important question becomes, how will he pay for it? Equipment which is provided free is often not valued or used productively. Even in the case of gifts of quantities of gear to fishermen, it may be best to establish a system of sale at cost. The proceeds could be used to start a fund for running a local fishing gear store which would sell gear to fishermen at attractive prices on a continuing basis.

If the technology is within a price range which could really be considered appropriate, there will probably be at least a few prosperous small scale fishermen prepared to pay cash for it. However, if availability were limited to the more prosperous fishermen, the innovations might cause serious socio-economic problems.

A system of vessel or gear acquisition on credit will probably be necessary. This is a very difficult area for development. Projects have tried a number of different strategies for administering credit, such as cooperatives, loans to individual fishermen, and hire-purchase schemes for

crew groups. A comprehensive discussion of the merits of different credit systems is beyond the scope of this discourse. Strong consideration must be given to local economic and social issues in order to devise a system which is likely to be beneficial and effective.

After the project has established successful operations in one community, it may consider opportunities for extension to other groups of fishermen in the area. A period of information-gathering to identify potential sites would be necessary. The project vessels and gear could move to other ports to work with interested fishermen, and after some operations to confirm that the technology is appropriate in the new site (perhaps with minor modifications), the demonstration and training activities could be repeated in the new communities. The simple spread of technologies, and exchange of fishermen's ideas along one nation's coast can be very valuable development activities.

Ideally, the conduct of extension activities should not end the applied research phase. Development of improved technology is a continuous process, and the ATARDE project should continue the research and extension of technologies appropriate for changing conditions. If extension, training, and applied research are conducted simultaneously, there may be a need to expand the project's personnel and facilities. If significant increases in production are achieved, resource management may at some point become an urgent issue.

5.3.5. International Exchange for Appropriate Technology

In recent years the United Nations has drawn some attention to a Plan of Action for Technical Cooperation Among Developing Countries (TCDC).[25] In order to identify and implement appropriate technology, an ATARDE project could serve as a focus for TCDC activities.

Project staff, including host country extensionists or fishermen, could make visits of up to perhaps two months' duration to countries where particular technologies are used which might be of value in the project area. The assignment would be to see the technology, and determine if it is likely to be of value to fishermen in the project community. If it is considered potentially appropriate, the staff member on assignment should learn to use it well enough to introduce it at the project site. The possibility of bringing a specialist to the project site for that purpose should also be considered.

Many countries possess particular artisanal fishing technologies which could be of great value to other countries, if those other countries were aware of the technology. The following are a few examples of such technologies which are very effective in specific locations, but which fishermen in some other countries of the region are apparently unaware of.

- In Teacapan and Puerto Madero, Mexico, there are very successful artisanal fisheries longlining sharks. In San Blas, Mexico, there is a successful drift gillnet fishery for

sharks. In many Latin American countries, shark fisheries are not nearly so advanced.

- In the Bay Islands of Honduras, fishermen use relatively inexpensive inboard, air-cooled gasoline engines in their dugout canoes. These are reported to be much more reliable and economical than outboards. (Similar technology is used in the Philippines and Southeast Asia, where it is more widely known.)

- In Ecuador, there is an extensive fishery using drifting longlines for dolphin fish (dorado). This fishery does not exist in most parts of Central America and Mexico. Ecuador also has relatively effective demersal longline methods, which are unknown in some other Latin American countries.

- Morocco has relatively effective demersal longline technology, which is not used in some other West African nations.

- In Puerto Rico, the Yucatan, and many other parts of the Caribbean, various types of reels are used for catching snappers and groupers in deep water. Although some Ecuadorean fishermen use hook and line in equal depths, they appear to be unfamiliar with reels, and they handle their lines manually.

In turn, there are some countries whose fishermen appear unaware of more effective technologies used by fishermen of

several neighboring countries. An ATARDE project should serve as a focal point for national as well as international exchange between fishermen.

5.4. Regional ATARDE Pilot Projects

In order to promote development with appropriate artisanal fishing technology in a particular region, an organization might consider the establishment of an ATARDE project to serve as a regional center for adaptive research and development. However, it must be remembered that the technologies developed may only be appropriate for communities which offer very similar ecological, technical, and socio-economic conditions.

5.5. The ATARDE Approach and the Interests of Involved Parties

The principal parties involved in typical fisheries development projects are usually the international devlelopment organization, the host country government, and the fishing community. In order to predict the degree of cooperation from each, it is necessary to examine the advantages which the approach will bring to each party.

Host government and international organizations may be interested in the ATARDE approach if they examine the records of failure and loan default/rescheduling incurred by past projects using conventional development approaches. A good case can be made that this new approach will have better chances of success. In addition, it will provide an excellent opportunity to train local fisheries officers in practical fishing operations and extension skills. Governmental fisheries services are often notably weak in these areas.

The ATARDE approach should bring several advantages to the participating fishing community. It can be expected to employ several community members. Community participation in planning and implementation will be encouraged, and should give local people a chance to influence the project's activities. On the other hand, local people are not required to make significant personal or financial investments in the project unless the proven effective technology stimulates them to do so on a voluntary basis. The project can be expected to develop and make available effective, locally appropriate

technology, including some technical improvements within the financial means of the poorest fishermen.

The fact that an ATARDE project could be implemented at lower cost than some conventional approaches could be considered an advantage or a disadvantage, depending on the means and priorities of the development organization involved. For an organization which has as a priority the disbursement of large sums of money for highly visible projects, this approach may not be desirable. On the other hand, where showpiece value is a consideration, an ATARDE project might invest in shoreside facilities such as a community center, landing sites, and workshops for boat and motor construction and repair.

Another consideration with regard to cost and visibility is that the long-range technical support required by the ATARDE approach suggests at least one international consultant on site for a minimum of five years, and this expertise is very expensive. For this reason, the cost of an ATARDE project may approach that of a small conventional project for throwing boats. Although the benefits of the new approach may be longer lasting, expenditure for personal services is not nearly so visible as expenditure for boats.

The long time frame required by the ATARDE approach is inconvenient for some development organizations. For example, the Interamerican Development Bank operates on four-year financial cycles, and it prefers to plan projects which can disburse all allocated funds within these periods.[26]

An additional disadvantage for some governmental donor agencies is that projects concentrating on the development and spread of appropriate technology often use fewer goods manufactured and sold by industrialized donor countries.

In light of the above considerations, one might expect the ATARDE approach to be more attractive to Private Voluntary Organizations (PVO), or Non-Governmental Organizations (NGO) which work in development. There are thousands of non-governmental religious and secular organizations which engage in international development activities. Some NGO's receive funding from governmental donor agencies, and execute projects independently. Others refuse governmental support, and rely entirely on private contributions.

The more independent NGO's usually lack most of the political motivations of governmental donors. They are certainly less concerned with disbursing large sums of money. Project visibility may be an issue for some who rely on private donations. However, even the publicity of NGO's often focuses more on people and grass-roots work than on impressive infrastructure.

NGO's often operate ongoing projects in individual communities for extended periods exceeding five years. This characteristic fits very well with the ATARDE approach.

Although the resources of NGO's do not compare with those of governmental donor agencies, their activities are substantial, and they sometimes produce significant impacts on developing areas. A few of these organizations, such as the

Intermediate Technology Development Group,[27] focus on the improvement and spread of appropriate technology. NGO's generally have concentrated on the areas of health, nutrition, and agriculture. At this time they are engaged in relatively few fisheries projects. However, there may be opportunities for their expansion in this direction.

5.6. Current Projects Incorporating ATARDE Concepts

One currently operating project which incorporates concepts of the ATARDE approach is the Tombo Fisheries Pilot Project being conducted in Tombo village in Sierra Leone. This is a bilateral, government project being funded and executed by the German Agency for Technical Cooperation (GTZ). The resources allocated for the project total several million dollars, and the project was planned for a period of about five years. It is generally patterned after the integrated, participatory approach described in an earlier section of this discourse. Components of the project include boatbuilding, fishing gear and methods, fish processing and marketing, public health, and potable water. A Community Fishery Center includes a fishing gear store as well as facilities for boatbuilding, netmaking, and sailmaking.

In the area of capture technologies, the project has concentrated primarily on developing and implementing technologies which may be useful for local fishermen who use

planked canoes with outboard motors and nets to catch chiefly small pelagic species such as bonga (Ethmalosa fimbriata). As of 1984, the project had not worked much with improvement of capture technologies for fishermen at the lowest technical level, in non-motorized canoes. The project started by building and testing V-bottom boats in the seven to nine meter length range. However, local fishermen felt that these boats were not appropriate for the local 3-meter tidal range, and extensive mud flats. Local people are accustomed to sliding their canoes over very shallow water or mud flats, and leaving the craft sitting on mud at low tide. The V-bottom boats did not work well under these conditions. In addition, fishermen were reluctant to use vessels substantially shorter than the common 15-18 meter Ghana-type plank canoes. In 1984, project personnel were discussing plans to work with the traditional long canoe type, and improve it by installation of diesel motors.

At an early stage of the project, vessel propulsion technology was identified as an area which needed improvement. In 1984, gasoline cost about US $4 per gallon (when it was available), and outboard motors generally lasted only one or two years in commercial service (two cycle outboard motor oil was very rarely available). When early trials of auxiliary sails on canoes produced a noteworthy capsize, staff went back to the drawing board and came up with sail and rig designs which are now finding increasing acceptance in various ports. These sails and rigs are being made with local materials and local skilled labor. Fuel savings up to 40% have been

demonstrated in commercial fishing operations with these sails, and increasing numbers of fishermen are beginning to purchase and use them. The project is also experimenting with different types of fishing nets.

One very commendable aspect of this project is its flexibility to learn from experience and adapt. When some of its original technical plans did not prove successful, it modified the technology or started over, and has since produced some appropriate technology which is beginning to spread along the coast. It is producing a wealth of valuable information and experience from which other development organizations in the country are learning.

A second example of an ATARDE - type project is the one being operated by Ocean Arks International in Costa Rica. Ocean Arks is a very small, private organization founded and directed by John Todd, who was a pioneer in developing appropriate technologies for housing, agriculture, and aquaculture. Ocean Arks identified some opportunities in developing fisheries for the use of multihull vessels constructed with the wood-epoxy saturation technique (WEST), and Constant Camber molding. It is hoped that this construction method, which uses far less wood than traditional boatbuilding methods, can ease the problems of canoe fishermen caused by deforestation and lumber shortages.

In 1982-1983, Ocean Arks built a ten-meter wood-epoxy trimaran for fishing under sail with auxiliary motor. The

vessel began fishing operations on the Atlantic coast of Costa Rica in early 1984. Ocean Arks' staff were competent sailors, but had relatively little experience in commercial fishing. However, fuel shortages were occasionally hindering the local fishermen's ability to fish, and fishing crews were easily recruited to work for shares of the catch. In effect, Ocean Arks provided sailing expertise, and local fishermen provided fishing expertise. Within a year, the vessel was demonstrating very substantial production with low expenses, and local fishermen were eager to obtain more vessels of this type. There are currently plans for the Canadian International Development Agency (CIDA) to fund the construction of a number of vessels of this type for Costa Rican fisheries.

This case demonstrates a point which may make the ATARDE approach very attractive for small organizations working in development. In some cases it is possible to run one or two small vessels at relatively low cost. If effective technology can be developed early on, and if necessary governmental permits can be obtained, the organization can let continued operation of the vessels cover costs while it waits for additional funding for project expansion. Such continued fishing operations can also be valuable for demonstration to local fishermen, local businesses, or international organizations which may be interested in the technology.

6. SUMMARY AND CONCLUSIONS

The Appendix following this body of text presents simplified flowcharts of the project approaches described in this discourse, with lists of some advantages and disadvantages of each. With regard to development projects which have attempted to introduce innovations in capture technologies, we have identified several reasons for past failures. Many projects which concentrated on the distribution of fishing boats and gear failed to introduce technologies which were locally effective and commercially viable in the long run. Coastal fishing conditions, and artisanal fishing technology, are quite complex. Fishing boats, gear, and methods which are effective in one area often require significant modification in order to be made effective in a new location. For small scale fisheries, technology development may be a more appropriate term than technology transfer.

In many projects, essential socio-economic issues were not given adequate consideration, and this caused technically effective innovations to be rejected. A common problem has been the lack of adequate time being provided for a project to introduce innovations, adjust them for local conditions, and train local people in their productive long term operation.

The integrated approach, treating a broad range of community development issues, and incorporating substantial community participation in project planning and

implementation, represents a significant improvement in project design. However, problems may be encountered in the participatory approach. There is no guarantee that community members and funding or advisory organizations will agree on what constitutes appropriate or desirable technology. Indeed, there is no guarantee that the community will have sufficient motivation, organization, interest, and trust in the project to facilitate constructive participation. The integrated, participatory approach can be expected to yield more positive results than the more conventional development strategies. However, this approach has not been employed in fisheries development extensively enough nor for long enough to allow reliable conclusions.

For appropriate coastal fishing technology, the Adaptive Research, Development, and Extension approach could deal with many of the problems encountered in previous approaches. It could be effective as part of an integrated project, or it could constitute the bulk of a smaller, less ambitious fisheries project. Its major advantage is that it addresses the interests of the different parties involved in the development process in a practical, realistic manner (assuming that the development organization has the introduction of lasting, improved technology as a high priority). The ATARDE approach does not attempt to promote the spread of an innovation until it has been demonstrated to be locally effective and judged to be likely to be appropriate in the

socio-economic context. Local interest stimulated by demonstration should give community members plenty of incentive to participate. A minimum five year commitment, with options for extension, should give the ATARDE project sufficient time for technology development, extension, and training of local prople.

The challenges involved in fisheries development are almost overwhelming, but so are the needs. While thirty years of experience in development have produced relatively few successes, some organizations are learning from past mistakes. It is hoped that the three development approaches presented here represent steps forward in a process whereby development organizations learn to work more productively in this challenging and difficult field.

FOOTNOTES

1. FAO, 1984. Report of the FAO World Conference on Fisheries Management and Development.

2. Ben-Yami, 1980.

3. Acosta et al., 1984.

4. Schumacher, 1973.

5. Thomson, 1980. Intermediate Technology and Alternative Energy Systems for Small Scale Fisheries.

6. Ibid.

7. Ben-Yami, 1980.

8. Pollnac, 1981.

9. Lawson and Robinson, 1983.

10. Pollnac, personal communication.

11. Ben-Yami, 1980.

12. Johnson, 1983.

13. Ben-Yami, 1980.

14. FAO, 1984. Report of the FAO World Conference on Fisheries Management and Development.

15. Johnson, 1983.

16. Fraser, 1966.

17. Lucio Gonzalez, commercial fisherman, personal communication, 1978.

18. Douglas Herdson, biologist, British Overseas Development Agency, Ecuadorean National Fisheries Institute. Personal communication, 1985.

19. Hendrix, 1983.

20. Johnson, 1983.

21. Pollnac, 1976.

22. Pollnac, personal communication, 1985.

23. Stevenson et al., 1982.

24. Drew and Pollnac, 1985.

25. FAO, 1983.

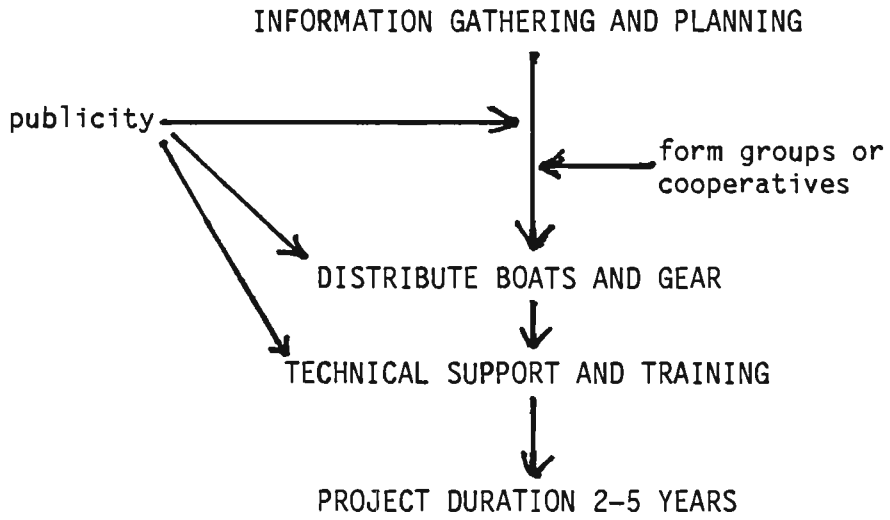
26. Peacock, Francis, fisheries specialist, Interamerican Development Bank. Personal communication, 1985.

27. McRobie, 1981, describes the work of the Intermediate Technology Development Group.

APPENDIX

SIMPLIFIED FLOWCHARTS OF FISHERIES PROJECT APPROACHES

"THROW BOATS" APPROACH



ADVANTAGES

- easy to administer loans and grants - common measure of project worth is $ distributed
- buy boats, motors, gear from donor country
- showpiece projects
- fits convenient time frame

DISADVANTAGES

- technology often ineffective under local conditions in LDC
- technology sometimes rejected by local people
- little or no consideration for broad range of socio-economic issues
- insufficient time for adjustment
- insufficient technical support and training
- abandoned boats and gear - little sustained progress -

VERY LOW RETURNS IN TERMS OF PROGRESS PER UNIT OF EFFORT AND $ INVESTED

Integrated, Participatory Approach - from Johnson, FAO, 1983

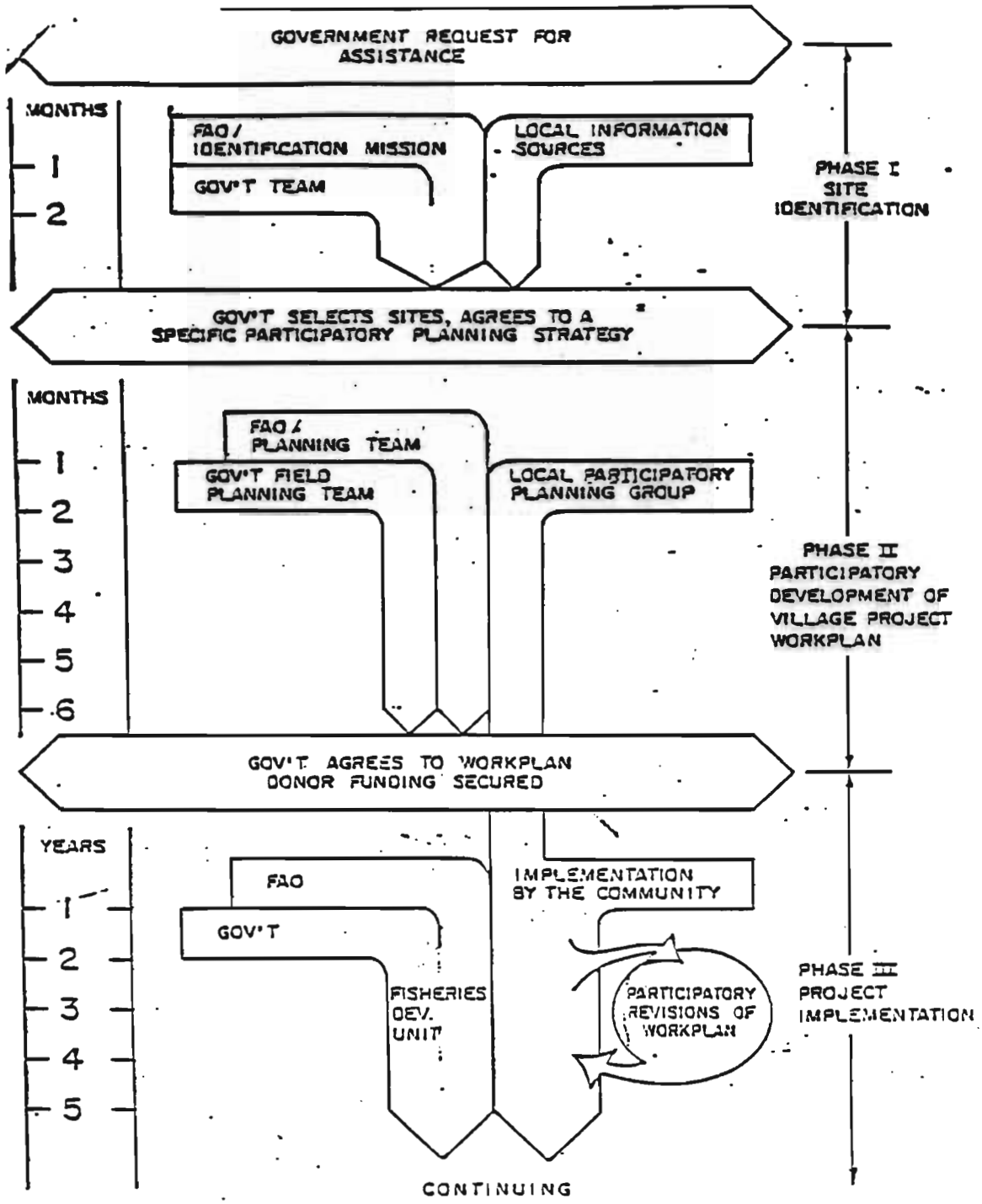


Figure C Identification, planning, and implementation phases of an integrated small-scale fishing community development project

INTEGRATED, PARTICIPATORY APPROACH

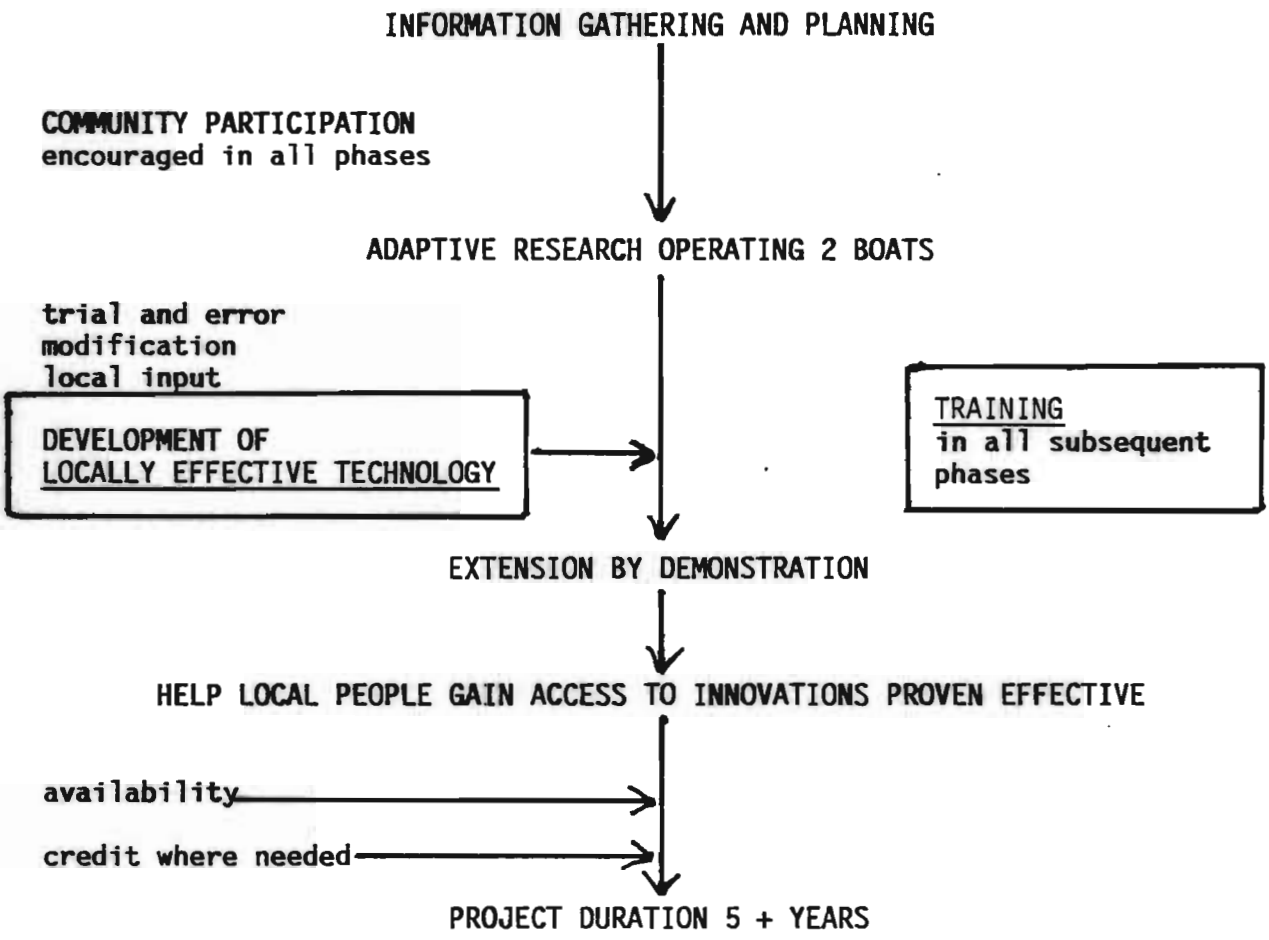
ADVANTAGES

- increased likelihood of using locally appropriate technology
- community has investment in project success
- strengthens community capability for self-development

DISADVANTAGES

- community may be mistaken about which technology is most appropriate
- possible conflict between community and project advisors
- difficult for introduction of unfamiliar innovations
- may be difficult for developing lowest cost technology
- may be difficult to stimulate community participation
  - lack of organization for planning purposes
  - disillusioned by previously failed projects
  - most capable people may be too busy or not interested

A. T. ADAPTIVE RESEARCH, DEVELOPMENT, AND EXTENSION APPROACH



ADVANTAGES

- develop locally appropriate technology - some lowest cost technology
- incentives for community participation
- demonstration is most effective for extension and training
- really appropriate technology often spreads on its own

DISADVANTAGES

- more difficult to administer large loans or grants
- less showpiece value
- long time frame inconvenient for some development organizations
- fewer goods from industrialized countries sold (disadvantage for IC's)

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fisheries in some parts of Costa Rica, after local construction of improved roads.[22]

The ATARDE approach should facilitate community participation while avoiding some of its difficulties. Project staff must solicit information and opinions from community members starting in the planning phase, and continuing through implementation and extension. However, the project does not depend on community members to make investments of a personal or financial nature before the demonstration of appropriate innovations which are beneficial to the community.

5.2 Personnel

The ATARDE project will require a full time master fisherman and major effort of a specialist in economic and social issues relating to community development. The master fisherman must have international experience with a wide variety of small scale fishing technologies, and an open mind about experimenting with different fishing methods which might be expected to be effective and appropriate. The socio-economic specialist must deal with the questions of determining which innovations might be locally appropriate, considering the range of socio-cultural and economic factors. Both experts must have a sensitivity for monitoring the social and economic effects of innovations as they are developed and introduced.

A competent business manager will be needed to ensure efficient support in logistics and materials, as well as to keep careful records of project monies and financial analysis of fishing operations.

Some crew members for the fishing vessel or vessels should be taken from the local community. They can provide essential local knowledge for fishing operations, and should also serve a valuable liaison function between the project and the community.

If members of the local fisheries service are interested in improving their fishing and extension skills, they should also participate in the fishing operations, and be assigned to the project on a continuing basis. Between fisheries officers and local fishermen, the project must have enough fisheries technologists to have some on land making or mending gear while the others are fishing at sea.

Although vessel and gear trials are aimed at achieving commercial levels of production, there is a strong research component in the fishing operations. Therefore, it would not be realistic to pay crew members according to a share of the catch. Crew members must have a guarantee of some steady earnings. On the other hand, the work will sometimes be very strenuous, and require long, uncomfortable days at sea. The project must develop locally appropriate pay arrangements which will provide adequate incentives for crew members to perform well in this skilled and demanding work.

5.3 Project Components and Activities

5.3.1 Information Gathering

An essential first step for any development activity is the gathering of as much information as possible about the local fisheries. A great deal of information is needed, not only about technology, but also about the biological, economic, and socio-cultural aspects of the fisheries. The importance of, and methodologies for this process are covered by Stevenson, Logan, and Pollnac.[23] The immediate goals of this phase are to determine if technical innovations might be appropriate, which types of innovations can be expected to be beneficial, and which sites appear most promising for a project.

Dialogue with local community members must begin at this point, to determine their interests and needs, as well as their willingness to work with a development project and consider technical changes. The establishment of good personal relations with community members, especially the more influential ones, is an indispensable part of the project right from the start. In order to gain the confidence of community members, it is important to present realistic accounts of the proposed project's goals, potential, and limitations. In many communities, people have heard a great deal of propaganda, whose promises were not realized. They often appreciate frankness about limited possibilities more than vague promises of great possibilities.

During the information-gathering process, and at times during subsequent project phases, the master fisherman will certainly want to make fishing trips with local fishermen on their boats. This will enable him to learn about local fishing technology and conditions, while building friendships with local fishermen.

The following criteria for site selection were proposed by Drew and Pollnac.[24]

- The Project should be based in a community where artisanal fishing is a major activity.
- The site should have abundant and diverse fishery resources within operating range of small craft.
- The site should be within a convenient distance from a commercial center for provision of logistic, material, and administrative support.
- A preliminary socio-economic analysis of the community is essential. It is important that local people be interested in artisanal fisheries development, open to possible innovations and changes, and not distrustful of the development organization.

After the project begins actual fishing operations, the information gathering component can expand to focus on the information yielded by these operations. Careful accounts should be kept in all relevant areas, including: fixed and variable costs, income, areas fished, possible effects of environmental factors on production, and species and quantities fished. Such records should enable the project to analyse and show which operations are profitable, to

demonstrate the economic benefits of sound practices such as motor maintenance, and to learn more about the local fisheries.

5.3.2. Equipment Selection and Acquisition

After the selection of a site, the project must select and obtain the boat or boats and fishing gear which it intends to test. In cases where the traditional boats are felt to be appropriate, and innovations are intended to concentrate on methods and gear or other aspects of the fishery, the next step may simply be to purchase local boats. In cases where the introduction of modified boats to be built locally is the goal, an expert project boatbuilder may begin to train and work with local boatbuilders, hired by the project, to construct the new craft.

In the selection of vessels to test, a project might consider both ends of the spectrum in artisanal fishing. On the one hand, the more prosperous artisanal fishermen may be using motorized vessels and significant quantities of fishing gear, which represent substantial investments. An ATARDE project might test vessels of similar size and cost, with fuel-saving innovations such as auxiliary sails and inboard diesel motors. Insulated ice boxes for improving product quality, locally unknown types of fishing gear, or mechanical net haulers, are other examples of new technologies which might be tested. In some cases, a project may want to test vessels made with new materials, such as fiberglass or

wood-epoxy. In any case, the most expensive new technologies should not be far beyond the financial means of the more prosperous fishermen, under existing financial constraints.

At the other end of the spectrum, most fisheries also have very small craft, often canoes, of less than six meters in length, without motors. An appropriate technology project should address the issue of improving technology which is accessible to fishermen at this level, whose financial means are extremely limited. For instance, in Sierra Leone, many fishermen use 5-meter dugout canoes with paddle or square sail for propulsion. Some development workers have voiced the possibility of improving this level of technology with improved sailing rigs or leeboards which might allow the canoes to sail to windward. The traditional use of handlines or very small demersal longlines might be improved by the introduction of longer, more effective longlines coiled in baskets or boxes.

Following adaptation to local conditions, such innovations would involve little additional investment for fishermen, and could be made with local materials. As small as these changes may appear, they could bring real benefits to thousands of West African fishermen, enabling them to increase their earnings without increasing dependence on imports. In recent years, FAO has published several catalogs of small scale and traditional fishing gear, which could be good sources of ideas for such innovations.

The ATARDE project may want to acquire one vessel in the financial range of the poorest fishermen, and one in the range

of interest of more prosperous fishermen. The master fisherman may want to test gear which is used effectively in other regions. In addition, it must be remembered that other communities not far from the project site may be using technologies which could be of benefit if introduced to the project's community.

5.3.3. Adaptive Research and Development Phase

After the project has obtained the first boats and gear, it must concentrate on operating the new technologies profitably under local conditions. This might be considered the adaptive research phase of the project. Technology which is effective in site A is often assumed to be effective in site B, and this is a serious mistake. Anyone who has visited a number of projects a few years after development organizations have completed their work and left, knows that many innovations were not profitable in the long run under local conditions.

In fact, even innovations which have proven effective in other small scale fisheries may require significant modifications for application in a new site. Small scale fisheries often require high skill levels and extensive local knowledge, so it may take an expatriate master fisherman and mixed crew some time to achieve the necessary skill and coordination. Training of the project crewmen is an essential part of the adaptive research and development phase. All

crewmen must become as competent as possible with the new technology, because they will later be the extension agents responsible for demonstration and training for other fishermen.

If the first innovations attempted do not produce positive results within a reasonable trial period of, say, a few months, project staff must begin to try technical modifications. This modification and trial process must continue until effective technology is developed. It is likely that effective technology will be developed and extended in small measures during this phase. For example, a project which is attempting to introduce inboard diesel boats which can be beached easily may also demonstrate a new, improved method for using traditional nets or longlines. Local fishermen who may not be interested in buying boats may want to learn the new method of using nets and longlines. Project operations must be flexible enough to work with interested fishermen when opportunities arise for formal or informal training and extension.

Indeed, there may be many opportunities for demonstration of small, but important changes which can be of benefit to fishermen. Project staff should continually practice and demonstrate proper maintenance of boats and motors, which is lacking in many developing areas. Local fishermen should be able to see that practices such as proper maintenance, and careful safety procedures, bring benefits of a concrete, demonstrable nature.

Effective innovations involving minor changes may be achieved in a relatively short time. However, for major changes, such as the introduction of new types of vessels, the development of technically effective adaptations which are economically and socially appropriate may take a few years.

During this phase, input from local fishermen employed in the project, as well as from other community members, should be solicited, in order to develop technology which is acceptable and appropriate in the social and economic contexts.

5.3.4. The Extension Phase

After innovations have been proven effective in fishing operations and judged to have a strong likelihood of being appropriate in the broad sense, the project can move into the extension phase. Extension activities should focus first on demonstration, then on training local fishermen who are interested in the innovations. Through observation and informal interactions with project staff, many local fishermen will have heard that the project is having some success with new technology. Interested fishermen can be encouraged to go fishing on project vessels to see the new technologies in action.

Demonstration and training with technology which is really appropriate should, in a relatively short time, stimulate some fishermen to attempt to acquire or use the

innovations. As fishermen begin to acquire new equipment, thorough and careful training by project staff will be essential. In addition to group training, individual training and hands-on methods will be important for preparing fishermen to use new equipment. If significant numbers of fishermen begin to adapt new technologies, it may be necessary to expand project staff in order to provide adequate training.

At this point we encounter the crucial question of how to help fishermen to gain access to new technology. This question has two facets. First, is the required equipment available locally? Ideally, if the technology is really appropriate, a fisherman should be able to gather, build, or purchase all required equipment from local sources. However, experience and demand from fishermen has shown that some equipment, such as motors and synthetic nets, are valuable enough to warrant importation from industrialized nations. In some cases, foreign exchange shortages and a number of other factors make the acquisition of imported manufactured goods extremely difficult for fishermen. The ATARDE project must start to consider this problem before the adaptive research phase, and plan to work only with equipment which will be available to fishermen.

A second constructive approach is to start early on to work with government officials to establish customs exemptions and special consideration for artisanal fishermen in matters relating to foreign exhange and importation of equipment. Such special consideration often exists officially, but the procedures and paperwork required for implementation put it

effectively beyond the reach of rural artisanal fishermen. Thus, this approach is generally not so effective as working with materials already available locally.

Commercial dealers of fishing gear are sometimes helpful in obtaining new types of gear, and the project should investigate their willingness to deal fairly with fishermen and cooperate with the project.

If the needed equipment is physically available for the artisanal fisherman, and not free to be gathered or built by his own efforts, then the important question becomes, how will he pay for it? Equipment which is provided free is often not valued or used productively. Even in the case of gifts of quantities of gear to fishermen, it may be best to establish a system of sale at cost. The proceeds could be used to start a fund for running a local fishing gear store which would sell gear to fishermen at attractive prices on a continuing basis.

If the technology is within a price range which could really be considered appropriate, there will probably be at least a few prosperous small scale fishermen prepared to pay cash for it. However, if availability were limited to the more prosperous fishermen, the innovations might cause serious socio-economic problems.

A system of vessel or gear acquisition on credit will probably be necessary. This is a very difficult area for development. Projects have tried a number of different strategies for administering credit, such as cooperatives, loans to individual fishermen, and hire-purchase schemes for

crew groups. A comprehensive discussion of the merits of different credit systems is beyond the scope of this discourse. Strong consideration must be given to local economic and social issues in order to devise a system which is likely to be beneficial and effective.

After the project has established successful operations in one community, it may consider opportunities for extension to other groups of fishermen in the area. A period of information-gathering to identify potential sites would be necessary. The project vessels and gear could move to other ports to work with interested fishermen, and after some operations to confirm that the technology is appropriate in the new site (perhaps with minor modifications), the demonstration and training activities could be repeated in the new communities. The simple spread of technologies, and exchange of fishermen's ideas along one nation's coast can be very valuable development activities.

Ideally, the conduct of extension activities should not end the applied research phase. Development of improved technology is a continuous process, and the ATARDE project should continue the research and extension of technologies appropriate for changing conditions. If extension, training, and applied research are conducted simultaneously, there may be a need to expand the project's personnel and facilities. If significant increases in production are achieved, resource management may at some point become an urgent issue.

5.3.5. International Exchange for Appropriate Technology

In recent years the United Nations has drawn some attention to a Plan of Action for Technical Cooperation Among Developing Countries (TCDC).[25] In order to identify and implement appropriate technology, an ATARDE project could serve as a focus for TCDC activities.

Project staff, including host country extensionists or fishermen, could make visits of up to perhaps two months' duration to countries where particular technologies are used which might be of value in the project area. The assignment would be to see the technology, and determine if it is likely to be of value to fishermen in the project community. If it is considered potentially appropriate, the staff member on assignment should learn to use it well enough to introduce it at the project site. The possibility of bringing a specialist to the project site for that purpose should also be considered.

Many countries possess particular artisanal fishing technologies which could be of great value to other countries, if those other countries were aware of the technology. The following are a few examples of such technologies which are very effective in specific locations, but which fishermen in some other countries of the region are apparently unaware of.

- In Teacapan and Puerto Madero, Mexico, there are very successful artisanal fisheries longlining sharks. In San Blas, Mexico, there is a successful drift gillnet fishery for

sharks. In many Latin American countries, shark fisheries are not nearly so advanced.

- In the Bay Islands of Honduras, fishermen use relatively inexpensive inboard, air-cooled gasoline engines in their dugout canoes. These are reported to be much more reliable and economical than outboards. (Similar technology is used in the Philippines and Southeast Asia, where it is more widely known.)

- In Ecuador, there is an extensive fishery using drifting longlines for dolphin fish (dorado). This fishery does not exist in most parts of Central America and Mexico. Ecuador also has relatively effective demersal longline methods, which are unknown in some other Latin American countries.

- Morocco has relatively effective demersal longline technology, which is not used in some other West African nations.

- In Puerto Rico, the Yucatan, and many other parts of the Caribbean, various types of reels are used for catching snappers and groupers in deep water. Although some Ecuadorean fishermen use hook and line in equal depths, they appear to be unfamiliar with reels, and they handle their lines manually.

In turn, there are some countries whose fishermen appear unaware of more effective technologies used by fishermen of

several neighboring countries. An ATARDE project should serve as a focal point for national as well as international exchange between fishermen.

5.4. Regional ATARDE Pilot Projects

In order to promote development with appropriate artisanal fishing technology in a particular region, an organization might consider the establishment of an ATARDE project to serve as a regional center for adaptive research and development. However, it must be remembered that the technologies developed may only be appropriate for communities which offer very similar ecological, technical, and socio-economic conditions.

5.5. The ATARDE Approach and the Interests of Involved Parties

The principal parties involved in typical fisheries development projects are usually the international devlelopment organization, the host country government, and the fishing community. In order to predict the degree of cooperation from each, it is necessary to examine the advantages which the approach will bring to each party.

Host government and international organizations may be interested in the ATARDE approach if they examine the records of failure and loan default/rescheduling incurred by past projects using conventional development approaches. A good case can be made that this new approach will have better chances of success. In addition, it will provide an excellent opportunity to train local fisheries officers in practical fishing operations and extension skills. Governmental fisheries services are often notably weak in these areas.

The ATARDE approach should bring several advantages to the participating fishing community. It can be expected to employ several community members. Community participation in planning and implementation will be encouraged, and should give local people a chance to influence the project's activities. On the other hand, local people are not required to make significant personal or financial investments in the project unless the proven effective technology stimulates them to do so on a voluntary basis. The project can be expected to develop and make available effective, locally appropriate

technology, including some technical improvements within the financial means of the poorest fishermen.

The fact that an ATARDE project could be implemented at lower cost than some conventional approaches could be considered an advantage or a disadvantage, depending on the means and priorities of the development organization involved. For an organization which has as a priority the disbursement of large sums of money for highly visible projects, this approach may not be desirable. On the other hand, where showpiece value is a consideration, an ATARDE project might invest in shoreside facilities such as a community center, landing sites, and workshops for boat and motor construction and repair.

Another consideration with regard to cost and visibility is that the long-range technical support required by the ATARDE approach suggests at least one international consultant on site for a minimum of five years, and this expertise is very expensive. For this reason, the cost of an ATARDE project may approach that of a small conventional project for throwing boats. Although the benefits of the new approach may be longer lasting, expenditure for personal services is not nearly so visible as expenditure for boats.

The long time frame required by the ATARDE approach is inconvenient for some development organizations. For example, the Interamerican Development Bank operates on four-year financial cycles, and it prefers to plan projects which can disburse all allocated funds within these periods.[26]

An additional disadvantage for some governmental donor agencies is that projects concentrating on the development and spread of appropriate technology often use fewer goods manufactured and sold by industrialized donor countries.

In light of the above considerations, one might expect the ATARDE approach to be more attractive to Private Voluntary Organizations (PVO), or Non-Governmental Organizations (NGO) which work in development. There are thousands of non-governmental religious and secular organizations which engage in international development activities. Some NGO's receive funding from governmental donor agencies, and execute projects independently. Others refuse governmental support, and rely entirely on private contributions.

The more independent NGO's usually lack most of the political motivations of governmental donors. They are certainly less concerned with disbursing large sums of money. Project visibility may be an issue for some who rely on private donations. However, even the publicity of NGO's often focuses more on people and grass-roots work than on impressive infrastructure.

NGO's often operate ongoing projects in individual communities for extended periods exceeding five years. This characteristic fits very well with the ATARDE approach.

Although the resources of NGO's do not compare with those of governmental donor agencies, their activities are substantial, and they sometimes produce significant impacts on developing areas. A few of these organizations, such as the

Intermediate Technology Development Group,[27] focus on the improvement and spread of appropriate technology. NGO's generally have concentrated on the areas of health, nutrition, and agriculture. At this time they are engaged in relatively few fisheries projects. However, there may be opportunities for their expansion in this direction.

5.6. Current Projects Incorporating ATARDE Concepts

One currently operating project which incorporates concepts of the ATARDE approach is the Tombo Fisheries Pilot Project being conducted in Tombo village in Sierra Leone. This is a bilateral, government project being funded and executed by the German Agency for Technical Cooperation (GTZ). The resources allocated for the project total several million dollars, and the project was planned for a period of about five years. It is generally patterned after the integrated, participatory approach described in an earlier section of this discourse. Components of the project include boatbuilding, fishing gear and methods, fish processing and marketing, public health, and potable water. A Community Fishery Center includes a fishing gear store as well as facilities for boatbuilding, netmaking, and sailmaking.

In the area of capture technologies, the project has concentrated primarily on developing and implementing technologies which may be useful for local fishermen who use

planked canoes with outboard motors and nets to catch chiefly small pelagic species such as bonga (Ethmalosa fimbriata). As of 1984, the project had not worked much with improvement of capture technologies for fishermen at the lowest technical level, in non-motorized canoes. The project started by building and testing V-bottom boats in the seven to nine meter length range. However, local fishermen felt that these boats were not appropriate for the local 3-meter tidal range, and extensive mud flats. Local people are accustomed to sliding their canoes over very shallow water or mud flats, and leaving the craft sitting on mud at low tide. The V-bottom boats did not work well under these conditions. In addition, fishermen were reluctant to use vessels substantially shorter than the common 15-18 meter Ghana-type plank canoes. In 1984, project personnel were discussing plans to work with the traditional long canoe type, and improve it by installation of diesel motors.

At an early stage of the project, vessel propulsion technology was identified as an area which needed improvement. In 1984, gasoline cost about US $4 per gallon (when it was available), and outboard motors generally lasted only one or two years in commercial service (two cycle outboard motor oil was very rarely available). When early trials of auxiliary sails on canoes produced a noteworthy capsize, staff went back to the drawing board and came up with sail and rig designs which are now finding increasing acceptance in various ports. These sails and rigs are being made with local materials and local skilled labor. Fuel savings up to 40% have been

demonstrated in commercial fishing operations with these sails, and increasing numbers of fishermen are beginning to purchase and use them. The project is also experimenting with different types of fishing nets.

One very commendable aspect of this project is its flexibility to learn from experience and adapt. When some of its original technical plans did not prove successful, it modified the technology or started over, and has since produced some appropriate technology which is beginning to spread along the coast. It is producing a wealth of valuable information and experience from which other development organizations in the country are learning.

A second example of an ATARDE - type project is the one being operated by Ocean Arks International in Costa Rica. Ocean Arks is a very small, private organization founded and directed by John Todd, who was a pioneer in developing appropriate technologies for housing, agriculture, and aquaculture. Ocean Arks identified some opportunities in developing fisheries for the use of multihull vessels constructed with the wood-epoxy saturation technique (WEST), and Constant Camber molding. It is hoped that this construction method, which uses far less wood than traditional boatbuilding methods, can ease the problems of canoe fishermen caused by deforestation and lumber shortages.

In 1982-1983, Ocean Arks built a ten-meter wood-epoxy trimaran for fishing under sail with auxiliary motor. The

vessel began fishing operations on the Atlantic coast of Costa Rica in early 1984. Ocean Arks' staff were competent sailors, but had relatively little experience in commercial fishing. However, fuel shortages were occasionally hindering the local fishermen's ability to fish, and fishing crews were easily recruited to work for shares of the catch. In effect, Ocean Arks provided sailing expertise, and local fishermen provided fishing expertise. Within a year, the vessel was demonstrating very substantial production with low expenses, and local fishermen were eager to obtain more vessels of this type. There are currently plans for the Canadian International Development Agency (CIDA) to fund the construction of a number of vessels of this type for Costa Rican fisheries.

This case demonstrates a point which may make the ATARDE approach very attractive for small organizations working in development. In some cases it is possible to run one or two small vessels at relatively low cost. If effective technology can be developed early on, and if necessary governmental permits can be obtained, the organization can let continued operation of the vessels cover costs while it waits for additional funding for project expansion. Such continued fishing operations can also be valuable for demonstration to local fishermen, local businesses, or international organizations which may be interested in the technology.

6. SUMMARY AND CONCLUSIONS

The Appendix following this body of text presents simplified flowcharts of the project approaches described in this discourse, with lists of some advantages and disadvantages of each. With regard to development projects which have attempted to introduce innovations in capture technologies, we have identified several reasons for past failures. Many projects which concentrated on the distribution of fishing boats and gear failed to introduce technologies which were locally effective and commercially viable in the long run. Coastal fishing conditions, and artisanal fishing technology, are quite complex. Fishing boats, gear, and methods which are effective in one area often require significant modification in order to be made effective in a new location. For small scale fisheries, technology development may be a more appropriate term than technology transfer.

In many projects, essential socio-economic issues were not given adequate consideration, and this caused technically effective innovations to be rejected. A common problem has been the lack of adequate time being provided for a project to introduce innovations, adjust them for local conditions, and train local people in their productive long term operation.

The integrated approach, treating a broad range of community development issues, and incorporating substantial community participation in project planning and

implementation, represents a significant improvement in project design. However, problems may be encountered in the participatory approach. There is no guarantee that community members and funding or advisory organizations will agree on what constitutes appropriate or desirable technology. Indeed, there is no guarantee that the community will have sufficient motivation, organization, interest, and trust in the project to facilitate constructive participation. The integrated, participatory approach can be expected to yield more positive results than the more conventional development strategies. However, this approach has not been employed in fisheries development extensively enough nor for long enough to allow reliable conclusions.

For appropriate coastal fishing technology, the Adaptive Research, Development, and Extension approach could deal with many of the problems encountered in previous approaches. It could be effective as part of an integrated project, or it could constitute the bulk of a smaller, less ambitious fisheries project. Its major advantage is that it addresses the interests of the different parties involved in the development process in a practical, realistic manner (assuming that the development organization has the introduction of lasting, improved technology as a high priority). The ATARDE approach does not attempt to promote the spread of an innovation until it has been demonstrated to be locally effective and judged to be likely to be appropriate in the

socio-economic context. Local interest stimulated by demonstration should give community members plenty of incentive to participate. A minimum five year commitment, with options for extension, should give the ATARDE project sufficient time for technology development, extension, and training of local prople.

The challenges involved in fisheries development are almost overwhelming, but so are the needs. While thirty years of experience in development have produced relatively few successes, some organizations are learning from past mistakes. It is hoped that the three development approaches presented here represent steps forward in a process whereby development organizations learn to work more productively in this challenging and difficult field.

FOOTNOTES

1. FAO, 1984. Report of the FAO World Conference on Fisheries Management and Development.

2. Ben-Yami, 1980.

3. Acosta et al., 1984.

4. Schumacher, 1973.

5. Thomson, 1980. Intermediate Technology and Alternative Energy Systems for Small Scale Fisheries.

6. Ibid.

7. Ben-Yami, 1980.

8. Pollnac, 1981.

9. Lawson and Robinson, 1983.

10. Pollnac, personal communication.

11. Ben-Yami, 1980.

12. Johnson, 1983.

13. Ben-Yami, 1980.

14. FAO, 1984. Report of the FAO World Conference on Fisheries Management and Development.

15. Johnson, 1983.

16. Fraser, 1966.

17. Lucio Gonzalez, commercial fisherman, personal communication, 1978.

18. Douglas Herdson, biologist, British Overseas Development Agency, Ecuadorean National Fisheries Institute. Personal communication, 1985.

19. Hendrix, 1983.

20. Johnson, 1983.

21. Pollnac, 1976.

22. Pollnac, personal communication, 1985.

23. Stevenson et al., 1982.

24. Drew and Pollnac, 1985.

25. FAO, 1983.

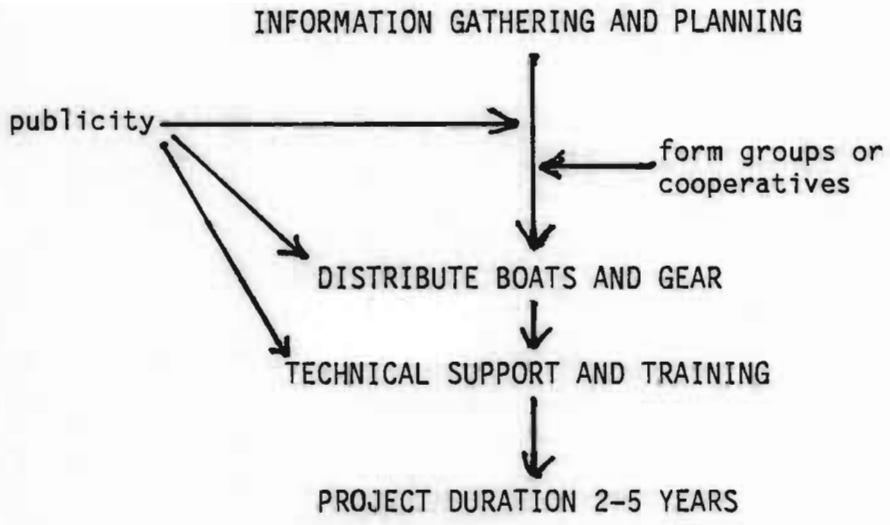
26. Peacock, Francis, fisheries specialist, Interamerican Development Bank. Personal communication, 1985.

27. McRobie, 1981, describes the work of the Intermediate Technology Development Group.

APPENDIX

SIMPLIFIED FLOWCHARTS OF FISHERIES PROJECT APPROACHES

"THROW BOATS" APPROACH



ADVANTAGES

- easy to administer loans and grants - common measure of project worth is $ distributed
- buy boats, motors, gear from donor country
- showpiece projects
- fits convenient time frame

DISADVANTAGES

- technology often ineffective under local conditions in LDC
- technology sometimes rejected by local people
- little or no consideration for broad range of socio-economic issues
- insufficient time for adjustment
- insufficient technical support and training
- abandoned boats and gear - little sustained progress -

VERY LOW RETURNS IN TERMS OF PROGRESS PER UNIT OF EFFORT AND $ INVESTED

Integrated, Participatory Approach - from Johnson, FAO, 1983

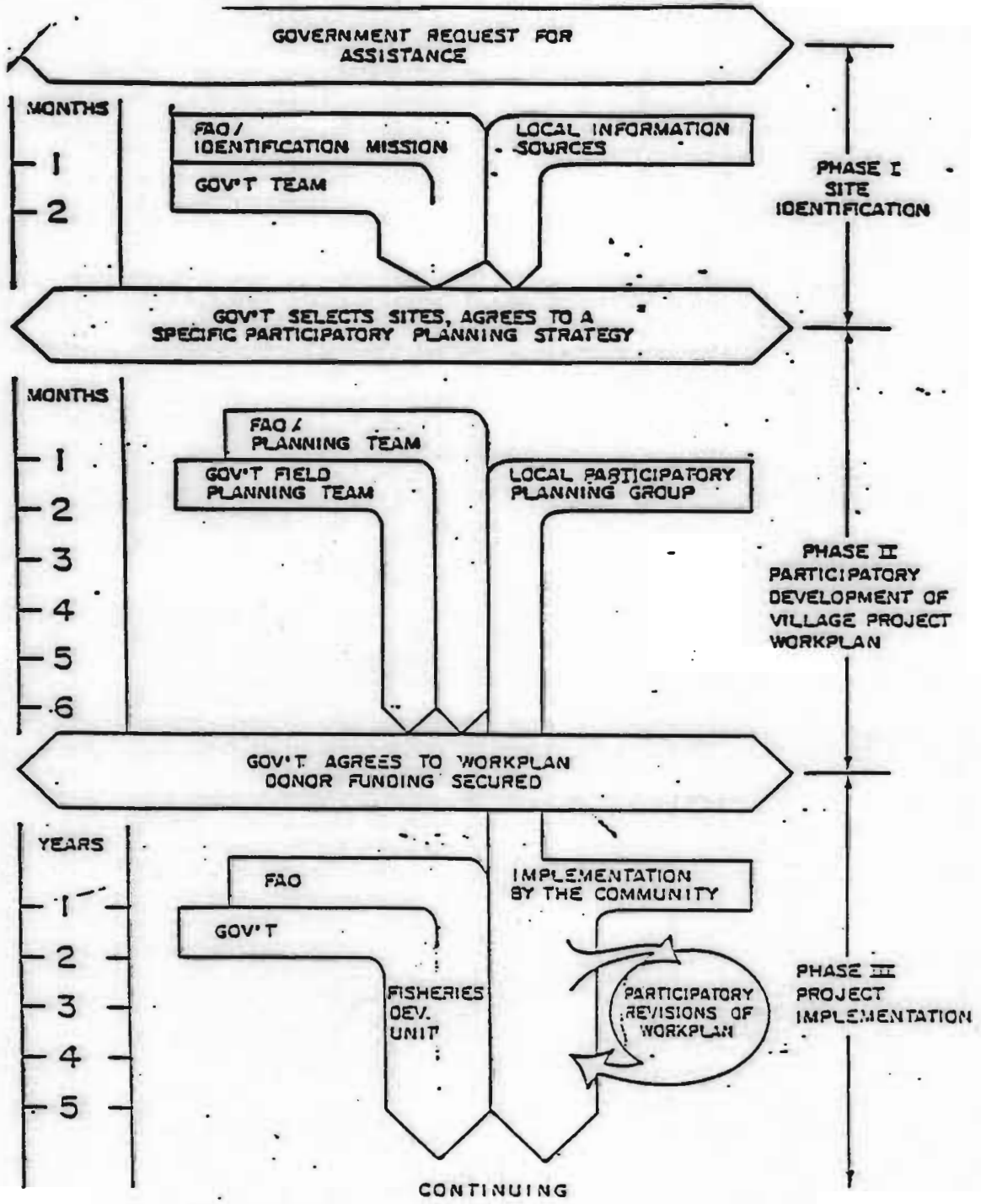


Figure C Identification, planning, and implementation phases of an integrated small-scale fishing community development project

INTEGRATED, PARTICIPATORY APPROACH

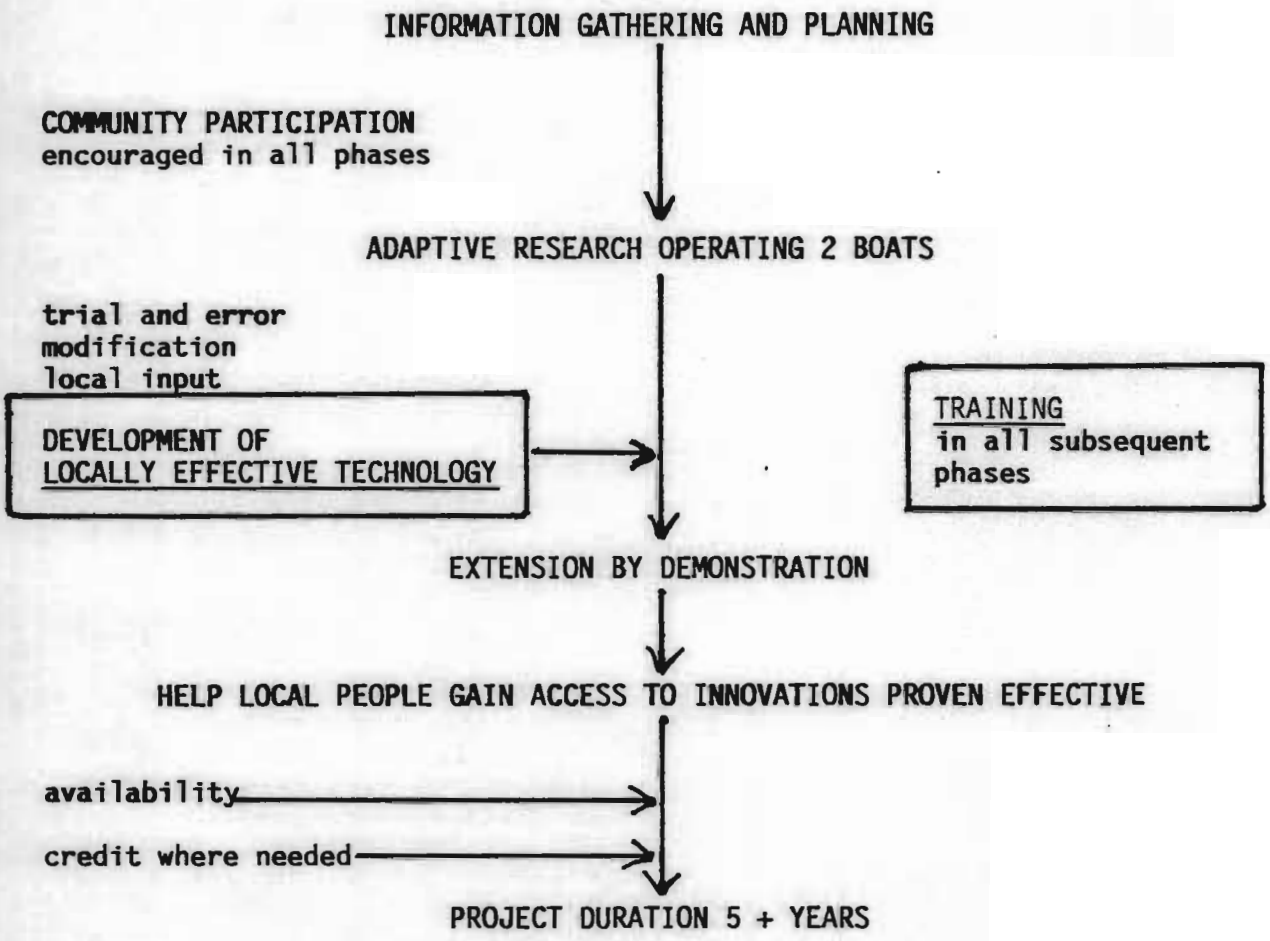
ADVANTAGES

- increased likelihood of using locally appropriate technology
- community has investment in project success
- strengthens community capability for self-development

DISADVANTAGES

- community may be mistaken about which technology is most appropriate
- possible conflict between community and project advisors
- difficult for introduction of unfamiliar innovations
- may be difficult for developing lowest cost technology
- may be difficult to stimulate community participation
  - lack of organization for planning purposes
  - disillusioned by previously failed projects
  - most capable people may be too busy or not interested

A. T. ADAPTIVE RESEARCH, DEVELOPMENT, AND EXTENSION APPROACH



ADVANTAGES

- develop locally appropriate technology - some lowest cost technology
- incentives for community participation
- demonstration is most effective for extension and training
- really appropriate technology often spreads on its own

DISADVANTAGES

- more difficult to administer large loans or grants
- less showpiece value
- long time frame inconvenient for some development organizations
- fewer goods from industrialized countries sold (disadvantage for IC's)

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