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A Research Framework For Traditional Fisheries

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Preface

As part of its research program on traditional fisheries, the International Center for Living Aquatic Resources Management (ICLARM), in cooperation with other fisheries organizations, is preparing a series of publications that review research conducted to date on the problems of traditional fisheries and fishermen and alternative development policies and programs that seek to alleviate them. These reviews seek to summarize and generalize from previous research results and development experience in the belief that valuable insights can be gained by taking stock of what is already known. Moreover, the reviews seek to address the broad issues of development and management policies regarding the traditional fisheries sector and to encourage a research and development climate in which meaningful discussion and analysis of alternative policies are possible.

This monograph, A Research Framework for Traditional Fisheries, which concentrates on Southeast Asia is the first prepared in this connection. It was written during my first year as an ICLARM staff member and serves as a backdrop against which country-specific research reviews are being undertaken. Country-specific papers, although of course varying in scope and underlying theme, cover resource, technological, socioeconomic, and institutional aspects of traditional fisheries production and distribution, and are joint projects of ICLARM and institutions in the country concerned.

A primary purpose of this monograph is to identify those areas of traditional fisheries research which have the greatest potential for contributing to the solution of problems facing traditional fishermen and their communities. To achieve this purpose, this monograph draws on both theoretical and empirical considerations available in the widely scattered literature of traditional fisheries. The conclusions of this monograph establish priority areas that will guide the traditional fisheries research program of ICLARM, details of which can be found in ICLARM's program statements.

IAN R. SMITH
ICLARM, Manila
September 25, 1979

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Smith, I.R. 1979. A research framework for traditional fisheries. ICLARM Studies and Reviews No. 2. International Center for Living Aquatic Resources Management. Manila. 45 p.

There is an explicit link between development programs and supportive research endeavors. If the goal of development programs is to raise the standard of living of traditional fishing communities, the goal of research should be to expand and clarify the alternative choices available to decision makers, be they government policy makers or project managers, private entrepreneurs, or fishermen themselves.

A primary purpose of this monograph is to identify those areas of traditional fisheries research which have the greatest potential for contributing to the solution of problems facing traditional fishermen and their communities. To achieve this purpose, the monograph draws on both theoretical and empirical considerations available in the widely scattered literature of traditional fisheries. Following an overview which examines the goals and potentially conflicting objectives of development planning, a categorization of problems of traditional fisheries as either empirical or suppositional is proposed. The former involves the concrete difficulties facing fishermen such as limited 'open-access' resources, inadequate vessels and gear, lack of market power, lack of alternative income sources, and inflation. The latter, on the other hand, involves the assumptions that decision makers bring to bear on matters of development policy, planning, and research. It is argued that fishermen and fishing community oriented perspectives are essential to understanding the problems and prospects of development in this sector.

After tracing the changing emphasis of past development programs, the paper discusses alternative development strategies, analyzes the relevant theoretical predictions and research issues associated with each, and concludes that long-term solutions to problems of low standards of living lie in reducing rather than in increasing fishing effort.

The futility of relying on approaches that directly or indirectly intensify the level of fishing effort (except in those decreasing number of cases where the resource remains underexploited) implies that priority for development and research should be given to those programs that reduce fishing intensity. The following four general research areas are therefore suggested:

1. Assessment of stocks exploited by traditional and industrial fishermen and estimation of maximum sustainable yields;

2. Development of management tools and programs appropriate for limiting fishing effort in the multispecies fisheries exploited by traditional and industrial fishermen;

3. Reduction of waste in the distribution system and exploration of ways in which resulting benefits can be

channeled to traditional fishermen; and, most importantly,

4. Development of alternative or supplementary income sources for traditional fishermen and their households.

Complementing these priority areas, indeed to some extent a necessary precondition of their application, is the requirement to develop an understanding, on the one hand, of the resource/fisherman/distribution continuum and, on the other hand, of the linkages among fisheries, fishing communities, and other rural sectors and institutions, including government. The former is a vertical concept and the latter an horizontal concept, which taken together imply the necessity for an holistic perspective of fisheries and fishing communities.

Introduction

The general conditions of poverty characteristic of traditional fishing communities around the world have increasingly drawn the attention of governments and other change agents in recent years, and have led to the initiation of development programs of varied hue and form. These programs, although expressing a variety of specific objectives, have as their urgent goal, implicitly if not explicitly, the raising of the standard of living of these communities. This objective is a recent addition to those generally ascribed to national fisheries development policies, which have on the whole concentrated on increasing production. This redirection of emphasis is important because it permits the search for solutions to the problem of low standards of living in fishing communities to expand beyond those areas which are fishery-specific.

An emphasis on technological solutions that sought to improve vessels and gear has declined as the fundamental biological constraint of the 'open-access' resources exploited by traditional fishermen has been appreciated and as both biological and economic overfishing have been documented.[1] Moreover, as evidence mounted that technology-based development programs frequently exacerbated income inequalities within and between communities, the relevant constraints to raising the standard of living came to be recognized as primarily socioeconomic and institutional in nature. Consequently, solutions are beginning to be sought within the context of rural development programs that have as their objective a general uplifting of rural areas. Fisheries should be seen as encompassing input supply, production, and distribution sectors, each with linkages to other sectors in rural areas, thus necessitating an appreciation by planners and managers for the broad economic and social impact of fisheries programs that they may recommend. Despite the generalized approach implied by rural development schemes, however, there is a need to retain flexibility in programs and projects designed for fishing communities. Variability in resource availability and the heterogeneity of fishermen and fishing communities imply the necessity for projects that are locale-specific, that take into account the needs that fishermen themselves identify, and that appreciate the vertical and horizontal linkages that traditional fisheries and fishing communites have with other sectors and institutions.

There is an explicit link between development programs and supportive research endeavors. If the goal of development programs is to raise the standard of living of traditional fishing communities, the goal of research should be to expand and clarify the alternative choices available to decision makers, be they government policy makers or project managers, private entrepreneurs, or fishermen themselves.

The purpose of this paper is to examine the problems of traditional small-scale fisheries and to establish a generalized framework for productive research in this field. Following an overview of the sector, which concentrates on the Southeast Asian region, and which examines the goals and potentially conflicting objectives of development planning, a categorization of problems of traditional fisheries as either empirical or suppositional is proposed. The former involves the concrete difficulties facing fishermen such as limited resources, inadequate vessels and gear, lack of market power, lack of alternative income sources, and inflation. The latter, on the other hand, involves the assumptions that decision makers bring to bear on matters of development policy, planning, and research. It is argued that fishermen and fishing-community-oriented perspectives are essential to understanding the problems and prospects of development in this sector.

After tracing the changing emphasis of past development programs, the paper discusses alternative development strategies and raises the relevant research issues associated with each. The paper concludes with a discussion of alternative approaches to traditional fisheries research and with recommendations for areas of concentration.

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[1] See Ciriacy-Wantrup and Bishop (1975) for the useful distinction between 'open-access' resource and 'common property' resource. An emphasis on 'open-access' would center on the fact that "the natural environment is available for use by whoever chooses to use it" (Bromley 1979), that is, upon use rather than ownership. 'Open-access' rather than 'common-property' will be used in this monograph.

An Overview of the Traditional Fisheries Sector

Discussions of development and research alternatives for traditional fishermen inevitably begin, and not infrequently end, with the question 'who are the traditional, or small-scale fishermen?' While a broad concept of the sector is necessary for further discussion, specific definitions appear to provide a less than satisfactory base from which to begin.

Classifications of fishing activities into small-scale or large-scale, inshore or offshore, artisanal or commercial have been made by numerous national bodies in attempts to define the target group for development purposes and for collection of statistics. Most often, the separation into groups has been made by vessel size or power unit, by type of gear, by distance from shore, or by some combination of these (SEAFDEC 1978). For example, Indonesia makes distinctions based on vessel size and whether or not the vessel is motorized. In the Philippines, all fishermen using vessels over 3 t are considered commercial; all fishermen using vessels of less than 3 t or no vessel at all are considered municipal fishermen. While Hong Kong and Singapore distinguish between inshore and offshore fisheries, Thailand's distinction between small-scale and large-scale is based upon type of gear used. Malaysia takes into account vessel displacement, type of gear used, and area fished. Because of these differences, one will find that what is considered small-scale in one country is large-scale in another; what is inshore in one is offshore in another.

While such distinctions are practical and indeed useful within a national framework, narrow definitions are not so useful when attempting to gain a broad understanding of the traditional fisheries sector. Rather than attempting to be specific, therefore, one could more usefully talk about ranges or rough categorizations of the technical and socioeconomic characteristics of the fishing activities of fishermen. For example, Kesteven (1973, 1976), using such an approach, distinguishes among industrial, artisanal, and subsistence fishermen. He considers both industrial and artisanal fishermen to be commercially oriented, while the catch of subsistence fishermen does not enter the market economy but is primarily for their own consumption or for barter trade. The vast majority of fishermen in the world fall into the artisanal and subsistence categories forming a continuum which in practice is difficult to separate in time and in space. It is to these two groups, which together shall be considered traditional fishermen, that the following discussion is addressed. Departing from Kesteven's distinction, the traditional fisherman category thus overlaps the commercial category, with a resulting distinction between industrial fishermen and traditional fishermen, rather than between commercial and subsistence. The distinction between industrial and traditional fishermen is therefore primarily one of scale and management and income levels, rather than of market orientation.

Table 1 classifies industrial and traditional fishermen according to the characteristics established by Kesteven which are: fishing unit, boat and equipment, fishing practices, investment level, catch per fishing unit, productivity per fisherman, disposal of catch, economic standing, and social condition. To these components have been added: ownership to reflect owner-operator relationships; time commitment to reflect the time spent by the fisherman in his fishing activity; and processing of catch to indicate degree of processing and type of end user. Of significance is the fact that this categorization is only indirectly related to the resources exploited by the fishermen, reflecting Kesteven's point of view that "artisanal fishermen can participate in the exploitation of most resources, and are favorably placed for the exploitation of certain of them" (1976, p. 132). This categorization of traditional fishermen is not resource-specific and therefore covers those involved in both marine and inland fisheries.

Summarizing from Table 1, traditional fisheries are carried out by small-scale fishing units, often consisting of kin groups using small, occasionally powered-boats or none at all. The fishing activity is often part-time, and household income may be supplemented by other non-fishing activities of the fisherman. Payment to fishermen is on a share basis and vessels and gear are usually owner operated, as distinct from industrial fishing where there is more distance between owners and fishermen. Gear, which may be machine made such as nylon netting, is usually operator-assembled and requires minimal or no machine assistance to operate. Investment levels are low, with capital often borrowed from those who market the catch. Catch per fishing unit and productivity per fisherman range from medium to very low. Catch most often does not enter large organized markets, but is sold at dispersed points of landing or even at sea. Part or all of the catch is operator- and family-consumed. Traditional fishing communities are frequently isolated, both geographically and socially, and the standard of living of traditional fishing households is low to minimal.

The usefulness of this distinction between 'traditional' and 'industrial' can be recognized through an example. A commonly used reef fishing method in the Philippines is the muro-ami, or drive-in net. The method uses up to 200 swimmers who drive the fish into the temporarily placed net with the use of scare lines. While the technique appears to be 'traditional' and reminiscent of

Table 1. Comparison of technico-socioeconomic situations of industrial and traditional fishermen. Categories (1), (4)-(10), (12) and (13) are from Kesteven (1973). Phrases in parentheses are additions to or changes in Kesteven's characteristics.

	Commercial		Subsistence
	Industrial	Artisanal	Traditional
(1) Fishing unit	Stable, with division of labor and career prospect	Stable, small, specialized with no division of labor	Lone operators, or family or community group
(2) Ownership	Concentrated in few hands, often non-operators	Usually owned by senior operator, or operators jointly	Widely dispersed among participants
(3) Time commitment	Usually full-time	Frequently part-time	Most often part-time
(4) Boat	Powered, much equipment	Small; inboard motor (or small outboard)	None, or canoe
(5) Equipment	Machine-made, other assembled	Partly or wholly machine-made materials, operator assembled	Hand-made materials, operator assembled
(6) Practices	Machine-assisted	Minimal machine assistance	Hand-operated
(7) Investment	High; large proportion other than by operator	Low; entirely by operator (frequently borrowed from buyer of catch)	(Extremely low)
(8) Catches (per fishing unit)	Large	Medium or low	Low to very low
(9) Productivity (per fisherman)	High	Medium to low	Low to very low
(10) Disposal of catch	Sale to organized markets	Unorganized local sale, significant consumption by operator	Exclusively consumed by operator, his family, and friends; exchange by barter
(11) Processing of catch	Considerable for fishmeal and other nonhuman consumption	Some drying, smoking, salting; primarily human	Little or none; all for human consumption
(12) Operators's economic standing	Often high	Lowest brackets	Minimal
(13) Social condition	Assimilated	Often separated	Isolated communities

similar methods used by whole communities in the South Pacific, the Philippine operation is supported by a large mother ship (up to 500 t), making the operation clearly 'industrial' by our earlier categorization. A similar technique on a smaller scale, not supported by a mother ship, would be 'traditional.' Distinctions that center on combinations of technical and socioeconomic characteristics rather than specific definitions appear to provide the broadest framework for our understanding of the sector and to shed the most light on the immediate problem at hand, which is the low standard of living of traditional fishing communities.

Although the concept of a 'standard of living' has many facets including income levels, infant mortality rates, nutrition, incidence of disease and sickness, and educational achievement generally grouped among others as 'quality of life,' the major dimension by which the standard of living of traditional fishermen can be readily measured is income levels. Above all, it is low income levels that set traditional fishermen apart from owners of industrial fishing vessels.

Despite the fact that information from the Southeast Asian region is neither complete nor consistent, it is possible to provide a broad picture of problems of low income from a few countries. Selected information from Indonesia, Philippines, Malaysia, and Thailand are pre-

sented in Table 2. Annual per capita incomes of fishermen are lower in all countries than average national per capita incomes. Income levels of fishing laborers, those who own no boat of their own, are particularly low, and, since the majority of traditional fishermen probably fall into this category (the ratio of fishermen to boats appears to be roughly 2.5:1), are more representative of the sector as a whole than are the higher income levels of boat owners. There appears to be rough equivalence between the extremely low levels of fishing laborers' per capita incomes in both Indonesia ($56) and the Philippines ($60). The higher household income of boat owners in the Philippines ($821) than in Indonesia ($455) is probably traceable, at least in part, to the higher percentage of motorized vessels in the Philippines (46%) than in Indonesia (2%). Annual household income of Philippine fishermen using nonmotorized vessels was $677 while per capita income was $106 (Herrin et al. 1978), both closer to the Indonesian boat operators' household and per capita averages of $455 and $81, respectively.

In addition to being absolutely low, fishermen's incomes exhibit marked seasonality. For example, on the east coast of Peninsular Malaysia, the northeast dry monsoon reduces the number of fishing days per month from 21 to 6 and the number of fishing hours per trip from 14 to 6 (Siwar and Ngah 1977). Fishing effort is thus reduced to one-eighth of nonmonsoon levels, and the result is that during the monsoon period, 94% of fishermen have household incomes below the M$230 monthly poverty income level arbitrarily established by the government. This compares to 77% below this poverty level during nonmonsoon months.

Regardless of absolute levels of incomes, changes in purchasing power provide a more accurate indication of the seriousness of the situation in most developing countries. According to the Asian Development Bank in almost all developing countries, "there is evidence of a decline in real wages in the 1970's . . . brought about by the runaway inflation in the 1972-1974 period" (1977, p. 53). Traditional fishermen, despite the higher prices that their catch may bring, are on balance probably adversely affected due to the higher costs of fuel and other inputs. Fishermen themselves indicate in personal interviews that their standard of living is worsening. For example compilation of responses from 16 barrios surveyed since 1975 in the Philippines shows that only 22% of respondents believe their economic condition has improved within the last 5 yr (Baum and Maynard 1976a, b,c,d,e; Herrin et al. 1978; Gagni and Luna 1978; Rubio et al. 1978). Even if one treats these results with some reservation, the situation is clearly alarming.

Because incomes are low throughout the rural sector, it is not low fishing incomes alone that have attracted the attention of national governments. These traditional fisheries are important to national economies most frequently measured by the contribution to GNP, by reference to nutritional aspects, such as annual per capita fish consumption or the percentage of protein intake contributed by fisheries products, or by the numbers of fishermen employed. With regard to the first two criteria, it should be pointed out that industrial and traditional fisheries' contributions are usually combined, and disaggregation is difficult. In addition to the above quantifiable aspects, fishing and other rural activities are viewed as important contributors to the stability of rural com-

Table 2. Fishing household income levels ($US) in Southeast Asia.

	Fishermen				
	Annual household income		Annual per capita income		Annual average national per capita income (1974)
	Operator	Laborer	Operator	Laborer	
Indonesia	$455	262	81	56	95
Philippines	$821	340	127	60	370
Malaysia	498		92		716
Thailand	210-374		n.a.		280

n.a.: Not available

Sources of data:

Indonesia : Atmowasono (1977)

Philippines : Herrin et al. (1978)

Malaysia : Labon (1974). Family size of 5.4 for Trengganu (Siwar and Ngah 1977) used to estimate per capita income.

Thailand : Cole and Anand (1975).

National per capita income figures from Gale Research Co. (1975).

munities. Raising the standard of living of traditional fishing communities is thus seen in part as a means of slowing rural-urban population drift.

Unfortunately, it must be emphasized that reliable statistics regarding traditional fisheries are notoriously hard to come by. In Southeast Asia, however, it is possible to develop an appreciation for the significance of traditional fisheries through an examination of the role of fisheries, including industrial and traditional, in terms of percentage contribution to GNP, of contribution to nutrition, and of employment. As indicated in Table 3, fisheries employ from 0.5% (Singapore) to 5.5% (Vietnam) of the economically active population and contribute from 0.3% (Singapore) to 6.7% (Kampuchea) of the value of GNP. A further indication of the important role of fisheries in terms of nutrition of the region is a range of 7.6 kg (People's Republic of China) to 48.1 kg (Hong Kong) annual per capita fish consumption. Additionally, fish makes up over 40% of the animal protein intake in most countries in the Southeast Asian region.

Traditional fishermen far outnumber industrial fishermen. Estimates of the numbers of traditional small-scale fishermen in developing countries worldwide reach as high as 15 million (URI 1975). If this estimate is taker to cover those who are essentially full-time, and thi certainly appears reasonable, the inclusion of those wh< are part-time would raise the estimate significantly. Th< sector's contribution to employment is further increasec by inclusion of those input suppliers, processors an< other middlemen also dependent upon the resource fo their livelihood.

Moving from a worldwide perspective, it is possible t< make some very rough estimates of numbers of tradi tional marine fishermen in the Southeast Asian regior based in part upon extrapolation from published infor mation on catch and gear types (SCS 1973). It is esti mated that 45% of the South China Sea catch is fron trawls, purse seines, and drift nets. An additional 4% i such locally important gear as longlines, bagnets, muro ami, liftnets, and trolling and 6.4% from sea musse collecting. The remaining 45% or 2.1 million mt (o which 0.93 million mt are estimated to come from th< People's Republic of China), is caught by 'other fisheries, which one can presume to be primarily traditional, o small-scale. Expanding the scope of available statistic beyond the South China Sea to include Indonesia an< catch from those countries in the region that fish beyon<

Table 3. Selected indicators of the role of fisheries (industrial, traditional) in national economies.

Country/region	Employment fisheries	Fisheries employment as % of labor force	Fisheries as % of GNP	Per capita fish consumption kg/yr	% of animal protein derived fish
Brunei	360	1.4[a]	N.A.	N.A.	N.A.
China	N.A.	N.A.	N.A.	7.6	N.A.
Hong Kong	45,000	3.1[a]	N.A.	48.1	29.7
Indonesia	1,081,000	2.4	3.4	10.2	65.3[b]
Kampuchea	40,600	1.2	6.7	25.4	68.0
Malaysia	81,700	1.9	2.2	25.7	47.6
Philippines	687,900	4.8	3.6	24.2	54.0
Singapore	2,200	.5[a]	0.3	41.5	42.8
Taiwan	298,000[d]	5.2	2.4	39.1[d]	N.A.
Thailand	64,277[e]	1.7	3.2	19.1	50.4[f]
Vietnam	317,400[g]	5.5[a]	5.2[g]	15.1[g]	67.2

N.A.: Not available.

Source: Except where noted, FAO (1973) Fisheries Circular 314. Labor force figures, from which the fisheries employment as % of labor force was computed, are from ADB (1978), except as noted below. Note the extremely high protein consumption of Hong Kong and Singapore. The estimate for Hong Kong appears questionable.

[a]Based on estimates of economically active population as reported in ILO Yearbook of Labor Statistics (1970).
[b]Hadiwidjaja and Sumintawikarta (1970) estimate 81.3%.
[c]Mahmud (1970) estimates 69.1%.
[d]Chang (1976).
[e]Fisheries Record of Thailand (1975).
[f]Chakrabandhu (1970) estimates 53.9%.
[g]South Vietnam only. Per capita fish consumption is average of North and South Vietnam as reported in Marr (1976).

the South China Sea increases the percentage share of total catch from traditional fisheries to 58% and allows an estimate of approximately 3.5 million traditional small-scale marine fishermen in the Southeast Asian region (see Table 4 for derivation of this estimate).

It should be pointed out that these estimates are based on extrapolation using two figures: (1) the estimated percentage of total marine catch caught by traditional fishermen and (2) the estimated weighted average annual catch per fisherman (1.33 mt) derived from numbers of traditional fishermen based on numerous and occasionally conflicting sources for 6 of the 11 countries in the Southeast Asian region. Consequently it is important to stress that the resulting figures should be viewed as only a rough guide.

Constructing similar data for the Southwest Pacific is much more difficult. FAO catch data for this region are incomplete and understated due to the nonreporting of subsistence catch data from outlying islands where fish, molluscs, and crustaceans are used almost exclusively for home consumption. Since no reliable estimates are available on numbers of fishermen, I have made what is probably a conservative estimate of 5% of the population or 230,000 traditional fishermen engaged at least part-time in capture or gathering. The total for the two regions thus approaches 4 million.

The number of traditional fishermen within the Southeast Asian and Southwest Pacific regions is thus extremely high, ranging on a national basis from lows of a few hundred in Brunei and Singapore, to hundreds of thousands in the Philippines, the Southwest Pacific, Taiwan, and Vietnam, to almost a million in Indonesia and over 1.5 million in China. If one assumes an average family size of six, there are approximately 25 million people in these two regions alone directly dependent upon traditional marine fisheries for their livelihood. The inclusion of traditional inland fisheries and of collectors of molluscs (e.g., Thailand) for which few statistics are available would further increase these estimates.

In addition to numbers of fishermen, the importance of the traditional fisheries sector is apparent from the goal-setting that results from national planning exercises. As observed by Lawson (1974, 1978), Lampe (1976), and Engvall (1978), the most common objectives of fisheries development plans are (1) to increase output; (2) to increase export earnings; (3) to raise income levels; and (4) to maintain or increase employment.

The first objective is based primarily upon a desire to meet nutritional requirements of rapidly expanding populations. The second objective reflects an interest primarily in development of industrial fisheries for export purposes. However, there are cases consistent with Kesteven's earlier point regarding access of traditional fishermen to most resources, where traditional fisheries can benefit from the expansion of export markets. For example, a significant proportion of the shrimp that is destined for export from Indonesia is caught by traditional fishermen. In the Philippines, those traditional fishermen catching tuna species often sell their catch at sea either directly to Japanese vessels or to larger industrial vessels operating out of the major ports who in turn sell their catch to exporters. The third and fourth objectives have direct bearing upon the traditional fisheries sector which has been shown to be the major employer in most national fisheries, and in which income levels are universally low.

It would be a simple world indeed if these major objectives could be simultaneously achieved. Unfortunately, there are inherent conflicts among them, the reconciliation of which requires the setting of priorities by national fisheries planning bodies. For example, if one assumes that output increases are to be achieved through modernization of fishing fleets, the labor input will be reduced and employment will decline. Trends around the world have demonstrated the inevitability of the capitalization process in 'open-access' resource exploitation. In response, deliberate steps such as closure of coastal areas to trawlers are undertaken to maintain more labor-intensive operations, that is, to legislate inefficiency.

Additional conflicts are also apparent between a consumer orientation and a producer orientation. Often implicit in the first objective of increasing output is the desire to increase the availability of cheap protein. If one assumes that increases in total output are possible through expansion of the industrial fishing fleet (and as shall be shown, this is not necessarily a valid assumption), prices will be lower than they otherwise would have been had reliance remained on the traditional fishing fleet, and output therefore not increased. The lower prices imply a lower income for the fishermen.[2] In other words, what is best for the national economy in the form of increased fish production and protein availability may produce better incomes for only a small number of fishermen and could actually reduce those of many more (Crutchfield et al. 1974). As in agricultural settings in other parts of the world, the government may choose to subsidize either producer or consumer or both. Short of such direct intervention in the market process, however, priorities must be established among these various conflicting objectives.

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[2]This is an oversimplification because the change in revenue (income) resulting from the increased supply depends upon the elasticities of demand and supply, and upon whether the maximum sustainable yield (MSY) has already been surpassed. See pages 25-27 for elaboration of this point.

Table 4. Estimated numbers of traditional fishermen (marine) and annual catch per fisherman in the Southeast Asian and Southwest Pacific regions.

Country	Total marine catch (mt)[a]	% from small-scale fisheries[d]	Marine catch small-scale (mt)	Estimated no. of small-scale fishermen	Annual catch per fisherman (mt)
Southeast Asia					
Brunei	1,561	28[b]	437	325[l]	(1.33)
China	2,312,000	98[c]	2,265,760	1,678,000[l]	(1.33)
Hong Kong	152,699	7	10,689	7,900[l]	(1.33)
Indonesia	1,039,354	98[e]	1,018,567	860,800[g]	1.18
Kampuchea	10,800	20	2,160	1,600[l]	(1.33)
Malaysia	513,059	23	118,004	65,000[h]	1.82
Philippines	1,206,654	55	663,660	500,665[f]	1.33
Singapore	15,775	29	4,575	650[i]	6.98[l]
Taiwan	531,000	46	244,260	181,000[l]	(1.33)
Thailand	1,464,396	13	190,371	60,000[j]	3.17
Vietnam	837,200	25	209,300	187,500[k]	1.12
Subtotal or weighted average	8,084,498	(58)	4,727,783	3,543,440	1.33
Southwest Pacific[m]					
Papua New Guinea	63,029[n]	25[n]	15,757		
Solomon Islands	18,600	N.A.			
New Hebrides	8,000	N.A.			
Fiji	5,456	N.A.	12,500		
French Polynesia	2,826	N.A.		230,000[o]	(?)
Trust Territory	6,053	N.A.			
Others	5,104	N.A.			
Subtotal or weighted average	109,068	25	27,267	230,000	(?)
Totals or weighted average	8,193,566	(58)	4,755,050	3,773,440	1.33

[a]Even though separate national statistics are available in a few cases, for consistency, marine catch estimates are compiled from FAO (1977), except for Taiwan data which originate from Table 1, Marr (1976).

[b]Based on average of Sarawak and Sabah from Table 1, SCS (1973).

[c]My estimate based on Solecki (1966). SCS (1973) estimate is 100% for 1971.

[d]Based on 'other fisheries' category, Table 1, SCS (1973), unless noted otherwise. Malaysia includes lift nets.

[e]Sidarto and Atmowasono (1977).

[f]Samson (1977). SCS (1973) estimate is 59% for 1970.

[g]Fisheries Statistics of Indonesia (1972).

[h]SCS (1973) reports 26,000 vessels in coastal fishing. Assuming ratio of fishermen to vessels of 2.5:1, estimated number of fishermen is 65,000.

[i]SCS (1973) reports that one-third of Singapore's 794 vessels in 1971 were engaged in coastal fishing. Assuming 2.5 fishermen per vessel gives an estimate of 650 fishermen. Note, however, that the results in an average catch of 6.98 mt per fisherman, a figure that subjectively appears to be too high.

[j]Aubray and Isarankura (1974) report 36,000 fishing craft, all but 3,200 devoted to artisanal fishing, and a fisheries population of 270,000. Fisheries Record of Thailand (1975) reports 64,277 fishermen. The number of traditional fishermen is probably around 60,000, not including sea mussel collectors whose number is not known.

[k]SCS (1973) reports 75,000 vessels in coastal fishing. Assuming ratio of 2.5 fishermen per vessel, estimated number of fishermen is 187,500. URI (1975) estimates number at 200,000, including inland water.

[l]Neither estimates of numbers of small-scale fishermen, nor annual catch estimates per fisherman are available for Brunei, China, Hong Kong, Kampuchea, and Taiwan. Numbers of fishermen are estimated for these countries using the weighted average catch of 1.33 mt per fisherman for other countries in the region.

[m]Figures for total marine catch are FAO estimates of total catch. Freshwater catch is assumed negligible. Australia and New Zealand are excluded.

[n]FAO (1977). Pownall (1972) and ADB (1978) estimate a higher figure of 80,000 t.

[o]My estimate, assuming 5% of the population of 4.6 million involved in fishing and gathering, at least part-time.

The conflicts among stated objectives arise in part due to the inherent divergent interests of various groups, including rural poor producers and urban poor consumers, and in part because of naive views or tacit assumptions regarding the limitlessness of the fisheries resource. These views of unlimited fishery resources have persisted for hundreds of years and were apparent in fisheries development programs and projects as recently as the early 1970s.

Our present interests are somewhat more parochial than an examination of ways and means to reconcile these conflicting objectives, although their outline aids in understanding the importance of the fisheries sector. As stated in the introduction, the purpose of this presentation is to examine the major problems of the traditional fishermen and the contribution that research can make to their resolution. Implied, therefore, is the belief that a priority of research must be to aid in the development of programs that seek to raise income levels and the standards of living in traditional fishing communities.

The Problems Facing Traditional Fishermen: The Fisherman's Perspective

FACTORS CONTRIBUTING TO LOW STANDARD OF LIVING

To this point, it has been emphasized that the problem of traditional fishermen is that of a low standard of living, or more specifically, low incomes. There are, of course, many contributing factors to this general problem, and an examination of the major factors will assist in identifying possible solutions to which research thrusts can be related.

When examining traditional fisheries, it is useful to distinguish between two kinds of factors contributing to the low standard of living. Empirical factors, on the one hand, involve the concrete situation faced by fishermen and the communities in which they live. Suppositional, or analytic factors, on the other hand, involve the assumptions and approaches that decision makers use when defining and trying to solve empirical problems.

To a certain extent, empirical and suppositional factors are related in that empirical problems can flow from suppositional problems. For example, the lack of adequate vessels and gear or lack of market power which are classified here as empirical problems result in part from national development priorities and their attendant assumptions. The best example of the causal relationship relates to the 'open-access' nature of the fishery resource. By tacitly assuming unlimited resources, governments have been able to rationalize the issuing of licenses to industrial fishermen in some countries on such a scale that contributes to conflicts with traditional fishermen.

There are three kinds of empirical problems–biological, technological and socioeconomic–that face the traditional fishermen. These areas have often been treated separately by the respective disciplines involved. Instead, they should be treated as complementary and interacting. For example where overfishing already occurs, policies aimed at increasing fishing effort in a traditional fishery may be self-defeating. At the same time, the lack of more and better information about biological aspects of a fishery should not be allowed to postpone attention to the socioeconomic and institutional problems of traditional fishing communities.

The major empirical problems that contribute to low incomes and low standards of living are limited fisheries resources, inadequate vessels and gear, lack of alternative income sources, lack of market power, and inflation (Figure 1). While, for sake of simplicity, Figure 1 indicates these as separate contributing factors, there is clearly interaction and reinforcement among them, making the figure reminiscent in some aspects to the 'vicious circle of poverty' identified by Nurkse (1953) as an explanation for agricultural stagnation. For example limited resources of an 'open-access' nature by themselves do not lead to low incomes unless entry of fishermen is unchecked. The lack of alternative income opportunities in the rural sector which intensifies fishing effort then couples with limited resources to reduce income levels. We will return to a discussion of solutions after examining these empirical problems, or contributing factors in detail.

Empirical problems must be put into a human context. What do they mean to the poorest of fishing households? On extreme days when bad weather precludes any fishing from the small barrios of Ilocos Norte, Philippines, for example, it means that the day's meals consist of rice and salt and nothing more. Even on good days the catch is so low that it does not go far when sold in order to purchase other necessities. It means that some families have never consulted a doctor, even though several are located only a few kilometers away, because they can not afford the nominal fee. It means that the family's sole possessions, besides its single room nipa palm house and the clothes they are wearing, are cooking utensils and some sleeping mats. It means that with no savings and no material possessions, the poorest fishing families

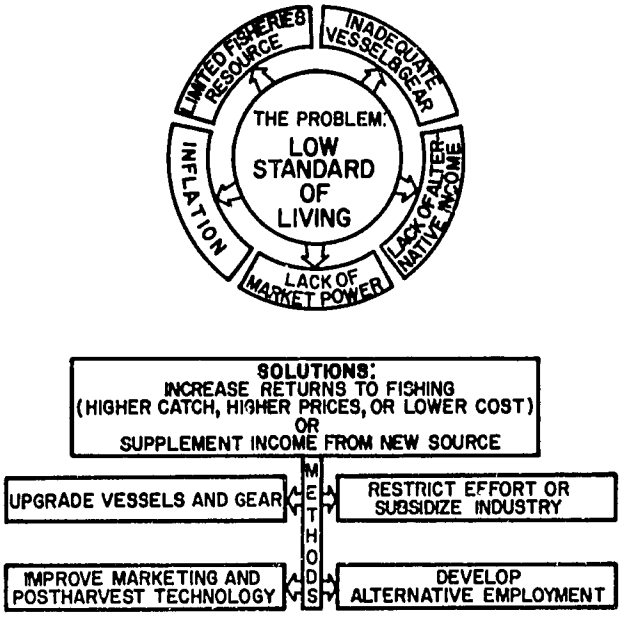

Fig. 1. Empirical problems of traditional fishermen and possible solutions.

can never hope to secure loans for gear purchase from collateral-minded banks, whose experience with previous loans to fishermen has been anything but rewarding. It means that with little or no education, and few non-fishing skills, the poorest fishermen have little hope of shifting to another occupation. It would be easy to become overly emotional regarding these conditions, but they need to be kept in mind as composite figures document these empirical problems. Empirical problems have a human scale and perspective that make them appear overwhelming to the families directly affected.

The major empirical problems that contribute to the above set of conditions will be discussed here. Also considered is a subset of difficulties associated with the 'open-access' nature of the resource; specifically, the two problems of surplus fishermen and conflicts between the traditional and the industrial fishing sectors. The choice of major empirical factors and the elimination at this time of others (e.g., waste in distribution) is a deliberate attempt to encourage initially a view of these problems from the perspective of the traditional fishermen. Suppositional problems, on the other hand, will deal with the problems of the traditional fisheries sector from the perspective of nonfishermen.

1. Limited Resources

Status of stocks: Fish stocks, though providing a flow resource, are finite. Underlying all concerns about low income levels is the growing indication that the demersal, reef, and to some extent the pelagic resources upon which the traditional fishermen depend are all biologically and economically overexploited. While the individual fisherman, especially one who faces a daily problem of survival, may not see 'open-access' and the resulting overexploitation as his problem, he certainly feels it in terms of low productivity and conflicts with the industrial fishing sector.

Economists and biologists either using their respective concepts of overfishing, or more frequently combining them in bioeconomic terms, are reaching much the same general conclusion regarding the status of stocks in the region. Although information on the level of exploitation of the coastal resources is fragmented and somewhat mixed, and there are exceptions, the general trend towards biological and economic overfishing appears evident. Biological overfishing results from a level of effort which produces catch beyond the maximum sustainable yield (MSY). A distinction is usually made between 'growth' and 'recruitment' overfishing, either one or both of which can lead to biological overfishing. "The latter is a reduction in stock caused by recruitment failure under the pressure of heavy fishing, but growth overfishing occurs when the little fish are caught before they have had a chance to grow" (Cushing 1977, p. 232). Economic overfishing, on the other hand, results from a level of effort which produces catch beyond the maximum economic yield (MEY). MEY is that point on the yield curve that maximizes net revenue, that is, where Total Revenue (TR) minus Total Cost (TC) is at its maximum (Figures 4-6). MEY will always be associated with levels of effort less than those which produce MSY.

Several authors (Lawson 1975; Pathansali 1976; Yap 1977) indicate that the resources of the west coast of Peninsular Malaysia, particularly the demersal and semi-pelagic species, are already fully exploited. Overfishing is documented by Yap (1977) who shows over the period 1969-1974 (1) a fall in landings per unit of fishing effort; (2) a fall in total landings; and (3) an increase of trash fish as a percentage of total catch. For the east coast of Malaysia, in contrast, Pathansali (1976) estimates that a potential three-fold increase in landings of demersal and semi-pelagic species could be achieved from an average of 35,000 t in 1967-1971 to 95-130,000 t. However, this depends on the fishery's expanding to the offshore areas by use of trawlers.

For Indonesia, Satari and Soewardi (1973) report the overexploitation of the Malacca Straits and the near over-

exploitation of the coastal seas north of Java but believe that other areas near Kalimantan, Sulawesi, and Irian Jaya are still underexploited.

In the Philippines, the Bureau of Fisheries and Aquatic Resources (BFAR) has identified several areas which have shown decreasing yields. Assuming constant or increased effort was applied in each case over the period of observed decline, the following areas appear to be overexploited: Manila Bay; Panquil Bay; Sorsogon Bay; Pagapas Bay; Tinagong-Dagat, Capiz; San Miguel Bay, Camarines Sur; Bantayan Island, Cebu; Maqueda Bay and Villareal Bay in Samar; a portion of Zamboanga Channel; Lingayen Gulf; San Pedro Bay; Asid Gulf; Polillo Island in Quezon; and Puerto Galera in Oriental Mindoro. Of these, Malampaya Sound in Palawan has been closed to commercial fishing, although municipal (vessel < 3 t) fishing is still permitted. In addition, commercial fishing is prohibited within 7 km of the coastline of Samar, Leyte, and Sorsogon provinces.

The overfishing that has occurred throughout the Gulf of Thailand, and the subsequent venturing of the trawl fishery to fishing grounds further afield have been well documented elsewhere (Bangkok Post 1974; Marr 1976; Marr et al. 1976). Silva, in a report to the Indian Ocean Fishery Survey and Development Programme (1973), reported that trawlers formerly operating in the Gulf of Thailand were in that year ranging from Bangladesh in the Northwest to the Straits of Malacca.

The effect of overexploitation of these Gulf of Thailand fish stocks on the traditional coastal fisheries is not clear. However, one would think that they would be adversely affected both for biological reasons and due to increased competition from trawlers. However, Silva (1973) holds out hope that all demersal species are not yet fully exploited due to the rough coral strewn bottom, and claims there is still the potential for a hook-and-line fishery. A similar implication is apparent from the experimental trawl and echo-sounding results reported by Aprieto and Patolot (1977) and Aprieto and Villoso (1977, p. 81) who state "cursory analysis of the echo-sounder tracings indicated an apparent abundance of fish in the Visayan Sea."

It has been estimated that for the South China Sea, the potential catch is 3.45 million t (Aoyama 1973). The geographical breakdown of this projected catch and the areas for which potential increases were thought to be possible is shown in Table 5. In the 4 yr since Aoyama's (1973) estimate, demersal catches have increased to approximately 3.7 million t, so it would appear that for the region as a whole the maximum demersal sustainable yield has now been reached, if not surpassed (Pauly 1979), although certain smaller areas where limited expansion is still possible may remain.

Table 5. Present and potential demersal catches in the South China Sea. Data are from Aoyama (1973). Note that by 1977, demersal catch reached 3.7 million metric tons, thus exceeding Aoyama's estimate of MSY.

Area	Present catch (1,000 mt) 1972	Potential catch (1,000 mt)
Mainland Shelf	553.5	956
Northern	293.5	
Gulf of Tonkin	128.2	
Southern	132.0	
Sunda Shelf	1,192.6	1,618
Northern	375.9	
Gulf of Thailand	653.9	
Central	30.6	
Southern	72.0	
Eastern	60.2	
Philippines Region	335.0	420
South China Sea Basin	0	59
Straits of Malacca	428.8	400
Total	2,509.9	3,453
		- 2,510
Potential increase (as of 1972):		943

Of course, the status of demersal stocks gives only a partial picture of the status and potential of traditional fisheries. Many reef fishes are not included in these demersal estimates, and in one country, the Philippines, up to 23% of all traditional fisheries catch is estimated to derive from coral reef areas (Carpenter 1977). Gear used by traditional fishermen to capture reef fish are traps, hook-and-line, drive-in nets, gillnets and makeshift spear guns. The use of dynamite, poison, and small-mesh traps, however, threatens these resources also. Even the smallest of fish are caught for consumption and ornamental fish for export. In the Philippines, the export value of ornamentals rose from approximately $100,000 in 1970 to over $5 million in 1976 (Fisheries Statistics of the Philippines 1975). The sodium cyanide used to gather ornamental fish, however, is damaging to the coral reef itself.

In contrast to the Southeast Asian region where demersal and pelagic catches predominate, coral reef fisheries prevail in the Southwest Pacific as far as traditional fishermen are concerned, and many coral atolls are clearly overfished (personal observations 1969-1972). Development efforts in the Pacific have concentrated on outer-reef rather than inner-reef programs as a result.

In addition to coral reef fisheries, traditional fishermen also exploit pelagic stocks. For example, tuna and anchovy make up 46% of the catch of municipal fisher-

men in Libertad, Misamis Oriental, Philippines (Herrin et al. 1978). Traditional fishermen thus exploit diverse resources, the degree of overfishing varying from country to country, but with an overall trend to inevitable biological and economic overfishing.

Low productivity: The immediate effect of limited and overexploited fisheries resources available to traditional fishermen is, of course, low productivity per fisherman. The low catches that along with low prices contribute to low incomes (summarized in Table 4) were found to average 1.33 mt annually per fisherman in the Southeast Asian region.[3] Assuming approximately 200 fishing trips per yr (this was the average for the 16 Philippine barrios cited earlier) catch per fisherman per trip is less than 7 kg. Scant information on productivity is available from the Southwest Pacific, although one study (Alkire 1965) estimated annual catch rates for fishermen on the small atoll of Lamotrek to be only 360 kg, with the average fishing effort of 90 d/yr, implying a catch per fisherman per trip of only 4 kg.

Just as average income figures do not provide information on the distribution or range of incomes, neither do these catch figures provide information on the range of productivity. In Indonesia, however, based on data presented in Collier, Hadikoesworo, and Saropie (1977), annual catch per fisherman for traditional sailboats ranges from 0.25 mt with handlines to 5.2 mt with gillnets. In Misamis Oriental, in the Philippines annual catch for operators of motorized bancas was approximately 2.6 mt, while operators of nonmotorized bancas caught only 1.0 mt on the average, despite making 20% more trips per yr (Herrin et al. 1978).

One might be tempted to conclude from these data that the key to improving fishermen's incomes lies in improving vessels and gear since it is apparent that owners of motorized boats and users of nets have higher productivity than those using less sophisticated gear. However, as is convincingly shown by Gibbons (1976), the effects of such modernization are apparently felt only by the very few. Despite the overall modernization of the Malaysian fisheries sector and increased national catches, 78% of the Chinese and 85% of the Malay traditional fishermen in Penang and Kedah have a per capita adult equivalent monthly income of less than M$40 (US$16.40). The traditional fishermen in these two areas have, on the whole, invested neither their capital nor their labor in the more productive techniques. This aspect of vessel and gear improvement will be elaborated on in a later section.

Surplus fishermen and lack of alternative income sources: Two important socioeconomic problems evolve from the finiteness of the resource base and from its 'open-access' nature. These are the volatile issues of (1) surplus fishermen and (2) conflicts with the industrial fishery. The importance of each issue is a direct function of the extent to which the resources presently tapped by traditional and industrial fishermen are overexploited.

Surplus labor has been estimated in Malaysian fisheries (Fisheries Division 1971) at 19,300, two-thirds of which is on the West Coast. These estimates were based upon a supposed optimum crew size per vessel assuming static technology and resource availability. As Lawson (1975) correctly points out, such an estimate is not valid when additional resources and improved technology are available as they are on the East Coast, albeit offshore. Lawson goes on to calculate that what surplus labor does exist on the East Coast will be absorbed by the alternative activities that will be generated by the Malaysian Fisheries Development Plan (Labon 1974). Since most of these alternative activities are projected to be in industrial fishing and in land-based aquaculture, there is a reason to question this optimism. There has not been to date a clear indication that development of either of these sectors directly benefits large numbers of traditional fishermen. For example Malaysia's experience on the West Coast and Thailand's experience indicate that those absorbed by the industrial fishing sector are more likely to be unemployed urban youth than former traditional fishermen (Yap 1977).

Some encouragement can be taken from experience on Malaysia's East Coast where limited numbers of traditional fishermen have been absorbed (C. Bailey, pers. comm.). However, the absorptive capacity of the industrial fishery is far from clear. Moreover, based on extensive personal exposure to fishing community problems in Java, Collier et al. (1977) believe that large numbers of traditional fishermen will not be easily attracted to full-time laborer work in capital intensive fishponds, with their low labor requirements.

In the Philippines, the BFAR 'Blue Revolution' program is perhaps more realistically concentrating on species such as oysters, mussels, and seaweed (primarily *Eucheuma*) that can be cultured in the foreshore area with minimal investment and thus might be more attractive to traditional fishermen as a supplemental source of income. A study of *Eucheuma* farming based on comparative data from the Aru Islands in Indonesia and Tawi-Tawi in the Philippines indicates, however, that seaweed farming has attracted, on a part-time basis,

[3]Of course low productivity is only part of the picture. With high valued species, and depending upon elasticities of supply and demand, low productivity (in terms of kg) may result in higher incomes. Such situations tend to be the exception, however.

many nonfishermen such as teachers and government employees in addition to fishermen, indicating that special legislation may be required if these activities are to be reserved for traditional fishermen (L. Hollenbeck, pers. comm.). While community profiles in the Philippines show that alternative household activities, particularly those of other household members, are providing an increasing proportion of total household income, this does not mean that nonfishing income or total household income is increasing; it may only reflect a decline in the proportion provided by fishing activities.

Relatively little is known about the comparative rates of return from or the marginal productivity of labor in alternative activities in the rural coastal areas, that is, what is the opportunity wage of traditional fishermen? Such data could provide important clues as to the movement of labor into or out of traditional fisheries and factors that constrain mobility. Are traditional fisheries the economic activity of last resort? Cordell (1973) concluded it is, at least for canoe fishing communities in Northeast Brazil that had to abandon their estuary fishing due to the superior technology of other fishermen and were "forced to colonize an inferior niche, the [mangrove] swamp" (p. 32). Laborers released from nearby coconut plantations had few alternatives except canoe fishing, thus placing further pressure on the resource. While Cordell was careful not to generalize to other fisheries, there is indirect evidence in Asia that fishing is a last resort activity for many.

Estimates for Malaysia indicate that the number of traditional fishermen are increasing (Larsson et al. 1975). Increases in the number of fishermen using small sailboats in Java are reported by Collier et al. (1977) who point out that it is fishing, not land-based activities such as rice farming and brackishwater pond culture, that is more likely to attract marginal workers and the landless. Not only are absolute investment requirements lower in fishing, the 'open-access' nature of the resource allows the newcomer to begin the activity with relative ease. In Thailand, while the number of fishermen apparently declined between 1967 and 1970, the percentage of fishing families that depended solely on fishing as their source of income increased from 42% to 60% during this period (Tiews 1976).

The size of the rural landless labor force appears to be growing throughout Asia, ranging from over 25% of rural households in Indonesia (undoubtedly higher in Java) to 38% in Bangladesh (ADB 1977). If Collier et al. (1977) are correct concerning the ease of labor movement into fishing, and there is little reason to conclude otherwise, there are two important implications for traditional fisheries development programs. First, the added fishing effort resulting from these additional fishermen will only hasten the depletion of resources upon which traditional fishermen depend, thus making even more urgent the need to design appropriate programs that reduce fishing effort. Second, if employment opportunities are declining in rural agriculture, and marginal labor is moving into fishing, it does not bode well for programs that expect surplus fishing labor to be absorbed by other present rural activities.

Conflicts between traditional and industrial fishermen: Conflicts between industrial trawlers and traditional fishermen are increasingly frequent occurrences throughout the Southeast Asian region and provide further evidence of the problems created by modernization of fishing fleets and their exploitation of a limited 'open-access' resource base. The potential areas of conflict have been identified by Robinson (1976) and by Lawson (1972, 1975) as (1) conflict over the resource base; (2) competition within factor (input) markets; and (3) competition in the marketing of the product.

Intra-country conflicts over the resource base have been widely reported in newspapers throughout Southeast Asia. In several instances these have resulted in violence and even deaths (see Malaysian National Delegation report in Tiews 1976). Despite legislation in many countries that prohibits operation of trawlers within certain distances from the shoreline, it has proven extremely difficult to enforce. The result has been a steady encroachment by trawlers on the resources previously exploited solely by traditional fishermen. The nets and gear of traditional fishermen have been destroyed as commercial trawlers made their passes along the coast during the night. Additionally, since many of these trawl fisheries are after shrimps with their high export value, the catch byproducts (i.e., trash fish) are often dumped at sea rather than marketed (Collier et al. 1977). As an indication of the seriousness of these conflicts, the Malaysian National Delegation to the International Seminar on Fisheries Resources and Their Management in Southeast Asia (Tiews 1976, p. 453) reported "a total of one hundred incidents . . . occurred between the traditional inshore fishermen and the trawler fishermen from 1970-1973." The severity of such conflicts can be gauged from the facts that 1200 boats were involved (about 400 trawlers and 800 inshore fishing boats), over 60 boats were sunk and 23 fishermen were killed. While most of these conflicts occurred in Perak, Malaysia is certainly not alone in having experienced such violence. Similar conflicts have occurred in Indonesia (Collier et al. 1977) and in the Leyte and Samar areas in the Philippines.

Competition between the two sectors in the factor (input) and product (output) markets is less obvious, but probably has an equally severe long-term effect on tradi-

tional fishermen. Economic theory predicts that competitive conditions will guide factors of production (i.e., labor and capital) to those activities where their marginal return is the greatest, and will lead to capital-labor ratios that reflect the contribution to output, in value terms, of these factors of production. Traditional fisheries and industrial fisheries appear to operate, however, in two separate labor and capital markets where competitive forces between them are constrained and thus do not bring about such an equilibrium. In traditional fishing communities where the usual source of capital is private moneylenders, rates of interest, which reflect the price or cost of capital, may be as high as 10%/mo for short-term loans where risks are high and investment capital is in short supply (Smith 1978). In contrast, development loans available to industrial fisheries have been highly subsidized, both by international lending agencies such as the World Bank and the Asian Development Bank and by domestic development banks through the establishment of lower interest rates in the 10-15% range. This bias toward the industrial fisheries and the encouragement of capital usage in a capital-scarce situation, coupled with the 'open-access' aspects of the resources, has encouraged overcapitalization of the industrial fisheries at the expense of the traditional fishery. Moreover, the industrial fishery is more capital intensive than would have been the case had interest rates been higher and thus reflected the true shortage of capital.

Competition in the product market may also work to the disadvantage of traditional fisheries. As stated by Lawson (1975, p. 8, 9):

"...*as* [*industrial*] *fisheries expand, the standard of living of the* [*traditional*] *fishermen relatively declines.* This arises because if both the [industrial] and [traditional] fisheries are simultaneously landing fish for the same market, the cost of fish landed will be lower from the modern vessels, which are producing on a large scale, than from the small-scale [traditional] fishery. If market prices are determined competitively then they will eventually fall to near the costs of production of the modern [industrial] sector (depending on the degree of competition between vessel owners and traders), which will cause the [traditional] fishermen to have even lower incomes than previously.

Furthermore, fish traders will become increasingly reluctant to incur the higher collection costs involved in procuring relatively smaller fish supplies from scattered and distant [traditional] fishermen than from the large vessels which land bulk quantities of fish at accessible centralized points. Indeed, few [traditional] fishery industries in other countries in the world are able to stand up, for long, to the competition of large-scale lower-cost producers unless they themselves are able to get considerable government support."

Of course, as claimed by Robinson (1976), there may be advantages accruing to the traditional sector from development of the industrial sector. Infrastructure improvement and the opening of new markets would be of mutual benefit, and it is not always the case that the two sectors are catching the same species, nor necessarily supplying the same markets. However, of more than passing interest, especially to researchers, is the contention that laissez-faire economic policies of many governments in the Southeast Asian region, coupled with close links between government and the business community, result in continued expansion of the industrial fishery at the expense of the traditional fishermen (Gibbons, pers. comm.).

In summary, the empirical problems of surplus manpower and conflicts between the traditional and industrial fishing sectors appear to have their roots in the finiteness and 'open-access' nature of the resources that both sectors exploit. Because of this resource finiteness, despite a few remaining underexploited areas, one can expect these problems to worsen in the future unless steps are taken through management schemes to reduce areas of friction, and through rural development programs to develop alternative income sources for 'surplus' fishermen.

2. Inadequate Vessels and Gear

The majority of fishermen do not own vessels and many do not own fishing gear, but rather work as share or wage laborers on other vessels. Some are able to borrow or rent vessels. The productivity of fishermen who must depend either on others to take them out or upon primitive gear such as makeshift spear guns, single hook-and-line, or pots that can be operated without a vessel is bound to be low. The inadequacy of vessels and gear is certainly a major contributing factor to the low productivity of the individual fisherman. Because they see their boatowner companions with higher catches, most hope to have vessels and gear of their own at some point in the future, thus creating pressure for development programs with a technological bias.

However, because this factor is a problem of the individual, its solution conflicts with problems of traditional fishermen as a whole. As has been already hinted, and as will be developed further in a later section, what appears as a solution for the individual fisherman in terms of upgraded vessel and gear may paradoxically impede a solution for the fisheries as a whole.

The Southeast Asian Fisheries Development Center has recently compiled regional statistics that help us

Table 6. Number of vessels and fishermen in Southeast Asia in 1975-76. Number of fishing craft by type and tonnage from SEAFDEC (1978). Number of fishermen from Table 3, present paper.

Country, subarea	Year	Number of fishing craft by type and tonnage: Total	Non-powered boat	Outboard powered boat	Inboard powered boat: Total	Inboard powered boat: Less than 5 t	Inboard powered boat: More than 5 t	Number of fishermen	Ratio of fishermen to fishing craft
Brunei	1976	492	n.a.	490	2	–	–	360	
China (Taiwan)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	298,000	
Hong Kong	1976	5,474	409	0	5,065	n.a.	n.a.	45,000	8.2:1
Indonesia	1975	257,152	242,221	6,771	8,160	4,348	3,812	1,081,000	4.2:1
South Sumatra	1975	*20,382*	*19,496*	*407*	*479*	*155*	*324*		
South Java	1975	*4,064*	*3,568*	*334*	*162*	*0*	*162*		
Malacca Straits, Sumatra	1975	*18,432*	*14,626*	*580*	*3,226*	*1,907*	*1,319*		
East Sumatra	1975	*13,775*	*12,671*	*701*	*403*	*222*	*181*		
North Java	1975	*49,603*	*47,436*	*760*	*1,407*	*298*	*1,103*		
Bali, Nusa Tenggara	1975	*22,022*	*21,752*	*240*	*30*	*7*	*23*		
Kalimantan	1975	*18,479*	*14,867*	*1,459*	*2,153*	*1,727*	*426*		
Sulawesi	1975	*78,534*	*76,401*	*1,695*	*138*	*29*	*109*		
Molucca, Irian Jaya	1975	*32,161*	*31,404*	*595*	*162*	*3*	*159*		
Kampuchea	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	40,600	n.a.
Malaysia	1976	32,091	6,906	5,803	19,382	6,385	12,997	81,700	2.5:1
Pen. Malaysia[a]	1976	*22,630*	*4,149*	*2,342*	*16,139*	*(5,303)*	*(10,836)*		
Sabah	1976	*4,521*	*921*	*1,924*	*1,676*	*932*	*744*		
Sarawak	1976	*4,940*	*1,836*	*1,537*	*1,567*	*150*	*1,417*		
Philippines	1976	305,461	117,388	0	188,073	185,778	2,295	687,900	2.3:1
Luzon	1976	*119,864*	*60,721*	*0*	*59,593*	*57,890*	*1,703*		
Visayas	1976	*93,371*	*26,019*	*0*	*67,352*	*66,993*	*359*		
Mindanao	1976	*92,226*	*31,098*	*0*	*61,128*	*60,895*	*233*		
Singapore	1976	709	216	265	228	41	187	2,200	3.1:1
Thailand	1976	26,135	5,367	10,333	10,435	4,657	5,778	64,277	2.5:1
Gulf of Thailand	1976	*21,622*	*3,291*	*8,676*	*9,655*	*4,322*	*5,333*		
Indian Ocean	1976	*4,513*	*2,076*	*1,657*	*780*	*245*	*535*		
Vietnam	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	317,400	
Totals		627,514	372,507	23,662	231,345	201,209	25,069		
			(59.4%)	(3.8%)	(36.9%)				

Figures in italics are subtotals by country.
n.a.: not available

[a]The classification of boats by tonnage for Peninsular Malaysia as shown in parentheses refer to long tons.

view the problems of inadequate vessels and gear from the perspective of the traditional fisherman (SEAFDEC 1978) (Table 6). SEAFDEC's compilation of statistics shows 627,514 fishing craft in the region, approximately 60% of which are nonmotorized, but this percentage is biased due to the skewed distribution in one country of the region. With the exception of Indonesia which reports 94% of its fishing craft as nonmotorized, all other countries report that the majority of their fishing vessels are powered either by outboards or by inboards. However, over 95% of these fishing craft displace less than 5 t, meaning that the vast majority of fishing craft belong to traditional fishermen. To obtain a rough indication of the extent of motorization in the traditional fishing fleet, one can discount those vessels which are over 5 t, finding that 62% of the fishing craft are nonmotorized (97% in Indonesia).

Using estimations of numbers of fishermen in each country (from Table 3), one can then calculate a ratio of fishermen to fishing craft which ranges from 2.3:1 (Philippines) to 8.2:1 (Singapore). A high ratio of fishermen to fishing craft could result from two factors. On the one hand, as in Hong Kong (8.2:1), it reflects the industrialization of the fishing fleet with high labor re-

quirements per vessel. On the other hand, as in Indonesia (4.2:1), it reflects the large numbers of traditional fishermen with no fishing craft at all. It is difficult to separate the effects of these two factors, but this is not terribly important as the purpose in presenting these ratios is not to provide precise estimates, but rather to understand the pressures that originate from within fishing communities for provision of and motorization of fishing craft. These pressures are due to the fact that fishermen with no vessel, or with an unmotorized one, often see upgrading as the solution to their personal problem of low standard of living.

While this argument borders on the obvious, it is helpful in understanding the fisherman's point of view. Some catch and income figures collected during a recent survey in the Philippines (Herrin et al. 1978) demonstrate the inequalities that can exist in small communities due in major part to the differences in fishing vessels available to fishermen. As shown in Table 7, in the small town of Libertad, Misamis Oriental in Mindanao, there are significant differences, first between catch rates of owners/borrowers of motorized vessel on the one hand, and owners of nonmotorized vessels on the other; and second, between incomes of vessel owners and those of nonowners (both borrowers and laborers). What is interesting from these figures as pointed out by Herrin, et al. (1978) is that use of a motorized vessel, while it significantly increases catch, does not significantly increase income. A borrower of a vessel in Libertad pays up to 50% share of his catch to the owner of the vessel. Ownership of a vessel, however, even if of a nonmotorized craft, does increase net income. It is certainly understandable, therefore, that traditional fishermen with no vessel see ownership as the solution to their low standard of living. Indeed, slightly over 60% of the respondents in Herrin's sample cited lack of fishing vessels and gear as their major problem. Recent increases in fuel prices may somewhat reduce these inequities, particularly if diesel fuel rationing becomes necessary or if whole communities cannot obtain fuel. The pressures for motorization and ownership will remain, however.

3. Lack of Market Power

The preceding sections imply that because catches are low, income is also low. Certainly productivity has a major bearing on fishermen's earning power, but other factors are also involved. A second potential contributing factor to low incomes, besides low catch, is the price received from sale of the catch. It is commonly alleged that fishermen have little, if any, control over marketing outlets or over the prices that they receive. Low incomes, and seasonal fluctuations in addition, create a situation of potential dependence that influences both choices of credit sources and marketing decisions by the traditional fishermen. Similar to the farmer who must subsist from planting to harvest with no source of income, so, too, must the fisherman face extended periods of limited income.

To overcome this, the choice in both cases has been to rely on private sources for loans to tide the family over until income is restored. In the case of fishermen, the lending source, if not family or friend, is either the middleman or boatowners. When the middleman is chosen as the credit source, the marketing decision is preordained.

The full role of middlemen is only recently becoming understood. Middlemen who fulfill multiple roles of marketing, merchandising, and moneylending are assumed to commonly exist in rural areas (Abbott 1959; Aziz 1960; Sabri 1977). Wharton (1962) calls such middlemen triple-threat monopsonists. However, he points out that the double-threat dealer (marketer moneylender) is

Table 7. Catch and income by type of vessel ownership (Libertad, Philippines). Data are from Herrin et al. (1978).

	Annual catch (tons)			Annual household income (in pesos)[a]			
Location	Owners of motorized vessels	Borrowers of motorized vessels	Owners of nonmotorized vessels	Owners of motorized vessels	Borrowers of motorized vessels	Owners of nonmotorized vessels	Laborers
Barrios Gimaylan and Dulong, Libertad, Misamis Oriental	2.59	2.61	.99	5,956	3,304	4,954	3,046
Poblacion, Libertad, Misamis Oriental	2.87	2.53	n/a[b]	6,478	2,518	n/a[b]	2,143

[a]Net of fishing operating costs and depreciation on vessel, motor, and gear.
[b]There were no nonmotorized vessels in the Poblacion sample.

probably much more common. Although the issue retains its emotional nature, it has now become recognized that in addition to disadvantages, middlemen also provide services that are advantageous to fishermen and that the fishermen's market risks are reduced as a result.

In a preliminary survey conducted in a Thai fishing village in 1974, Ondarn (1977) found that only 28% of the fishing families were in debt. One might be tempted to conclude from this information that the financing role of middlemen is not too high. In contrast Lawson (1972) cites an example in Madras where 90% of fishing families were in debt and where the average debt was equivalent to a 4-mo income. Fewer than 40% of the loans, however, were for fishery related purposes. Undoubtedly there is also seasonal variation to indebtedness levels. Because loans or gifts are often provided by middlemen to fishermen for nonfishery purposes, middlemen play a very important role in maintaining fishing households in times of poorfishing. In Malaysia indebtedness among fishermen seems to be high, and ties of obligation to the "towkays" strong (Firth 1966). Permanency of the buyers has much to do with this. In the Philippines, for example, patron-client ties between those part-time fishermen who gather milkfish fry and their buyer-concessionaires were found to be quite weak due to the frequent turnover of concessionaires (Smith 1978). "Suki" buying marine catch from fishermen, however, often live in the same community as the fishermen, so relationships between fishermen's wives, who do much of the selling in the Philippines, and the middlemen are likely to be stronger.

Part of the difficulty in measuring the true extent of dependence on middlemen comes from a tendency to look at fishermen's indebtedness in only monetary terms. Dependency results from more than just formal, though private, indebtedness. Gifts from boatowners or middlemen in times of need are probably not considered debts per se, but reflect strong ties of mutual obligation, and thus dependency. In the Philippines fishermen have obligations of sale of catch to their "suki" who will often pay medical bills or school fees or help with the fisherman's subsistence in times of need (Librero et al. 1976; Jocano and Veloro 1976). The extent of the monetary value of these benefits has never been fully measured, however, and it is possible that beliefs in their high levels are overstated, at least in the Philippines.

Certainly there is variation in the role of middlemen from country to country, and variation in the degree of dependence of fishermen as a result. In most cases, however, the ties serve to provide security to the fishermen and a guaranteed source of supply to the middlemen. The underlying question remains, however. Do middlemen exploit fishermen? Because of the monopsony or oligopsony position (single buyer or few buyers) that many middlemen enjoy, are they able to manipulate prices to their advantage, at the expense of the fishermen? If so, what form of marketing institution should replace or compete with them?

To answer these questions, one must examine fisherman-middleman ties on a case-by-case basis, as sweeping generalizations of rapacious middlemen serve only to obscure the facts and to postpone in-depth analysis of the relationship. Moreover such generalizations lead governments to too easily believe that state control will be more efficient and more beneficial for producers. So that the potential problem is made clear, it is possible at this stage to provide some of the theoretical underpinnings of the monopsony position through the use of a simple economic model.

As Wharton (1962, p. 4-5) pointed out, one must distinguish between necessary and sufficient conditions to prove the existence of an exploitive monopsonist:

"As long as the monopsonist or oligopsony can maintain exclusive power as sole buyer and as long as the commodity, service, or factor exhibits marked price inelasticity of supply, there are sizeable monopsony gains to be reaped, . . . The greater the price inelasticity of supply (which in fact is the elasticity of the firm's average factor cost schedule) the greater the gap between the factor's marginal value product and the factor's average factor cost when marginal factor cost is equated with marginal value product."

Price elasticity of supply is a measure of the responsiveness of supply to changes in price. Assume a 10% increase in price. If the change in quantity supplied is more than 10%, supply is considered elastic; if the change in quantity supplied is less than 10%, supply is inelastic. For example referring to Figure 2, the portion of the supply curve (S) that is below but close to the MSY point is more inelastic than that portion of the same supply curve in the lower lefthand corner of the graph.

Figure 2 depicts the monopsonist facing a perfectly competitive market for his product. The demand curve (D), that he faces is horizontal because it is assumed that he has little, if any, influence over the price at which he will sell his fish. D is also his average value product (AVP) curve and marginal value product (MVP) curve. While undoubtedly more realistic, assuming an imperfect sellers market in which the monopsonist does have some control over his selling price and hence a downward sloping demand curve does not alter this basic analysis of the monopsony position. The monopsonist faces a fish supply (S) curve that is, on the one hand, assumed to be

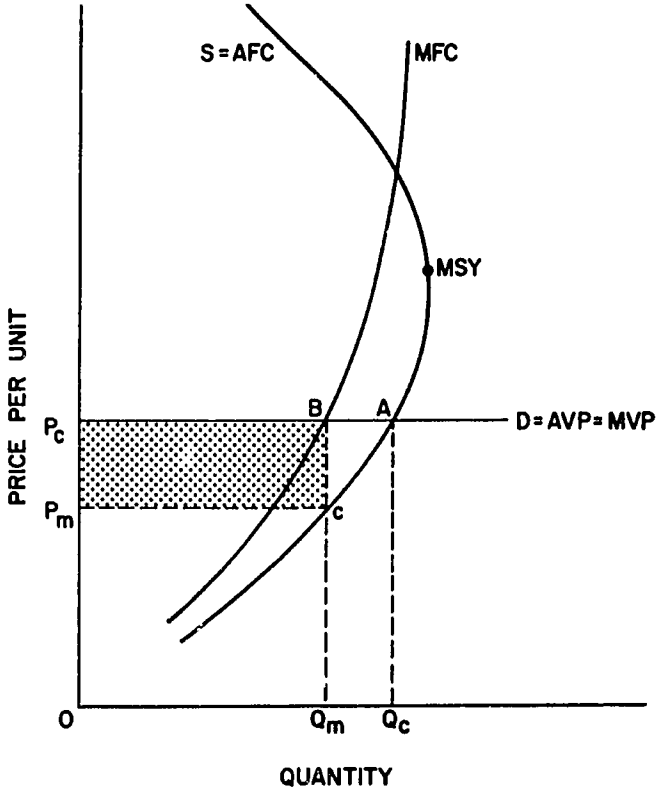

Fig. 2. Theoretical model of monopsonist in factor market facing perfect competition in product market: the fishery case.

upward sloping (implying that fishermen will intensify their efforts and thus attempt to supply more fish to take advantage of higher prices) and on the other hand, that is also equal to the average factor cost (AFC) curve. The model is derived from the 'traditional' model (Gordon 1954; Christy and Scott 1965), except that price is a proxy for numbers of fishermen or fishing effort. This particular model assumes that the fishery is operating in that portion of the long-run supply curve that slopes upward to the right, that is, below the point of maximum sustainable yield (MSY). At catch levels above MSY, the supply curve would bend backwards, implying that the higher prices, while inducing increased effort, yield a lower catch because of the biological limits of the resource (Copes 1970 and Appendix).

The supply curve indicates cost per unit as a function of output and shows the quantities of fish that would be offered for sale by fishermen at each price level, or alternatively, the amount of fish that can be purchased by the middleman monopsonist at each price level. A marginal factor cost (MFC) curve which shows the added or marginal cost per unit increase in output is therefore also upward sloping, can be derived from the supply (AFC) curve. Under perfect competition, equilibrium would result at Point A, the intersection of supply and demand where AFC = AVP, with a price of P_c and quantity purchased of Q_c. This point A is analogous to the point where total costs equal total revenue in the traditional fisheries model (Gordon 1954; Crutchfield and Zellner 1962). The monopsonist, however, would equate MFC = MVP, the marginal factor cost to the marginal value product rather than AFC = AVP. Purchases would be restricted to Q_m and a lower price of P_m would be paid to suppliers. The monopsonist would be willing to pay a price as high as P_c to secure the desired quantity, Q_m, but because he controls the price paid to fishermen, only needs to pay a price of P_m. The shaded rectangle $P_m BP_c$ would thus represent potential monopsony gains.

The model at hand can become quickly complex if it is extended to deal with downward-sloping and shifting demand curves and issues of fisheries management that arise from divergence of private and social costs and revenues (Copes 1972). The simpler version above is offered only to demonstrate the necessary condition for monopsony gains, that is, inelasticity of supply.

A monopsony position could be created and maintained by any one or more of the following power factors that would provide sufficient conditions (Wharton 1962):

1. Legal power such as license or exclusive right.
2. Illegal power such as force or threats.
3. Economic power such as control of complementary inputs used by sellers, or through extension of credit or cash advances to sellers, or control over transport, or where the volume of transaction is too low to support additional buyers.
4. Technical or natural power that results from either physical isolation or from declining average costs over the relevant range of quantity produced. (This is the counterpart of utilities on the monopoly side.)
5. Cultural power which results from social structures and relationships that prevent transfer of business by the seller.
6. Psychological power resulting from propagandizing or brainwashing that reinforce habitual behavior.
7. Informational or educational power that results from poor knowledge of the price and sale alternatives on the part of sellers.

In traditional fishing communities, combinations of 3) economic, 5) cultural, and 7) informational power factors appear in varying degrees implying satisfaction of the sufficient conditions for the existence of monopsony exploitation of fishermen by middlemen. However a major caveat is that costs of operation of the middleman must be correctly identified before one concludes that these conditions warrant interference. For instance one may find net returns to middlemen exceeding 30%. Since this includes returns to management skill and to risk, these factor costs must be specified before one can conclude that 30% represents "too high" a rate of return. A more balanced perspective can be obtained by comparing

this rate of return to other alternatives in the rural sector.

Fisherman/middleman trading relationships are not in all cases static. Many factors will work to change them over time, including the following identified by Lawson (1972):

1. Grouping and concentration of the presently highly dispersed traditional fisheries.

2. Mobility of labor, capital, and entrepreneurial resources, particularly of intermediaries who perform varied and multipurpose functions. Specialization can be expected as industry integration occurs.

3. The growing capital requirements of the sector which lead to involvement of investors from other nonfishery sectors.

4. The level of economic growth, increases in which may provide alternative employment to fishermen and improve communications and roads to remote areas.

5. Institutional developments including fish marketing organizations, cooperative societies, state of fishing corporations, numerous types of loan schemes to fishermen and boatowners, and provision of improved market information services.

The dynamic nature of the relationships presents particular challenges for research which could helpfully document these changes and examine the reasons for and the potential for flexibility in the fisherman/middleman ties.

To further understand the economic function of the middleman, it is helpful to distinguish between technical and price efficiency in the distribution of catch. "Marketing efficiency is usually subdivided into two different categories–operational (technological) efficiency and pricing (economic) efficiency. Operational efficiency assumes the essential nature of outputs of goods and services remains unchanged and focuses on reducing the costs of inputs doing the job . . . Pricing efficiency is concerned with improving the operation of the buying, selling, and pricing aspects of the marketing process so that it will remain responsive to consumer direction . . . Pricing efficiency, then, is a result of the nature of competition and balance of economic power that exists within the marketing process." (Kohls 1972, p. 11). Studies on the pricing efficiency of fish marketing systems are few and far between.

Instances where middlemen are able to achieve some degree of monopsony power and thus large profit margins are examples of price inefficiencies in distribution. That is, market forces are unable to bring the price differentials between producers' price received and consumers' price paid into line with the cost of the services provided by middlemen.

Technical inefficiencies, on the other hand, result primarily from waste in the distribution system. It has been estimated that up to 40% of catch of fishermen never reaches the consumer due to spoilage caused by bacteria, fungi, and enzymes resulting from poor handling practices (Craib and Ketler 1978). Waste in the traditional fisheries sector in the tropics is caused primarily by a lack of chilling facilities, which, although perhaps not seen as such from the perspective of the traditional fisherman, is one of the major problems facing the sector. Reduction in waste, and hence improvements in quality, offers one potential way to increase the price that the fisherman receives for his catch.

The necessity for objectively evaluating all benefits derived by fishermen from the middlemen has been stressed in recent literature, mainly to explain the failure of cooperative and credit programs that sought to obviate the dependency on middlemen (FAO 1975; Lawson 1972, 1977; Emmerson 1978; Elliston 1976). The same cautionary flag could be raised with regard to state-run marketing organizations and their likely impact. As observed by Lawson (1975), traditional fishermen are preoccupied with survival. Despite their theoretical appeal, cooperatives have generally been unable to provide the security that the fisherman receives from a flexible and mutually beneficial tie with his financier/marketer. Although details of this arrangement are available for Sri Lanka (Alexander 1975) and for Malaysia (Firth 1966), very little is known for the Southeast Asian and Southwest Pacific regions as a whole.

While the above discussion may sound equivocating as far as the problem of exploitation is concerned, the point remains that though perhaps not exploited, traditional fishermen are poor; middlemen, on the other hand, generally are not. Researchers, and economists in particular, must be careful not to be apologists for the status quo. Again, bearing in mind that this is a discussion of problems from the perspective of the traditional fishermen, the lack of market power and freedom of choice inherent in dependence on middlemen and the income inequalities that result between producers and those that distribute the catch argue for the development of ways to increase the return received by producers. Integration by fishermen forward in the marketing chain, once they have the requisite skills to handle their own books and business arrangements, may be one of these. This assumes, of course, that economies of scale can be achieved by fishermen's groups as they are presently achieved by middlemen.

4. Inflation

The factors contributing to low standards of living that have so far been discussed center on the fisheries production or distribution sectors. There is one other

important factor that should be mentioned briefly before moving on to a discussion of solutions to the problems raised. This factor is inflation, which affects rural communities as a whole and not only fishermen.

The Asian Development Bank (1978) has calculated that there has been a general decline in real wages in Southeast Asia within the past decade, due in great measure to the rapid inflation during 1972-1974. While measuring effects of this inflation on traditional fishing communities would entail considerable research and collection of data not presently available, the following few paragraphs are offered as a probable scenario for what has occurred within the past decade.

Data from the Philippines will be presented as suggestive of the situation in Southeast Asian region as a whole. Using price indices available through the Central Bank of the Philippines, it is possible to show the changes in retail prices for selected items since 1970. Referring to Figure 3, the price changes for the following commodities or composite groups are shown: food, clothing, fuel, fish, and all items. Price indices for food, clothing, and all items are for all income households in areas outside Metro Manila. These indices reflect prices in the major urban market areas in the 12 regions of the Philippines. Indices for fuel and fish are for Metro Manila retail prices. Although the increases for these items have been roughly comparable since 1972, fish price increases have been somewhat lower than increases in prices of clothing and fuel.

What are the implications of these rates of increase for the traditional fishermen in the Philippines? One must bear in mind that only a small fraction of these fishermen are in the Manila area for which fuel and fish price data are available. Their catch, if it is widely distributed at all, has to be transported to the major markets including Manila. Consumer goods, including food and clothing, and fishing inputs such as fuel must on the whole be distributed from major market centers to the more isolated fishing communities. What this implies is that the price the fisherman receives for his catch has probably not risen as fast as the Manila fish retail price index, and that the rural price index for fuel and other consumer goods which he must buy has probably risen faster than those for Manila and other major market centers outside Manila. Fishermen would be particularly susceptible to fuel price increases. In economic terms, the terms of trade for fish may have worsened. The result, not proveable without considerably more information of course, is that in all likelihood in the rural areas the rise in price of fish has not kept up with the rise in prices of fuel, food, and clothing, thus combining with lower catches to make the traditional fisherman worse off now than a decade ago. The fact that only 20% of the traditional fishermen interviewed in recent surveys in the Philippines believe their living conditions have improved in the past 5 yr would tend to confirm the above observations.

It is possible that in the future the terms of trade for fish may improve as natural limits to the expansion of wild stocks are reached and as demand increases due to population growth. As will be shown in a later discussion, demand increases can contribute to overfishing, so in reality it is the factors of price increases and reduced productivity per fisherman that combine to worsen the fisherman's position.

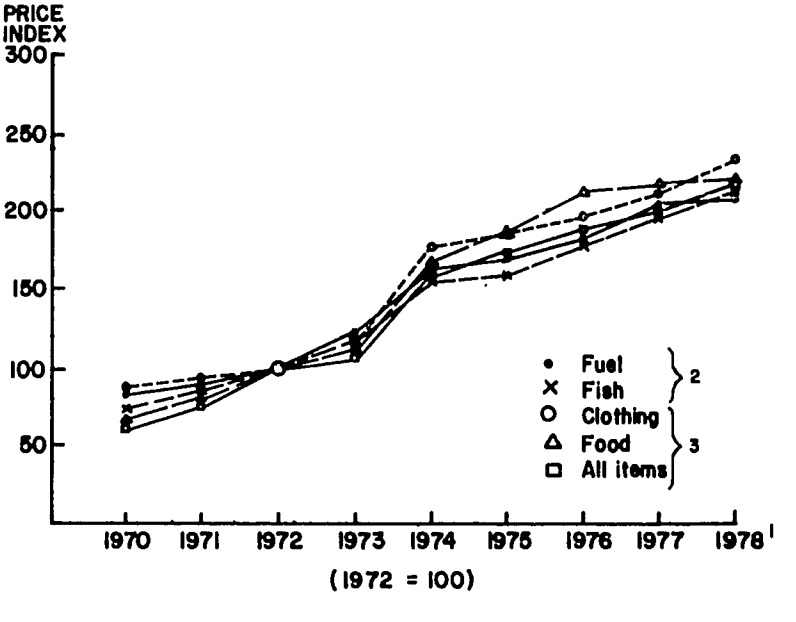

Fig. 3. Consumer prices for fish, fuel, food, and clothing (Philippines) 1970-1978.
Source: Central Bank of the Philippines.

[1]Through October 1978.

[2]For fuel and fish, index is for Metropolitan Manila retail prices.

[3]For food, clothing, and all items, 1972-1978, index is consumer price index for all income households in areas outside Metro Manila. For 1970-1971, index is Metropolitan Manila price index of the respective commodity chiefly of domestic origin (not using imported inputs) which is thought to be more representative of consumer goods available in rural areas.

SUMMARY OF EMPIRICAL PROBLEMS

The foregoing discussion has developed a view of factors contributing to low standards of living from the perspective of fishermen themselves. As such it has concentrated on low productivity, inadequate vessels and gear, lack of alternative income sources, lack of market power, and inflation. These concrete day-to-day concerns of traditional fishermen have been classified as empirical problems. While the first two are related directly to the 'open-access' resources traditional fishermen exploit, the last three are problems characteristic of the rural sector as a whole, rather than confined to the fisheries sector per se. The marketing and distribution of fishery products in the tropics present particular problems due to the extreme perishability of the product that distinguishes it from other major rural marketing systems that deal with storable commodities. Aside from occasional processing through drying, salting, smoking or fish paste or sauce fermentation, the traditional fisherman, or more accurately the female members of his family, are unlikely to be involved in marketing catch other than their own. Except for spoilage that occurs before first sale, the later wastage occurring in the distribution of the catch to the final consumers is beyond the control of fishermen and not viewed as an empirical problem of traditional fishermen per se. However, reduction in waste, particularly through proper use of ice and/or freezing facilities, may be an avenue for increasing the price received by traditional fishermen for their catch, or alternatively may present opportunities for intermediate processing technology that permits the fishermen to take over some of those functions previously performed by middlemen and thus vertically integrating the fisherman in the marketing chain.

Because the resource is limited and therefore can support only a limited number of fishermen, the search for solutions to the empirical problems of traditional fishermen must take an holistic approach that considers a resource/fisherman/distribution continuum existing within the context of a larger rural sector with attendant social, political, and economic institutions. Implied is the necessity for viewing the fish production sector, on the one hand, as vertically integrated with factor (input) markets and with product markets, and on the other hand, as horizontally integrated with other nonfishing sectors and institutions within the rural area.

While retaining a clear view of the empirical problems of traditional fishermen, it is possible to broaden the perspective of the sector as a whole by discussing first, the attempts in the past two decades to solve these empirical problems; second, a theoretical framework for predicting the likely effects of development programs; and third, the suppositional problems that have been uncovered in the process. Suppositional problems, it will be recalled, are related to the often inflexible, tacit, and unwarranted assumptions that are made by those seeking solutions to empirical problems. They include on the one hand, assumptions about traditional fishermen and their behavior, particularly in regard to their homogeneity, irrationality, and immobility, and on the other hand, assumptions regarding resource availability and the likely effects of development projects and programs. A broadening of these perspectives is the purpose of the following section.

Solutions to Low Standards of Living of Traditional Fishermen

THE ALTERNATIVES

It is apparent that solutions to these extremely complex problems of traditional fishermen will not be easily defined and applied. Indeed, the history of past development efforts has been one of frustration and failure, with only limited successes. Early in this paper, a schematic was presented (Figure 1) that showed the major empirical factors contributing to the low standard of living of traditional fishermen. The low living standard has been defined primarily, if not exclusively, in terms of household income. The lower half of that same figure indicates hypothetical ways in which income can be raised. On the one hand, fishery-centered solutions can be sought that (1) increase catch; (2) increase prices received for the catch; or (3) lower the costs of fishing. On the other hand, solutions can be sought outside the present traditional capture fisheries through (4) creation of alternative employment opportunities in aquaculture or in other nonfish related activities. Such employment opportunities could be for the fisherman himself or for other members of his household.

To achieve these specific objectives, four possible methods can be considered for the sake of discussion: (1) vessel and gear upgrading; (2) restricting effort or subsidizing the fishing industry; (3) improving marketing and postharvest technology; and (4) rural development. One of the purposes of this section is to examine which of these, if any, has potential for alleviating fishing community poverty.

The purpose of upgrading vessels and gear would be primarily to increase the catch or productivity of the fishermen. To the extent that the new vessels and gear are designed to tap new, more valuable stocks, this method could also increase the price that the fisherman receives for his catch. There are major problems with vessel and gear upgrading as shall be shown; results are often quite the opposite of what is intended.

An alternative method to increase productivity is to restrict fishing effort by limiting the number of fishermen; of course, this method eliminates income entirely for those fishermen who are displaced and is thus not socially or politically acceptable in most, if not all, Southeast Asian countries. Limitations on entry also involve the government in the marketplace, as would government subsidies to the industry to either raise prices received for catch or to lower the costs of fishing inputs. Examples of such subsidies would include subsidized fuel costs or even credit programs that make capital available at less than the market rate. It should also be pointed out that management prescriptions should vary depending on the type of biological overfishing that is taking place. Growth overfishing, for example, may require enforcement of minimum mesh sizes, while recruitment overfishing will require a more direct approach to reducing fishing effort, such as reductions in numbers of fishermen.

Improvements in marketing and postharvest technology aimed at reducing price or technical inefficiencies in the distribution and processing of traditional fisheries catch would be aimed primarily at reduction in waste or at provision of marketing infrastructures, such as transport, ice and cold storage, or landing areas. The rationale for programs in this category is that increases in price and technical efficiency will result in higher prices being received by the fishermen.

Rural development is a multifaceted method of raising the standard of living in rural areas. It is much more than simply the provision of physical infrastructure, although this is an integral part, because it involves the development or adaptation of rural institutions to changing society. As such it covers among other activities the formation of cooperatives or other fishermen's groupings that are designed to raise the market power of their members to either increase prices received or to lower costs. It also includes programs to develop alternative sources of income for rural households, thus raising the opportunity wage of fishermen. Underlying many, though certainly not all, rural development programs is an attempt to involve rural communities themselves in project identification and thus avoid centralized planning from the top down.

A review of the general direction of past development programs will provide a backdrop against which these alternative methods can be evaluated. In the process the changing view of constraints to development will be documented and some remaining suppositional problems identified.

POTENTIAL CONSTRAINTS TO DEVELOPMENT

Potential constraints to raising the living standards of small-scale fishermen can be broadly grouped into three categories: biological, technological, and socioeconomic. Biological constraints are the obvious ones of stock limitations and the resultant overfishing that can occur. These have been long recognized as major potential constraints to fisheries development and no detailed discussion of the theory is necessary here.

In a theoretical sense technological constraints would be based on the inability to design the improved gear, vessels, motors, or supporting infrastructure such as boat yards, roads, ice and cold storage facilities, or processing equipment that would be necessary to develop the fishery. The more important aspect for traditional fisheries is that production and processing technology may not be available in the appropriate form or scale.

Potential socioeconomic constraints involve fishermen themselves and those formal and informal institutions, private and governmental, that influence production and distribution. For example fishermen may be reluctant to adopt improved technology. As will be shown later, there may be perfectly rational reasons for this reluctance, but it is at least hypothetically possible that fishermen would be resistant to change per se. Community social and economic organizations can also be expected to resist disruptive change. Government extension personnel could be overworked and underpaid, unwilling to serve in rural areas, or have close ties with the business sector—all factors which make it difficult for the traditional fishermen to benefit from government services. Credit may not be available without collateral, an almost impossible criterion for most traditional fishermen, or if available, may be unwisely administered. Market infrastructure may not be developed enough to handle increased production. Development projects themselves may hinder further attempts due to unexpected social costs. Finally, in some countries (e.g., Pakistan) market demand may not be sufficient to support a greatly expanded fishery without successful efforts to change consumer tastes (B. Lockwood, pers. comm.). Underlying all three areas is a general lack of data which can be used for intelligent planning and policy formulation.

Prior to the 1970s it was widely believed that the

key to uplifting the living conditions of traditional fishermen in an expeditious way could be found in improved vessel and gear technology. Development projects of the 1950s and 1960s reflected this emphasis through their concentration on more efficient techniques, almost to the exclusion of other, nontechnical, considerations (Sainsbury 1977). Failures of communities to adopt the techniques made available were attributed to shortcomings in the fishermen themselves. As difficulties with this approach grew, despite some limited localized successes (e.g., outboard motors in Ghana), it became apparent that technological change could not, to borrow a phrase from Alexander's (1975) study of Sri Lanka fisheries, take place in a cultural vacuum. Neither, might one add, can it take place in a biological vacuum.

The effects of modernization on numbers of fishermen required can be dramatic. Off the north coast of Java in 1974, "a motorized boat using traditional gear and employing 22 crew members caught the same amount of fish as 41 sailboats employing 287 people" (Collier et al. 1977).

In fact, the emphasis on technology was seriously questioned as early as the mid-1960s (Hamlisch 1967, p. 33). In a wide-ranging paper, Hamlisch attacked the thesis that the "biggest obstacle (to increasing production) is human ignorance and slowness of dissemination of technical knowledge." Some of his more salient points bear repeating here. Hamlisch emphasized the role of market forces in spurring development of fisheries and cited Peru and South Africa as examples, both of which successfully entered the expanding fishmeal market. Development in other sectors of a country's economy can also benefit or adversely affect the fisheries sector, as in the cases of the Congo and Mauritania when mining activities stimulated fisheries development to meet the new demand of workers, or as in the case of Oregon (U.S.) when the higher wages and more stable income derived from tourism attracted sufficient workers from the fishery so as to destroy the coastal fishery. The opportunity wage available from tourism meant that the fishery could no longer compete for labor.

Hamlisch cites earlier attempts to classify factors influencing development that distinguished between "natural" and "human" influences (Netherlands Economic Institute 1958; Traung 1960; Morgan 1956). "Natural" influences would include those earlier classified as biological; "human" would include technological and socioeconomic factors. Since "natural" influences are not dealt with in Hamlisch's paper, the "human" influences that he discussed at length are summarized in Table 8 under the sociological, cultural, psychological, economic, and institutional headings that he identified. Sociological factors were identified as those that influence produc-

Table 8. "Human" input factors influencing development of fisheries, summarized from Hamlisch (1967).

A. Sociological factors influencing production
   1. Availability of labor
   2. Future recruitment prospects
   3. Attitude toward work
   4. Labor productivity
   5. Social discrimination: inferiority of fishing and fishermen

B. Cultural and Psychological factors influencing producer attitudes
   1. Goal direction and reaction to stimuli
   2. Desire for material possessions and economic independence
   3. Fatalism
   4. Reluctance to make long-term investments or accumulate capital
   5. Lack of deferred gratification
   6. Religion and traditional authority
   7. Working conditions
      a) hard and fatiguing work
      b) no regular hours of work
      c) no family life
      d) limited opportunity to participate in community or political life
      e) irregular and uncertain earnings
      f) restricted mobility
      g) lack of safety
   8. Basic conservatism
   9. Fishing boat doubling as home of the family (e.g., Hong Kong)
   10. Prestige factors influencing vessel design
   11. Desire for quick turnover of investment

C. Economic considerations influencing entrepreneurial decisions
   1. Degree of control over prices of inputs and outputs
   2. Vertical integration
   3. Level of entrepreneurial skill; ability to adjust input ratios and assess markets
   4. Cost-benefit analysis, including capitalization of expected operating costs
   5. Availability of materials and facilities for manufacture of boats
   6. Import duties on new technology: engines and gear
   7. Fuel costs
   8. Bank and private market interest rates
   9. Financing opportunities
   10. Risk

D. Institutional factors
   1. Dependence upon middlemen (threefold role of supplier/marketer/financer)
   2. Middlemen's attitudes toward risk and financing for long-term development
   3. Share-catch vs. hourly wage: effects on incentives
   4. Cooperative possibilities
      a) roots of cooperative endeavor
      b) lack of apparent immediate economic benefits
      c) aids channeling of investment
   5. Role of government: direct legislative intervention
      encourage private initiative
      discourage private initiative

tion; cultural and psychological factors as those which influence producer attitudes; and economic factors as those which influence entrepreneurial or management decisions. Underlying these factors are institutional considerations which include the producers' relationship with middlemen, the method of sharing the catch value, middlemen's economic considerations, and the role of formal institutions such as cooperatives and government.

While one might argue over how Hamlisch chose to categorize certain factors (e.g., is 'attitude toward work' a social or psychological influence?), I do not propose to discuss each of these categories in detail beyond making a necessary comment regarding the elements identified by Hamlisch under cultural factors. Several of these points, particularly those of fatalism and lack of deferred gratification, are common observations made by others at roughly the same time, notably Rogers (1969), regarding the characteristics of peasantry subculture in general. Rogers' work became most controversial (as did Hamlisch's though for different reasons) and his assertions have since been widely disputed by those citing farmers' willingness to adopt new technologies (e.g., Castillo 1975). The important point for the moment is not the disagreement itself which will be commented on later, but rather the inclusion of attitudes of producers and middlemen into the mix of potential constraints. Appreciation of these attitudes is crucial to an understanding of the problems and potential of fisheries development.

A second point raised by Hamlisch is also worth emphasis. Related to the role of government in fisheries he states:

"While government policies are seldom as well defined as to allow a clear identification of . . . aims, and while several aims may be pursued simultaneously, an industry may seriously delude itself if it expects public issues resolved solely in terms of its parochial interests . . . economic progress will lead to a transfer of resources from primary industry to other sectors. This may have as consequences the lowering of total fishing income as well as a redistribution of that income within the industry, and eventually the exit of marginal producers. Governments may decide to accelerate rather than retard this process, while simultaneously trying to alleviate the attendant hardship.

Welfare considerations make it mandatory to bring policies for economic progress in line with capacity of other sectors to absorb marginal elements. The pleas of an industry that is destined to decline within the natural course of economic evolution, on the other hand, should not, in the national interest, always be answered with increased financial support" (p. 43).

Hamlisch thus brought a broad social perspective to the forefront, a perspective that appears to have been ignored in more recent years as huge sums have been 'invested' in projects to increase fishermen's productivity. Governments may choose, among other alternatives for development of traditional fisheries, to encourage marginal fishermen to depart from the fisheries and engage in alternative income-generating activities. This argument was later repeated by Proude (1973), among others, who argued that "in cases where there is little or no prospect that small-scale fisheries can be developed to the point of competing effectively without requiring protection of a kind that seriously distorts factor allocation, adjustment policies must not seek to prevent a natural withering away" (p. 2191). The importance of this point will be more readily apparent after an examination of the theoretical underpinnings of change in the traditional fisheries sector.

Alternative activities may be in midwater or deepwater commercial fisheries for a select few where underexploited or untapped resources might exist, in aquaculture, or in nonfishery sectors entirely. The rationale for such alternatives derives from the conflict between goals of maximizing employment on the one hand and net economic returns on the other. As pointed out by Christy (1973), once a fishery is fully utilized as most coastal fisheries are, increases in net revenue can result only from cost reductions, implying reduced numbers of fishermen.

This should not be taken to imply encouragement to all small-scale fishermen to leave the fishery; such a suggestion would be both naive and ludicrous. As pointed out by Cole and Anand (1975), even in countries with highly developed commercial fisheries such as Japan and some European countries, the majority of fishermen still operate from relatively small vessels catching fish of occasional high value or species such as bivalves not capable of being caught from larger vessels. In fact, there are examples where a highly capitalized fishery is reverting back to one with smaller boats, as in the case of the British Isles where large freezer trawlers are being sold or scrapped in favor of relatively tiny bottom seiners and pair trawlers, with a corresponding increase in the total number of fishermen employed (D. B. Thomson, pers. comm.).

The important point being made, however, is that ways have to be found to evaluate all development alternatives, including those of reducing the numbers of fishermen or the level of fishing effort. These are not necessarily the same thing as it may be possible to encourage full-time fishermen to become part-time fishermen, thus reducing fishing effort but not the number of fishermen.

It is helpful at this point to examine the theoretical

basis for these concerns that reflect the underlying 'open-access' nature of the resource and the lack of restrictions on fishing effort. Christy and Scott (1965) used the 'traditional model' to show the effects of technological change and of increased price on sustainable yield and on revenue curves (Figures 4 and 5). The 'traditional' model can also be used to demonstrate the effects of cost changes (Figure 6). The Christy and Scott analysis was based on several restricting assumptions, namely:

1. The fishery is already exploited at that point where total costs equal total revenue; that is, the resource is economically overfished (their diagrams also tacitly assume biological overfishing);
2. Changes in output have no effect on prices;
3. Uniform operating costs and no fixed costs;
4. No variation in length of fishing season; and
5. Freedom of entry and exit.

Because an increase in price received by fishermen has been cited as one means by which standards of living can be raised, we need to relax the second assumption, while retaining the other four. Therefore, rather than using the 'traditional' model, a theoretical model that allows for price changes is required. The resulting scenario is essentially the same as that predicted by Christy and Scott but adds the price dimension and thus makes elasticity of demand a crucial determinant of the resulting changes in total revenue. The model which helps to analyze these changes is a variation on that presented in Figure 2, which demonstrated the monopsony position, and represents the framework developed by Copes (1970, 1972) in his analysis of factor rents and resource management. The effects of changes in technology, input cost, and prices of catch are shown in Figures 7 and 8, which can then be compared to those of the 'traditional' model. For the sake of the present argument, it will be assumed that the demand curve (D) intercepts the supply curve (S) at a point above (beyond) MSY. For those interested, the Appendix which is taken from Copes (1970) shows the relationship between the 'traditional' model and the model which includes the price dimension.

Examining first the effects of a change in technology which we will assume to be labor-saving to some degree, one finds a shift in the supply curve from S to S′, a reduction in quantity, and an increase in price. How do these effects come about? Referring first to Figure 4, and assuming that equilibrium has been reached where total costs equal total revenue, the introduction of the new technology will first increase the level of fishing effort so that total costs exceed total revenues, implying that the same quantity can be supplied with less effort. According to the 'traditional' model, marginal producers will then be driven out of the industry, the sustainable

THE 'TRADITIONAL MODEL'

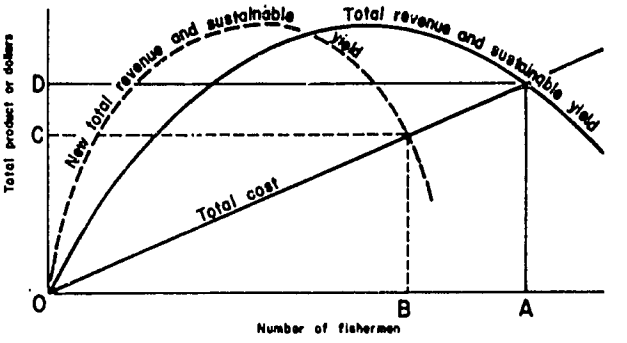

Fig. 4. Effect of technological innovation on yield and revenue curves. Source: Christy and Scott (1965).

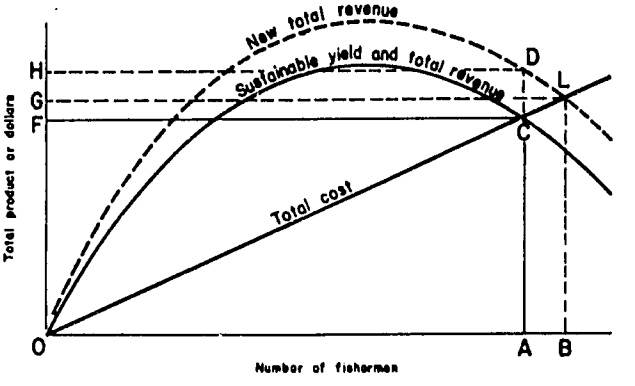

Fig. 5. Effect of increased prices on yield and revenue curves. Source: Christy and Scott (1965).

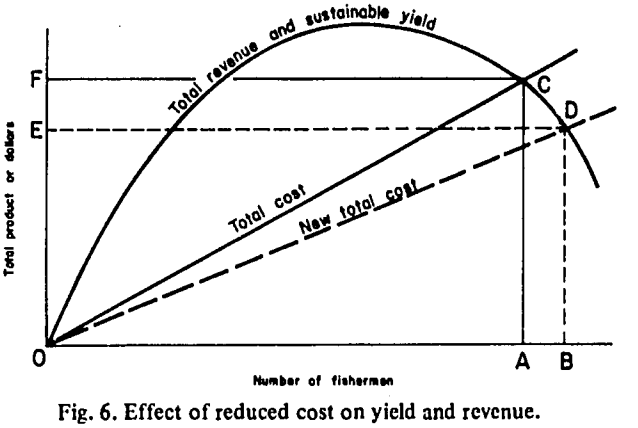

Fig. 6. Effect of reduced cost on yield and revenue.

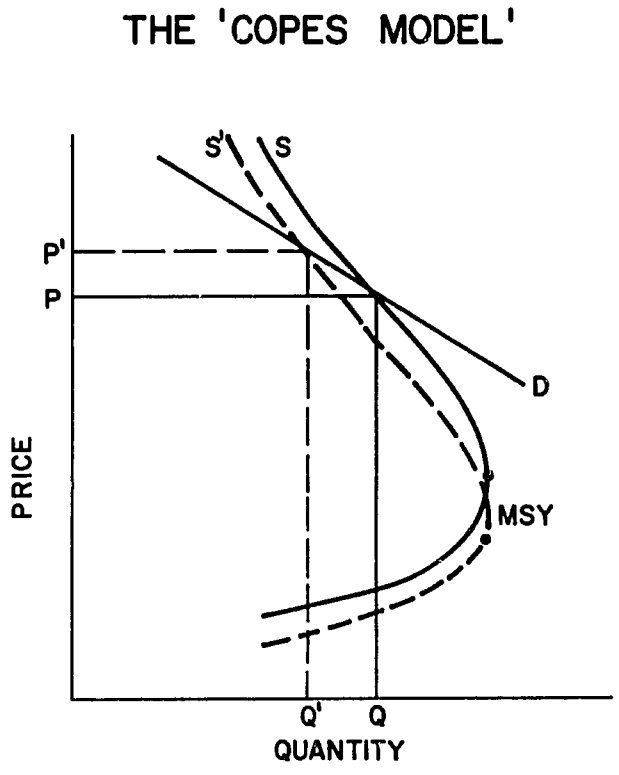

Fig. 7. Effects of a change in technology or a change in input cost on quantity and price.

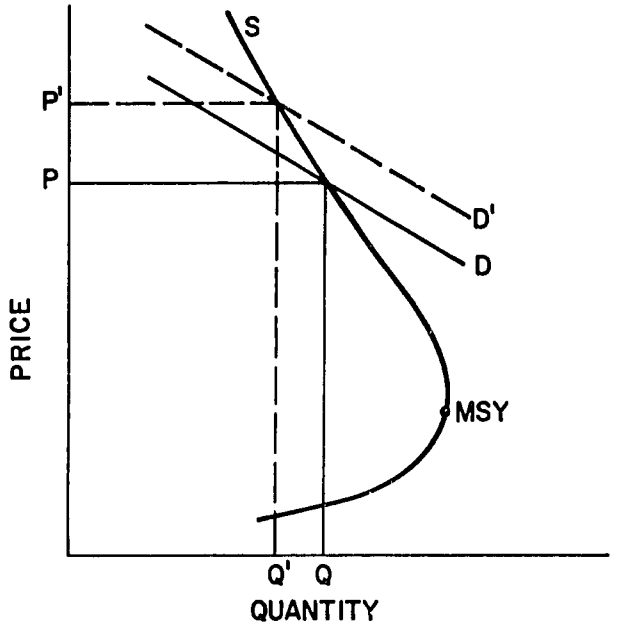

Fig. 8. Effects of an upward shift in demand on quantity and price.

yield will be reduced, and total revenue will decline. Regarding effects on employment, the 'traditional' model as developed by Christy and Scott must be interpreted with caution, because it measures number of fishermen rather than fishing effort along the horizontal axis.

In the Copes model (Figure 7) whether or not total revenue declines depends upon the elasticity (or slope) of the supply and demand curves. It is possible, with a highly inelastic demand curve, that total revenue would increase rather than decrease. It is also likely, unless the demand curve is totally elastic (horizontal), that the number of fishermen could actually increase. Without knowledge of the elasticities, the effects of a technological advance on total revenue and employment are thus indeterminate. However, "there is a *prima facie* case to be made in Figure 7 that a shift (in the supply curve) from S to S' would mean an increase in the number of equivalent units of fishing effort, because the intersection with the demand curve is higher on the S' curve than on the S curve. The number of units of fishing effort is not shown directly in Figure 7, but it increases monotonically as one moves upwards on the S and S' curves" (Copes, pers. comm.). Whether the increase in units of fishing effort will result in increased numbers of fishermen depends on the degree to which the new technology is labor-saving.

Despite these different conclusions regarding effects of technological change on revenue and employment of fishermen, both models predict that more overfishing would result. While productivity and income may increase initially for those with access to the improved technology, there would be an eventual decline in both productivity and hence income for the majority of fishermen. It is important to remember that the purpose of this discussion is to elucidate means of improving fishermen's incomes. Vessel and gear upgrading thus does not appear to be one of them.

A reduction in input cost, such as might occur from a fuel subsidy or from the design of cheaper vessels that retain the same catching capacity, will also result in increased fishing effort. The downward shift in the total cost curve is shown for the traditional model in Figure 6, and the shift in the supply curve which is caused by the reduced average cost per unit of output is shown for the Copes model in Figure 7. The reduced average cost, and the higher profits achieved as a result, attract additional fishermen until a new equilibrium is reached where total costs equal total revenue. As resulted from a technological advance, the result of an input cost reduction is also increased overfishing, a lower sustainable yield, and a higher price. Total revenue may be higher or lower depending upon the elasticities of supply and demand. The difference between technological change and cost reduc-

tions is that in the former the overfishing results from the use of more productive vessels and gear, while in the latter the overfishing results from increased numbers of fishermen using the original or perhaps cheaper vessels and gear with the same catching capacity.

Finally the models can be helpful in depicting the effects of price increases, such as might be secured by a cooperative with increased bargaining power, by technology that reduces spoilage after catch, or as a result of an upward shift in demand. The increased prices produce increased profits which in turn attract more fishermen, thus increasing total costs until a new equilibrium is reached where total costs again equal total revenue (Figure 5). Again the 'traditional' model is somewhat confusing because though the total revenue curve has shifted upward, the sustainable yield curve has not. As shown in Figure 8, the 'Copes' model clearly shows the shift in demand which results in increased overfishing and hence reduced quantity produced. There will be no benefits to the fishermen in the long run. Of course, reductions in waste that increase quantity and quality of fish available will produce benefits for consumers.

It is recognized that these three scenarios are abstract models of reality where fishing costs are not uniform, where there is variation in the length of the fishing season, and where fishermen are not always free to enter and leave the industry. Despite these simplifying assumptions that have permitted some degree of abstraction, the implications seem very clear. Once a traditional fishery is overexploited, the only solution with any long-range outlook is one that reduces fishing effort, either through limitations on entry or harvesting power or through sufficient incentives in alternate activities. Given the thought (and costs) of trying to manage 3.5 million traditional fishermen, planners would be excused if they opted for the latter!

A major question that must be addressed and answered, therefore, before development planning for the traditional fisheries can achieve any degree of sophistication is whether or not the exploited resources are biologically overfished. If the MSY has not yet been reached (and TC intersects TR beyond MSY), development approaches that increase fishing effort can achieve some short-term success. Once the MSY has been surpassed, overfishing will continue even without the prodding provided by development projects.

As observed by Sainsbury (1977) development programs in the 1960s continued to be based upon upgrading of production technology despite Hamlisch's appeal for broadening the scope of alternatives. Because the individual fisherman's attempts to improve his vessel and gear were often hampered by lack of capital, the major mechanism for introducing the new technology was through various credit schemes, most often tied to the formation of cooperatives through which the financing could be administered. A second, often implicit objective of such credit schemes was to reduce the dependence of traditional fishermen upon middlemen, input suppliers, and owners of gear and boat.

On the whole these attempts to provide supervised credit have not been successful (Lawson 1972; Elliston 1976). In some cases even though the loans have not been repaid, the improved gear has not been returned either, and the programs have later been characterized as "social financing" (Baum and Maynard 1976e).

Lawson (1972) completed a thorough assessment of credit programs for artisanal fishermen in Southeast Asia in 1972, and her observations regarding the failure of loan schemes due to technological, economic, and sociological reasons bear repeating here:

1. Inappropriate technology, lack of adequate experimentation or support.
2. Lack of supervision resulting in expenditure by fishermen on consumption, rather than on production goods such as gear and boats.
3. Lack of debt management and no discipline of defaulters.
4. Difficulty in finding appropriate collateral as security for the loan when so few fishermen have material possessions that would satisfy collateral requirements.
5. Inadequate credit, in that either only part of the improved gear or vessel could be purchased, the remainder having to come from the moneylender source, or failure to cover short-term working capital requirements.
6. Fixed periodic loan repayment schedules while fishing income was subject to seasonal fluctuations.
7. Difficulty in collecting payment from fishermen who frequently off-loaded their catch elsewhere or sold it at sea to avoid payment.
8. Diversion of loans to nonfishermen.
9. Lack of supportive training programs.
10. Lack of spare parts or maintenance facilities caused by too many types of engines being introduced at one time.
11. Lack of supporting infrastructure such as landing facilities, ice and cold storage plants, processing facilities, and roads.
12. Lack of adequate marketing system to absorb the increased supply.
13. Community resistance to programs that disrupted existing social relationships and ignored traditional sanctions for repayment.

Many of these same reasons for failure were confirmed by Elliston (1976), who examined the cooperative pro-

gram in Malaysia. Gibbons (1976) added one important factor that has been prevalent throughout the region; that is, the manipulation of schemes by the local elite for political reasons, particularly where a cooperative was involved and where cooperative membership was a prerequisite for loan approval. In an extreme case, new gear and vessels introduced to Muncar, Indonesia were destroyed by villagers, and it was hypothesized by an observer (Emmerson 1976) that the underlying causes were related to concepts of community justice and the fact that the project appeared to result in benefit for only a favored few, while the vast majority were excluded.

Several of the shortcomings cited by Lawson (1972) were corrected where possible in later schemes. The Philippines' imaginative attempts to solve the problem of inadequate vessels and gear and of dependency upon middlemen indicate the extreme complexity of the problem. In addition to the use of cooperative channels, loans were provided to seldas or groups of five fishermen. Each member was provided with his own gear and boat and was to guarantee repayment by the other four selda members. The attempt to build in moral persuasion to repay through the relationships inherent in the selda were not successful. Fishermen, most of whom do not own land, often simply picked up stakes and moved to another location. Boats and gear were sold back to suppliers who then resold them. The apparent lack of loan supervision doomed the project from the start. By December 31, 1977 the Development Bank of the Philippines had lent approximately ₱308 million ($42 million) to 75, 225 fishermen under this scheme. The default rate subsequently exceeded 75% (Business Day 1978), and the selda program was halted.[4] Currently loans are channeled through fishermen's associations, where the gear is jointly owned in contrast to the individual ownership possible through the selda and where training, supervision, and marketing assistance are integral components of the program. One major problem remaining, however, is that rural banks are generally reluctant to provide the collateral-free loans that the fishermen's associations require for their improved gear.

Because of these difficulties, the cycle of indebtedness and low productivity remains the predominant condition of the vast majority of traditional fishermen. It is also apparent from the experience with vessel and gear technology programs that they offer little hope of raising the standard of living of the majority of traditional fishermen. Undoubtedly there are areas where underexploitation of resources will permit such an approach on a limited scale, but a long-term view of the problem demands that other alternatives be explored.

Recapitulating, the theoretical possibility of biological constraints (resource limitations) has long been recognized, but only in recent years in tropical fisheries have clear-cut cases of overfishing been sufficiently convincing for the practical aspects to be recognized. Increases in productivity from traditional fisheries were thought to be achievable through the application of upgraded technology. Currently technology per se does not appear to be a constraint as the necessary and more efficient production techniques exist. Introducing them to traditional fishing communities, however, has proved to be most difficult, frequently self-defeating, and what is worse, often reinforcing inequities in income distribution. The belief persists in some quarters, however, that the failure of fisheries development programs can be attributed to the traditional fishermen and their unwillingness to adopt the new techniques, and to adapt to their effects. It was the conclusion of an ICLARM workshop in June 1978, in contrast, that rather than lying solely with the fisherman, the relevant socioeconomic and institutional constraints can be traced in a large measure to the limited and narrow perspectives that developers and other change agents hold regarding traditional fishermen and the resources that are available to them. The problems that are related to these perspectives are suppositional, rather than empirical in nature.

SUPPOSITIONAL PROBLEMS

An earlier distinction was made between empirical and suppositional problems. Empirical problems, such as those discussed in the previous section, involve the concrete needs of fishermen for a standard of living above the bare subsistence level and thus involve contributing factors such as limited resources, inadequate vessels and gear, lack of market power, lack of alternative income, and inflation. Suppositional problems are those that relate to the assumptions that decision makers put forward regarding behavior of fishermen, the social and economic structure of the communities in which production and distribution take place, the extent of the resource base, and the likely effects of development projects. The term 'decision makers' is broad and includes fishermen and entrepreneurs providing inputs and handling fish distribution, in addition to government officials and other individuals and institutions that influence fishing in its broadest sense.

The June 1978 ICLARM traditional fisheries workshop discussed these suppositional problems in detail

[4]The Development Bank of the Philippines reports that all but 536 of these accounts are in arrears.

and workshop conclusions are summarized here. In looking for solutions to the critical problems of traditional fishermen, the participants endorsed approaches that take into account the particular socioeconomic and cultural context of the community and its own sense of priorities, and place fishermen at the center of any changes to be proposed, whether they be in technology, institution-building, or marketing. This suggested approach, which is consistent with those adopted by rural development programs, acknowledges that programs not supported by fishermen themselves have little chance of success.

"An essential requirement from the start is to find out and take into account the hopes, needs and aspirations of the fishermen and their communities and to ensure that they understand and agree with the objectives of the project and become fully involved in it" (FAO 1975, p. 14).

This does not mean that fishermen-centered solutions are necessarily always optimal, but it does mean that changes that are sensitive to the perspective of the traditional fishermen are more likely to succeed.

What are those perspectives? Too often outsiders have assumed that fishermen are homogenous, immobile, and irrational. No generalization holds across all cases, of course, but the opposite assumptions distort reality less.

First, traditional fishing communities and fishermen are heterogenous. A holistic view of fishing communities including all those dependent upon or having a stake in the fishery in addition to the fishermen themselves, including middlemen and other marketers, boatowners, shopkeepers, village officials, and fishermen's families who may market and share the catch. Development projects focused narrowly on catchers of fish may end up being subverted by nonproducers who have been left out of official plans. Traditional producers themselves also differ greatly, for example, in terms of their individual fishing task (if they are laborers on another's boat) or in terms of gear used, local reputation, and the degree to which they engage in fishing full- or part-time.

Marketing systems also show great variation among middlemen based upon the services that each provides. On the one hand, one can differentiate intermediaries according to the functions they perform, such as transport, storage, processing, risk bearing, market information, and buying and selling. Alternatively one can distinguish among intermediaries in an institutional sense; that is, among retailers, wholesalers, brokers, commissionmen, processors, speculators, and facilitative organizations such as financial institutions, auctions, or providers of public market news (Kohls and Downey 1972). Within fisheries market systems, intermediaries may fulfill a multiplicity of functions and these are neither static nor necessarily confined to fishery products. A "standard package" approach that does not take these differences in the production and distribution sectors into account is that much less likely to be effective (Ondam 1977).

It is also important to understand the extent to which fishing community households depend exclusively on fishing. After an examination of household census results for 1971 in the Philippines, Castillo (1977) was able to conclude that the more rural and agricultural the area, the more frequent was the diversity of household income sources. She hypothesized that this was due to the lower income from rural activities and the desire to reduce the risk that dependence upon a single activity would entail. The implication is that development projects that are biased in favor of full-time fishermen and discourage subsistence producers from diversifying their sources of income may hurt them by making them more vulnerable to fluctuations in the availability and salability of fish, and may ignore the reasons that former full-time fishermen had for becoming part-time in the first place (Emmerson 1978). If a biological constraint already exists, the effects of such increased pressure on the resource would actually lower rather than raise fishermen's incomes.

Second, many traditional fishermen are highly mobile both geographically and occupationally, in that they migrate in response to changing agricultural and fishing seasons, and psychologically, in that they are eager to adopt and adapt to new activities that will raise their incomes. In five community studies conducted in the Philippines (Baum and Maynard 1976a,b,c,d,e) it was found for example, that depending on the community, anywhere from 20% to 65% of respondents were willing to leave fishing for another occupation. Modernization and commercialization have rendered increasingly invalid the image of fishing communities as isolated entities cut off from the outside world. What this means for development policy is that traditional fisheries must be visualized as enmeshed in larger rural and national frameworks of communication and interchange where fishermen themselves are becoming aware of alternatives.

Third, traditional fishermen should be assumed to act rationally in terms of their own perceptions and preferences. An outside sponsor of development who offers subsistence producers a high-gain but high-risk strategy is asking them to act against their own primary interest. A traditional low-gain, low-risk strategy in which middlemen shoulder the burden of risk in the market, guarantee producers an outlet for their production, and provide loans for consumption in times of need, may seem more attractive to traditional fishermen than an uncertain, if

potentially more promising, alternative offered by government. Once traditional fishermen are assumed to be rationally preoccupied with survival (Lawson 1975) development decision makers can better mesh the probable benefits of new arrangements with the proven benefits of old ones. To accomplish this, traditional institutions for sharing the value of the catch and the ways in which these are affected by technological and other changes should be a major focus in researching, planning, and monitoring fishery-specific development projects.

In addition to these assumptions regarding fishermen's attitudes, assumptions are also frequently made regarding relationships between fishermen and those input suppliers and marketers upon which they depend. Government planners, anxious to demonstrate their commitment to changing the status quo, often overlook the productive role of middlemen and assume that all are exploiting the fishermen from whom they purchase catch. Sufficient qualifications to this supposition have been presented in this paper to indicate the importance of a reexamination of these assumptions before state-run marketing corporations are established.

Emmerson (1978) points to the high level of subjectivity that accompanies all levels of fisheries development planning and suggests that while it is probably not realistic to achieve total objectivity, the researcher can at least "try to ensure that official biases are constructive" (p. IV-5). All too often the social costs of development programs are overlooked (Juanite 1978). Certainly the negative repercussions resulting from many vessel and gear technology programs demonstrate the need for a more objective look at all development alternatives and their potential social costs and benefits, so that net social benefits can be maximized. Despite the need for such an approach, however, it is difficult to translate such a recommendation into action. Besides the general lack of information available to decision makers, there is also a wide gap between the theory of welfare maximization and the practical decisions that must be made immediately to raise the standard of living of traditional fishermen. One very important step in developing an appreciation for these suppositional problems is an in-depth examination of the development planning process, its objectives, and its implementation, probably best undertaken on a country-by-country basis.

POSSIBLE GENERALIZATIONS AND CONCLUSIONS

If one were to come up with a simple generalization regarding the traditional fisheries sector, it would most likely be "too many fishermen, not enough fish" (Bardach 1977). Given this situation certain common-sense conclusions can be reached regarding the alternatives available to decision makers. At the risk of oversimplifying, these can be summarized here: (also see Table 9).

1. Despite the fact that vessel and gear improvement may benefit small numbers of fishermen in the short run, such an emphasis on production technology, except in very specific locales where resources are not yet fully exploited biologically, will likely have very high social costs in terms of (a) disruption to the social and economic fabric of the communities concerned; (b) the low return on government investment that appears to result from such schemes; and (c) increased overfishing.

2. Programs to subsidize the traditional fisheries through government price control over inputs or through provision of inputs at less than the market price will most likely lead to increased fishing pressure on the resource, but will in the short-term allow accommodation of an increased number of fishermen.

3. Programs to legislate inefficiency by prohibiting introduction of labor-saving vessels or gear, while meeting short-term objectives of maintaining employment, will most likely lead to continued stagnation of the sector.

4. Improvements in marketing and postharvest technology will not necessarily result in increases in prices received by the traditional fishermen. Depending upon the market power of intermediaries, and on the elasticities of supply and demand at each link in the marketing chain, the resulting benefits from waste reduction may accrue in part to the middlemen, to the ultimate consumers, or to both. Even if the resulting benefits take the form of increased prices received by fishermen, they will probably be dissipated as more fishermen are attracted to the resource, and further overfishing results. Intermediate processing technology may present an opportunity for fishermen to receive some of the profits previously received by middlemen.

5. Rural development programs that lead to cooperative or other organizational development will, to the extent they result in higher prices received, most likely encourage more fishermen to enter the industry and thus further contribute to overfishing. If cooperatives or fishermen acting individually take over some of the functions previously performed by middlemen, their incomes will presumably be increased to the extent that they are able to capture the profits previously enjoyed by the middlemen.

6. Rural development programs that provide alternative sources of income to fishermen and their families on the other hand, represent the only method that reduces fishing effort and thus the only long-term solution that offers any chance of raising the standards of

living of those who remain in the traditional fisheries sector.

7. Doing nothing by adopting a policy of benign neglect, while possibly resulting in transformation in fishing communities through natural social and economic forces, is politically unacceptable at this time. Also if fisheries are an activity of last resort for many, the hoped-for movement of fishermen out of fishing may not occur.

Given the large numbers of traditional fishermen, the above conclusions make the situation appear dismal, indeed. Moreover there is a strong possibility of conflict between individual fishing community perspectives of appropriate response to empirical problems and the generalizations drawn above. However the attitudes of fishermen to geographical and occupational change appear to offer an opportunity, not a constraint to development. Once traditional fishing community perspectives are understood, it appears that change will be possible as long as the fishermen themselves are able to participate in the decision making that leads to the introduction of new or alternative income-generating methods or activities.

It is clear from past experience in both developed and developing countries that the traditional fishermen will bear the brunt of the burden of changing and adapting to the pressure of modernization. Marketing and postharvest technology improvement may provide temporary benefits. Government's employment-related goals and programs to halt rural-urban drift and improve rural incomes may provide short-term respite for traditional fishermen through their emphasis on labor-using rather than labor-saving technology, as recommended by Lawson (1977).

It is common to hear arguments that the traditional fishermen must be protected from rapacious trawlers and other industrial fisheries. Proponents of this point of view would argue, it is presumed, for legislated in-

Table 9. Effects of development alternatives on traditional fishermen.[a]

Development method	First- and second-round effects on: Productivity (catch per fisherman)	Prices	No. of fishermen	(Sustainable yield) resource	Income of fishermen
1) Vessel and gear upgrading	increases for a few; declines for most	increase	indeterminate, (depends in part on degree of labor-saving)	more overfishing	increase for a few (in short run only) probable decline for many
2) Restrict fishing effort	increase for those who remain	indeterminate	reduced	less overfishing	increases for those who remain
3) Subsidize industry (lower input cost)	declines	increase	increased	more overfishing	probable decline (in long run)
4) Improve marketing and postharvest technology	declines	possibly increase	increased	more overfishing	possibly increase (in short run only)
5) Rural development: institutions (e.g., cooperatives)	declines	possibly increase	increased	more overfishing	possibly increase (in short run only)
6) Rural development: alternative income	increases for those who remain	indeterminate	reduced	less overfishing	increases

[a]Assumptions: 1) The fishery is already exploited to that point where TR = TC and all economic rent is dissipated; that is, economic overfishing already occurring.
2) The fishery is already biologically overfished; that is, MSY has been exceeded. Note that assumptions (2) and (3) together imply that the TC curve intersects the TR curve beyond MSY. There may be cases where this is not true; that is, for all economic rent to be dissipated before MSY is reached.
3) Freedom of entry and exit.

efficiencies such as banning of trawlers from coastal waters. In the short run, but in the short run only, this may make sense from a social point of view. (It never makes sense from an economic efficiency point of view because it increases the costs of fishing.) In other words, so the argument goes, there is some socially optimum yield (OSY) between MEY and MSY that takes into account other noneconomic (nonefficiency) goals such as employment or social stability. The problem with this approach, however, is that in the long run it condemns the majority of traditional fishermen to their present cycle of poverty and indebtedness. Even a policy of benign neglect could result in a more rapid, and thus in the long-run less socially costly, transformation. If stagnation of the traditional fisheries sector is to be avoided, an ultimate solution will necessitate reducing the number of fishermen or reducing the fishing effort through active and concerted government programs and incentives that provide alternative income opportunities to a traditional fishing sector that at present has few, or none at all.

Alternatives for Research

RESEARCH TO COMPLEMENT DEVELOPMENT PROGRAMS

It was argued in the Introduction that while a major purpose of development programs is to raise the standard of living of traditional fishermen, the goal of research is to expand and clarify the alternative choices available to decision makers, be they government policy makers or project managers, private entrepreneurs, or fishermen themselves. The preceding section, in its discussion of alternative solutions to the problem of low living standards, has presented certain conclusions, based on the one hand, on theoretical models of the fishery that incorporate biological and economic parameters, and on the other hand, on a review of development programs and of changing perspectives regarding the constraints to development of the traditional fisheries sector. Combinations of biological, socioeconomic, and, to a lesser extent, technological constraints to raising living standards have been identified. While broad conclusions have been drawn regarding the long-term potential of alternative development approaches, the seriousness of the problems facing traditional fishermen demands that short-term solutions also be found. The need for locale-specific information thus remains, so that where they exist, underexploited resources can be identified and tapped, and so that local institutions, attitudes, and socioeconomic conditions can be understood and incorporated into development programs.

Research in traditional fisheries should have as its long-term objective the developing of a capacity to provide answers not only to questions that can be raised in connection with alternative development thrusts, but also to evaluate the alternatives vis-a-vis each other. The need to evaluate the alternatives leads, however, to a further research-related constraint; that is, the statistics and other preliminary analytic studies to permit such evaluations in a convincing empirical manner are generally not yet available in Southeast Asia or the Southwest Pacific. For example, stock assessment and estimates of sustainable yields require time series data even for a single species fishery. The task is seriously complicated by the multispecies stocks exploited by traditional fishermen in the tropics where catch and effort data are generally not available. Effort is now being expended throughout the Southeast Asian region in an attempt to determine these parameters, but success is hampered by a lack of expertise in population dynamics and by the apparent inapplicability of single species models to multispecies fisheries (Pauly 1979).

It is apparent that a multidisciplinary perspective of potential constraints and alternatives is necessary, and it helps to pose the major questions related to each so that the link between empirical and suppositional problems can become clear. Based upon the earlier categorization of alternative methods of raising incomes, the most pressing questions are:

1. Vessel and Gear Improvement

Will the resources permit the expansion in effort that improved production technology implies? To what extent does technology displace fishermen? What are fishermen's attitudes toward technological change? What forms are most appropriate? To what extent does it disrupt community social structure and make income levels more unequal? How broadly based can participation in technology advances be?

2. Marketing Improvement

Will reductions in marketing inefficiencies (technical and price) result in higher prices received by fishermen, in lower prices paid by consumers, or some combination of both, or will the benefits be captured by intermediaries in the form of higher profits? Will the development

of alternative market outlets (e.g., frozen, dried, processed) or improved infrastructure result in higher fishermen's incomes? Will a more efficient distribution system increase the fishing pressure on the resource? Will the provision of intermediate processing technology allow fishermen to capture some of the profits previously received by middlemen? What is the most appropriate form of management and/or guidance for the marketing system? What, if anything, should be the government's role?

3. Institution Building

Will the formation of fishermen's cooperatives, associations, or other formal and informal groupings lead to increases in production and/or increases in prices received? Will dependency of fishermen on middlemen and boatowners be reduced as a result? How broad can participation in the new or adapted institutions be? What will be the effects of institutions on levels of and equity of community income? Will fishermen's organizations encourage conservation of the resource? What should be the government's role in institution building?

4. Effort Reduction

Will reducing the fishing effort result in higher catch and income for those that remain? What management tools can be developed to limit fishing effort?[5] How can they be implemented? Can they be enforced? Can reductions in effort be achieved by encouraging full-time fishermen to become part-time? Can nonfish capture sectors, such as aquaculture and agriculture, absorb those fishermen displaced? What alternative activities are sufficiently attractive to fishermen to encourage them to reduce their fishing effort? Will education and training programs designed primarily for children of fishermen result in a reduction of fishing effort? What are the attitudes of fishermen towards effort reduction?

In addition to these four alternatives which deal primarily with the fishermen themselves and are thus fishery-specific, development policy and accompanying research may not be directed specifically towards fishery-specific solutions but rather at (5) rural development, or a general uplifting of the rural sector, thus equipping rural dwellers, including fishermen, with the skills and awareness to adapt to their changing society. For example it is essential that the role of fishing relative to other rural activities be clearly understood, and that external linkages to political, social, religious, and economic structures and institutions (including government) be explored. Indeed, integrated or area rural development programs, as distinct from broader national programs, have become popular throughout the Southeast Asian region for this reason, but fishermen are still not generally included in the target group. Moreover, as pointed out by a recent consultative group from the Southeast Asian region (SCS 1977), horizontally integrated development schemes are much more difficult to conceive and manage than vertically integrated development schemes.

Despite the relative simplicity of vertical integration and associated pilot projects, however, long-term improvement in living standards of fishing communities will be attained only as improvements are concurrently achieved throughout rural areas, of which fishing communities are but a part. A host of research questions thus relate to potential, approaches, and attitudes regarding rural development programs.

The above questions relate to the major policy alternatives. The categorization of problems facing traditional fishermen and the subsequent discussion of alternative solutions suggest two approaches, which are definitely not mutually exclusive, through which research can play an important, complementary role: (1) documentation of the existence and degree of empirical problems and (2) testing of hypotheses regarding suppositional problems.

An examination of these approaches and some specific examples of each will assist in the setting of priorities or general themes by research organizations which have identified the problems of traditional fisheries as an area of research concentration.

DOCUMENTING EMPIRICAL PROBLEMS

On the biological side, stock assessment and estimation of sustainable yields are crucial to all development efforts as the theoretical models showed. Socioeconomic research in this category would be primarily descriptive and would include the type of community profiles that are becoming more readily available throughout Southeast Asia. While providing extremely valuable baseline information, this descriptive work is primarily static in nature presenting a picture of income and social indicators in fishing communities at a point in time. Annual data, if presented, are based on the recollection of respondents, and thus potentially suffer from extreme bias. An exception to these usually static surveys is the am-

[5] Again, the appropriate management tools will depend in part upon whether the underlying problem is one of 'growth' or 'recruitment' overfishing, or some combination of both.

bitious Rural Dynamics Study presently being conducted in Java, Indonesia, by the Agro-Economic Survey. The study includes three coastal villages in its sample and considerable data, including household income and labor allocation that cover up to a 5-yr period, are now available to permit some preliminary conclusions regarding change in these rural areas (Collier et al. 1977). Data have been collected monthly, thus reducing the recollection bias. It must be recognized at the outset that dynamic research of this type is expensive, and there are limitations to the extent that national generalizations can be drawn from a three-village sample. This approach, however, is consistent with earlier exhortations that development projects and accompanying research must be locale-specific and multisectoral, and can provide valuable insights into changing land, labor, and other resource use.

As development programs move to become more vertically integrated and less purely production-oriented, the necessity for knowledge about linkages in the resource/fisherman/distribution continuum increases and thus provides a fruitful area for research. For example an examination of the price structure and rates of return through the entire distribution system would indicate possible areas where increases in competition would be beneficial, and whether prices received by fishermen would likely increase as a result. Returns to fishermen that represent 30-40% of the consumer price of fish are comparable to those received by primary producers in other activities, but until fisheries marketing costs including risk are identified, some observers will continue to think these returns are too low a share of consumer expenditure and thus warrant intervention.

HYPOTHESIS TESTING IN RELATION TO SUPPOSITIONAL PROBLEMS

On the other hand traditional fisheries research can test hypotheses regarding suppositional problems. The purpose of studies that examine mobility, rationality, and heterogeneity issues, for example, would be to provide a more balanced perspective of fishermen's behavior and attitudes towards change, including willingness and ability to seek alternative employment outside capture fishing.

The necessity for coordinating research of the empirical and suppositional categories is obvious if one is to move beyond the descriptive and become analytic. For example the establishing of functional relationships between empirical problems and behavioral characteristics of fishermen and their communities might point to ways in which empirical problems can be solved. Alternatively, perhaps positive correlation can be shown between diversity of income sources and land ownership, implying that land reform programs that include landless fishing families could raise family incomes. Frederick J. Smith (1974) cautions against the unquestioning use of functional models drawn from the agricultural sector, however. While production and profit functions commonly used by economists to shed light on producer behavior can make use of capital, land, labor, and management inputs to explain a high degree of the variance among explanatory and dependent variables in an agricultural setting, the same is probably not true for the fishing sector where "it is . . . hypothesized that natural biological variability and externalities would explain a significant variation in profit" (p. 1043). Again, the need for multidisplinary research is apparent.

Pursuing this argument for hypothesis-testing a bit further for the moment, Lampe (1978) has argued the case for including demand analysis into fisheries planning for fish and fishery products. The income and price elasticities of demand which can be crudely estimated from survey data would be particularly valuable to planners who are fortunate enough to operate in the context of underexploited traditional fisheries. Too often it is assumed that supply will create its own demand or that substitution of imported fish products with domestically caught fish can be readily achieved. Certainly, Pacific island nations have experienced difficulty in persuading consumers to abandon their taste for imported tinned mackerel, with its frequent high prestige, in favor of higher priced fresh fish. While the lack of a social laboratory, where controlled experiments related to demand analysis can be conducted, greatly hampers the specification of exact elasticities, their rough estimation based on survey data allows some predictions to be made regarding the price effects of shifts in supply. Also, as noted by Lampe (1978) when commenting on a recent survey in Guatemala, income elasticity estimates allow one to make certain predictions regarding shifts in consumer expenditures from lower class fish to higher class fish as per capita income increases. The implication, at least in Guatemala, is that producers of the lower class fishes will be further disadvantaged. A similar situation may exist in areas of the South Pacific. However in Southeast Asia where population expansion is shifting the demand curve upward and to the right, it is hard to conceive of a reduced demand for any species of fish. Still, estimations of price quantity relationships and of elasticities can shed considerable light on the structure of fisheries markets, and might suggest areas of improvement in distribution systems and the need for developing alternative product forms to the benefit of traditional fishermen.

Contrary to the situation in industrial fisheries where production economics research as discussed by Smith (1974) could be of benefit to individual producers in the short run the pressing problems of traditional fisheries and fishing communities call for long range attention to broad policy research issues.

CONCLUSION

It should be clear that only through analytical research on both empirical and suppositional problems will it be possible to develop an holistic perception of traditional fisheries and fishing communities and their linkages with other sectors and institutions.

At the beginning of this section, certain questions were posed regarding each of the major policy thrusts of technology improvement, institution building, marketing improvement, and effort reduction. These questions could be rephrased as hypotheses to be examined as part of an evaluation of development alternatives. This area would include research related to rural development programs in all their variety and the possible benefits to be derived by fishing communities from their more specific inclusion within such programs. Or, for example it would be possible to design a research project that monitored the effects of a cooperative or association on traditional fishermen's income and community structure. Or, more ambitiously the impact of port development or other infrastructure improvements could be monitored to see to what extent benefits accrued to the small-scale fishermen.

Traditional fisheries research should also be directed towards the development of management programs and tools. It is reasonably clear that in the very near future, ways must be found to regulate the amount of effort expended in certain overfished areas. What forms of community and governmental organizations can be developed to deal with management problems? Should or can the controls center on industrial or traditional fishermen or both? What are the most appropriate forms of controls? One might be inclined to think that it is unheard of to argue for controls on effort in the context of fisherman poverty. However, a long-run view of the potential of the coastal resources demands that such management programs and controls be devised and implemented.

Particularly in the area of socioeconomics, much of the previous research on traditional fisheries in the tropics has been essentially descriptive. When research funds are limited the usefulness of research is much reduced unless it is undertaken preliminary to or in conjunction with government programs or community initiatives that seek to raise the standard of living of traditional fishermen. Above all, an analytical framework and methodology is required if the results of research are to be useful to decision makers.

To some extent success in policy-related research will depend upon the availability of reliable secondary data and of previous studies based on surveys. Although steps are being taken in most countries to improve collection and reporting of statistics, it will be some time before these data are of sufficient scope and cover sufficient time to allow sound analysis of policy issues to proceed. In certain other countries where this information is already available, fisheries development and management issues such as surplus fishermen and conflicts between traditional and industrial fisheries have already been addressed. It is fair to conclude that with much variation in data availability and in the quantity and quality of previous fisheries research, choices of priorities among alternative research approaches will vary from country to country, and from region to region.

Despite variability in research approaches and methodology however, the urgent nature of the problems of traditional fishermen and their communities demands that subject area priorities be set. In this regard the theoretical models presented in Figures 4-8 allowed the drawing of certain conclusions regarding the likely effects of various development thrusts. These conclusions were confirmed by a brief review of development programs initiated to date. The futility of relying on objectives that directly or indirectly intensify the level of fishing effort (except in those decreasing number of cases where the resource remains underexploited) implies that priority for development and research should be given to those programs that reduce fishing intensity. The following four general research areas are therefore suggested:

1. Assessment of stocks exploited by traditional and industrial fishermen and estimation of maximum sustainable yields;
2. Development of management tools and programs appropriate for limiting fishing effort in the multispecies fisheries exploited by traditional and industrial fishermen;
3. Reduction of waste in the distribution system and exploration of ways in which resulting benefits can be channeled to traditional fishermen; and most importantly,
4. Development of alternative or supplementary income sources for traditional fishermen and their households.

Complementing these priority areas, indeed to some extent a necessary precondition of their application, is the requirement to develop an understanding, on the one hand, of the resource/fishermen/distribution con-

tinuum and, on the other hand, of the linkages among fisheries, fishing communities, and other rural sectors, and institutions, including government. The former is a vertical concept and the latter an horizontal concept, which taken together imply the necessity for a holistic perspective of fisheries and fishing communities.

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IN JUNE 1978, the International Center for Living Aquatic Resources Management (ICLARM) invited a small group of social scientists to Manila to examine the problems of traditional fisheries and fishing communities and to recommend areas of focus for ICLARM's research program. This monograph is an outgrowth of that meeting, and I am very grateful to the participants–Donald Emmerson, Lim Teck Ghee, and Gelia Castillo–for the guidance that their insights afforded me in preparation of this manuscript. In particular, the writings of Donald Emmerson and subsequent discussions with him have encouraged a focus on multidisciplinary aspects of traditional fisheries, and on fishermen's perspectives.

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Appendix: Derivation of the Fishery Supply and Demand Model (the Copes Model) from the 'Traditional' Model[1]

The analysis proceeds from relationships established in the existing literature,[3] which are brought out through Figure 1. In this diagram the S.W. quadrant remains vacant, its two axes recording, identically, varying amounts of fishing effort. The S.E. quadrant shows the relationship of output—measured by total weight of catch—to fishing effort, assuming a fixed pattern of gear selectivity.[4] An important characteristic of the yield curve is that it peaks at a specific level of sustained effort, measuring at that point the 'maximum sustainable yield' (OM).

In the N.W. quadrant the total cost of output is recorded in relation to fishing effort. Assuming fixed techniques, fixed factor proportions and a multiplicity of small fishing units, the amounts of factors used will be proportional to fishing effort. Cost is calculated here for all factor units at the rate of marginal opportunity costs. It therefore includes any rents that intramarginal factor units may enjoy by virtue of their lower opportunity costs. Bearing in mind that some increase in rewards will need to be offered to divert additional factor units from alternative employment, a gradually rising cost-of-effort curve has been portrayed.

From the two relationships described, total cost may be derived for each weight of output, as is shown in the N.E. quadrant. The derived total cost curve may be readily converted to a cost curve per unit of output, portrayed in Figure 2. Owing to the stipulated condition of unrestricted entry, the fishing force (and consequent fishing effort) will adjust itself to demand conditions in such a fashion that the opportunity cost of producing a marginal unit of catch will equal its market price. No rent is enjoyed at the margin; the rent that the fishery resource itself could yield having been dissipated by the unrestricted entry.[5] The curve described in Figure 2, then, relates long-run equilibrium output to each given price and is therefore in the nature of a long-run supply curve.

Biometric studies suggest that for a typical fishery the yield curve will have the sigmoid shape indicated in Figure 1.[6] The curve for total cost in relation to output will be of exactly the same shape (allowing for expansion or contraction of the scales used) if cost is a linear function of fishing effort, which in much of the relevant literature is considered a justifiable simplification. The assumption of moderate curvature in the latter function—suggested above—would modify the curvature of the total cost curve but would not affect its general shape. The important characteristic of this total cost function is that, while cost increases continuously, output rises until it reaches the maximum sustainable yield and then declines. This characteristic is transmitted in modified proportions to the average cost curve of Figure 2. This latter curve, then, has a backward-bending segment at prices higher than the level that will bring forth a maximum output. If the assumptions of the model are realistic in their essential features, such a curve may be considered representative for the fishing industry.

As a result of this reversing slope of the supply curve, one may expect that with a steadily increasing demand for the product of a fishery, typically the quantity produced will first increase (Q_1, Q_2) and eventually decrease (Q_2, Q_3), while the price will continue to rise (P_1, P_2, P_3). There are enough recognized instances of 'overfishing' (. . .) to intimate that for specific fisheries demand levels have indeed pushed operations to a point on the backward slope of the supply curve, where increased effort is accompanied by lower output and a higher (real) price.

[3] See particularly Ralph Turvey, 'Optimization and Suboptimization in Fishery Regulation', *American Economic Review*, Vol. 54, March 1964, pp. 64-76. The definitions and qualifying assumptions of this article apply here insofar as they are relevant.

[4] By changing the selectivity of fishing gear with respect to the size of the fish caught, the effect of any level of fishing effort on the equilibrium catch may be modified. Turvey's analysis (op. cit.) applies specifically to a trawl fishery in which the selectivity of gear may be manipulated by regulated variation in the permissible minimum mesh sizes. In the present article a fixed pattern of gear selectivity is assumed (not necessarily confined to trawling gear) in conformity with the postulation of a fixed technology. The yield curve in the S.E. quadrant of Figure 1 here corresponds with a yield curve for a fixed mesh size in Turvey's analysis.

[5] However, intramarginal factor units will enjoy rents attributable to themselves as measured by the difference between marginal opportunity costs and their own opportunity costs (cf. Turvey, op. cit., p. 66.)

[6] The standard work in the field is R. J. H. Berverton [sic] and S. J. Holt, *On the Dynamics of Exploited Fish Populations*, United Kingdom, Ministry of Agriculture, Fisheries, and Food, 1957.

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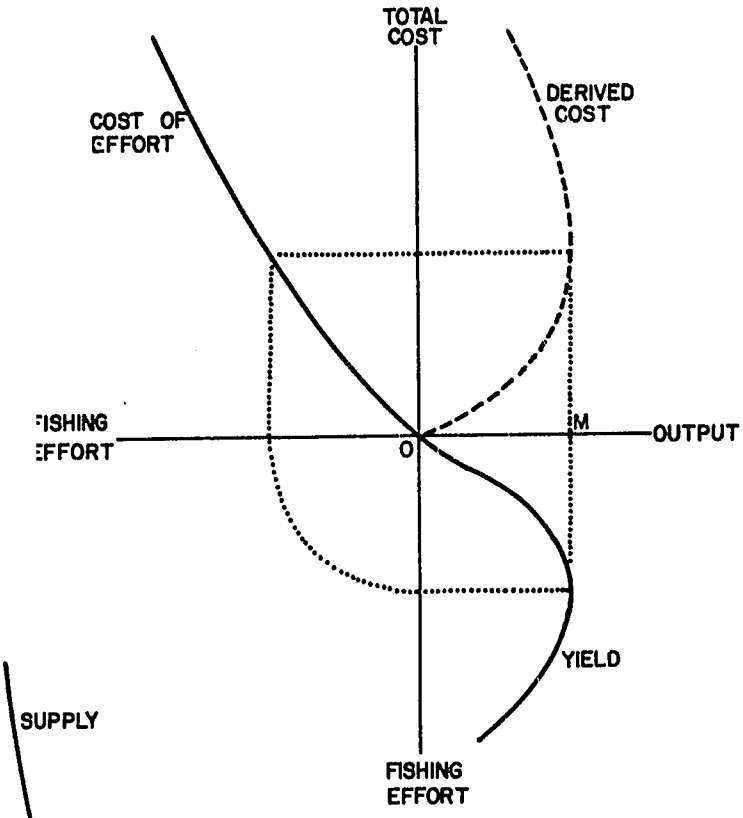

Fig. 1. Relationship among fishing effort, output, and total cost [caption by author, not Copes].

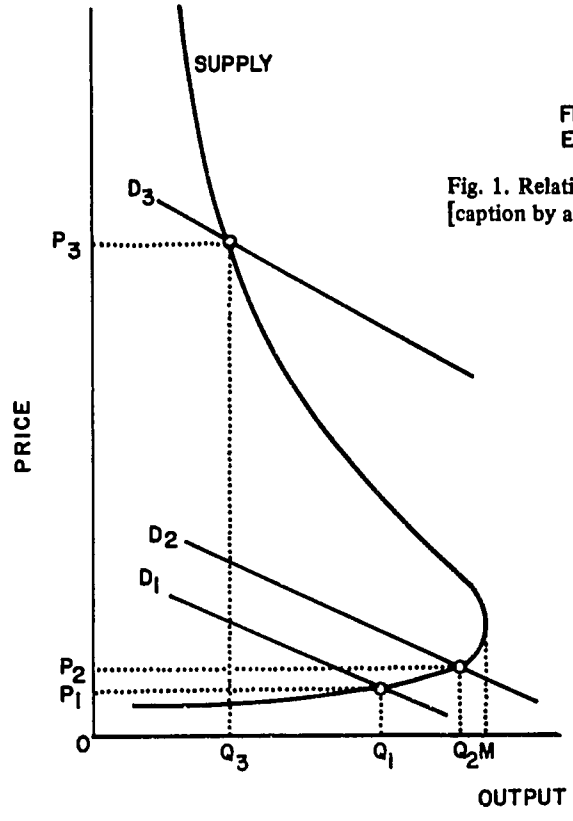

Fig. 2. Long-run fishery supply and demand curves [caption by author, not Copes].