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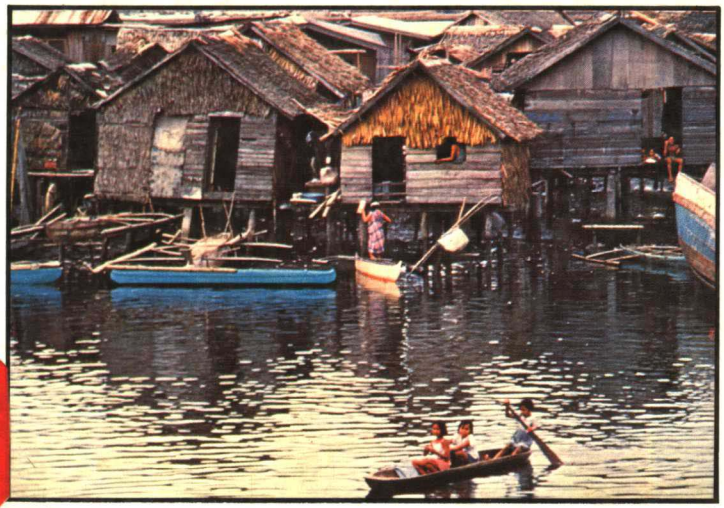
Philippine Municipal Fisheries:
A Review of Resources, Technology and Socioeconomics

IAN R. SMITH, MIGUEL Y. PUZON
and CARMEN N. VIDAL-LIBUNAO



ICLARM INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT

FISHERY INDUSTRY DEVELOPMENT COUNCIL

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By IAN R. SMITH, MIGUEL Y. PUZON and CARMEN N. VIDAL-LIBUNAO

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Cover: The four cover photographs indicate aspects of Philippine municipal fisheries: mixed gill net catch; beach landings for bancas; fishing village with little if any land ownership, and a municipal retail market where much of the municipal catch ultimately reaches the consumer, emphasizing the market rather than subsistence orientation of municipal fisheries.

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List of Abbreviations

ACA	- Agricultural Credit Administration
ADB	- Asian Development Bank
AID	- Agency for International Development
BAEcon	- Bureau of Agricultural Economics
BFAR	- Bureau of Fisheries and Aquatic Resources
CB	- Central Bank of the Philippines
DA	- Department of Agriculture
DAP	- Development Academy of the Philippines
DBP	- Development Bank of the Philippines
DNR	- Department of Natural Resources (now Ministry)
FAO	- Food and Agriculture Organization of the United Nations
FIDC	- Fishery Industry Development Council
FIRM	- Fishery Resources Management Program
GOP	- Government of the Philippines
ICLARM	- International Center for Living Aquatic Resources Management
IFDR	- Institute of Fisheries Development and Research
IOP	- Indian Ocean Program
IPFC	- Indo-Pacific Fisheries Council
ISEAS	- Institute of Southeast Asian Studies
LBP	- Land Bank of the Philippines
LLDA	- Laguna Lake Development Authority
MLGCD	- Ministry of Local Government and Community Development
MNR	- Ministry of Natural Resources
MSC	- Marine Sciences Center, University of the Philippines
NEDA	- National Economic and Development Authority
NEPC	- National Environmental Protection Council
NFAC	- National Food and Agriculture Council
NMPC	- National Media Production Center
NSDB	- National Science Development Board
PCARR	- Philippine Council for Agriculture and Resources Research
PD 704	- Presidential Decree 704, otherwise known as the Fishery Decree of 1975.
PFMA	- Philippine Fish Marketing Authority
PNB	- Philippine National Bank
PREPF	- Population, Resources, Environment and the Philippine Future
SCSP	- South China Sea Fisheries Development and Coordinating Programme
SEAFDEC	- Southeast Asian Fisheries Development Center
SEARCA	- Southeast Asian Regional Center for Graduate Study and Research in Agriculture
SFSCP	- Small Fishermen Special Credit Fund
UNDP	- United Nations Development Programme
UPCF	- University of the Philippines College of Fisheries
UPLB	- University of the Philippines at Los Baños
USAID	- United States Agency for International Development
WB	- World Bank

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 on development policies and programs that seek to alleviate them. The first monograph prepared in this connection, "A Research Framework for Traditional Fisheries" (Smith 1979a), serves as a theoretical backdrop against which country-specific reviews are being undertaken. Country-specific papers cover the resources, technology, and the socioeconomic and institutional aspects of traditional fisheries production and distribution.

"Philippine Municipal Fisheries: A Review of Resources, Technology, and Socioeconomics" is the first of these country-specific reviews. A joint undertaking of ICLARM and the Fishery Industry Development Council (FIDC), Ministry of Natural Resources, Republic of the Philippines, it synthesizes publicly available research studies and secondary data. As such, it is not a statement of official Philippine government policy on municipal fisheries, although conclusions of the study may have implications for such policy.

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January 1980

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Philippine Municipal Fisheries: A Review of Resources, Technology and Socioeconomics

IAN R. SMITH, MIGUEL Y. PUZON
AND CARMEN N. VIDAL-LIBUNAO

Abstract

Smith, I. R., M. Y. Puzon and C. N. Vidal-Libunao. 1980. Philippine municipal fisheries: A review of resources, technology and socioeconomics. ICLARM Studies and Reviews 4, 87 p. International Center for Living Aquatic Resources Management, Manila, and the Fishery Industry Development Council, Manila.

Recent research findings related to the technology and socioeconomics of small-scale municipal fishermen in the Philippines and the "open-access" resources they exploit are reviewed. Evidence is provided of a trend towards overfishing of Philippine coastal waters, and of a willingness among fishermen to consider alternative activities to capture fishing.

Also documented is the encouraging shift in emphasis in government programs from a resource "development" orientation to one of resource "management." The review concludes with a discussion of the implications of these research findings to fisheries management and research.

Introduction

The last decade has seen a rapidly growing interest throughout the world in the economic and social aspects of traditional small-scale fisheries development. Prior to the 1970s it was widely believed that the key to raising the living conditions of traditional fishermen could be found in improved vessel and gear technology. Development projects of the 1950s and 1960s reflected this emphasis in their concentration on improved production techniques, almost to the exclusion of other nontechnical considerations (Sainsbury 1977). As difficulties with this approach grew, despite some limited successes, 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.

As was true in many other parts of the world, interest developed in the Philippines for socioeconomic research to precede and complement development programs aimed at the small-scale fisheries sector. The first research to result from this shift of emphasis in the Philippines were the community studies by Baum and Maynard (1976a, b,c,d,e) which, in addition to the measurement of certain social indicators (income, house ownership, and housing

standards), also assessed attitudes of municipal fishermen to occupational and geographic change.[1] Many studies similar in nature, though richer in data, have either followed or are in the planning stage.

In addition to these fishing community studies, three recent research projects have shed considerable light on the relationship of the production sector to the distribution sector, and on the "suki" relationships that link the two (Cuyos and Spoehr 1976; Jocano and Veloro 1976; Hopkins and McCoy 1976).

Other marketing studies, though only indirectly related to municipal fisheries, have broadened the perspective of fisheries development problems (Navera 1976; NORCONSULT/IKO 1976; BAEcon/BFAR 1978). These marketing studies are of interest not only for their insights but also because improvements in marketing infrastructure are now seen as an indirect means to increasing fishermen's income. The NORCONSULT/IKO report, which also contained recommendations for upgrading vessel and gear technology, presaged the expansion and improvement of the Navotas fishing port, landing and market facilities. However, only a very small proportion of landings at Navotas and other major ports in the Philippines derive from municipal fisheries, the landings from which are dispersed along the whole Philippine coastline.

Complementing the increased interest in socioeconomics, several Philippine researchers have begun to address the extremely difficult problems of stock assessment and estimates of maximum sustainable yield in this multispecies environment (PREPF 1977; Aprieto 1977; SCS/GEN/76/7; SCS/GEN/77/11; FIDC 1977b).

In short, there is a rapidly growing body of literature on the biological, technical, and socioeconomic aspects of Philippine municipal fisheries.

The purposes of this review are: 1) to consolidate and summarize and, where possible, generalize from research conducted to date and 2) to examine the general thrust of development programs aimed at the municipal fisheries sector.

This review makes no pretext of either setting priorities for fisheries research or of being a long range plan for municipal fisheries development in the Philippines. Such plans more properly result from deliberations of the Marine and Inland Fisheries Committee of the Philippine Council for Agriculture and Resources Research (PCARR), and from planning efforts of the Bureau of Fisheries and Aquatic Resources (BFAR) and the FIDC. Rather, this review will build on the earlier work of Samson (1977) and of Samson et al. (1977) by summarizing empirical data on resources, technology, and socioeconomics, much of which have been collected since that time, and by suggesting certain broad areas for research concentration. This review is based almost exclusively on previous published information despite the recognition that considerable useful knowledge and unpublished manuscripts would probably be available from entrepreneurs and employees working with municipal fisheries on a day-to-day basis. The collection, analysis, and publication of such information would be a further research project in and of itself.

There are three underlying themes to this reserach and development review. First, it appears that more information is available regarding municipal fisheries than is commonly supposed. Second, a multidisciplinary approach is necessary to appreciate the problems and potentials of municipal fisheries. Third, the search for solutions to the widespread poverty of municipal fishermen must include areas outside of capture fishing, in addition to those that are fishery specific.

After a broad overview that describes the role of municipal fisheries in the national economy and the major problems facing the sector, the review summarizes research on the following topics:

1. Municipal Fisheries Resources (Marine and Inland).
2. Technology of Municipal Fishermen.
3. Socioeconomics of Production and Distribution.

The paper concludes with sections on:

1. Development Programs to Aid the Municipal Fishermen.
2. Conclusion: Implications for Management and Research.

FIDC records and "Papers and Proceedings of the National Workshop on Municipal Fisheries Development," published in 1978 by FIDC, have been the primary sources of information on development programs for municipal fishermen (Section VI). These were supplemented with interviews with various government officials.

[1] In the Philippines the term "municipal fishermen" most closely approximates the more common worldwide terms of small-scale, artisanal, or traditional fishermen. Municipal fishermen are those using vessels of 3 t or less, or using gear not requiring the use of boats. All other fishermen are considered commercial fishermen. Municipal fishermen fish in both marine and inland waters.

Overview of the Municipal Fisheries Sector

A. THE IMPORTANCE OF MUNICIPAL FISHERIES[1]

As stipulated in Presidential Decree 704 (PD 704), otherwise known as the Fishery Decree of 1975, the term "municipal fisheries" refers to fishing that utilizes boats of 3 gross tons (gt) or less, or uses gear not requiring the use of boats. The area of operation, known as municipal waters, includes not only streams, lakes, and tidal waters within the municipality but also marine waters within 3 nautical miles of the municipal coastline. With the introduction of motorized boats, however, the actual area of operation of vessels registered in municipalities now extends to far beyond 3 miles (mi). Municipal fisheries thus include both marine and freshwater (inland) fishing activity and are roughly equivalent to the artisanal, small-scale or traditional fisheries referred to by other countries. All nonmunicipal marine fisheries activities in the Philippines are termed "commercial."

The contribution of municipal fisheries to annual fish production in the Philippines is significant (Table 1). While maintaining an approximate 55-60% share of total catch over the past two decades, municipal fisheries production has quadrupled from 218,983 (mt) in 1955 to 874,934 mt in 1977.[2] Of this 1977 amount, approximately 81% or 712,514 mt was caught by marine municipal fishermen, and approximately 19% or 162,420 mt was caught by inland municipal fishermen (Table 2).

Per capita consumption of marine products in the Philippines was 24.2 kg in 1972 (FAO 1973), representing approximately 54% of animal protein intake. Thus, municipal fisheries highly contribute to meet the nutritional needs of the average Filipino.

In addition to this, municipal fisheries contribute approximately 3% of the annual GNP and provide employment to about 5% of the Philippine working force of 14,000,000. Municipal fisheries are estimated to directly employ approximately 500,000 full-time and part-time fishermen who live in some 10,000 fishing barangays scattered in coastal villages throughout the country (see Table 2). The major regions where municipal fishermen are located are Southern Tagalog (Region IV-A), Bicol (Region V), and Central Visayas (Region VII), which between them account for almost 40% of the total (see Figure 1). In addition, it is thought by many that there are probably large numbers of families not included in official statistics that gather molluscs or fish for for their immediate household consumption.

In 1976 the total value of fish production was ₱7.3 billion. Despite its 55.4% share of production, however, the value of municipal fisheries catch was estimated at only ₱2.7 billion, or 37% of the total value. While the average wholesale prices for fishpond and commercial production were estimated to be ₱7.60/kg and ₱7.35/kg, respectively, the average wholesale price for municipal fisheries catch was only ₱3.50/kg.

Municipal fisheries catch is either sold fresh, consumed fresh by the household, processed by the household, or sold to local processors. It is thought that the catch, which is landed at points dispersed throughout the country, may compose a significant proportion of fishery products that move through the marketing chain to the final consumers. By no means does the catch appear to be restricted in distribution to the immediate locale where it is caught. Of course, in the more isolated areas of the country, catch distribution is more likely to be restricted. Recent marketing studies appear to indicate a surprisingly high degree of integration between the marketing of municipal and commercial catch (see Section VI for an elaboration of this point of view).

Table 1. Annual catch: municipal fishing (marine and inland), 1955-1977. Catch and value data are from Fishery Statistics of the Philippines, BFAR, Manila.

Year	Catch (mt)	Value (P1000)[2]	Value per kg[2]	As % of total catch[1]
1955	218,983	201,465	P0.92	60.3
1960	264,481	274,560	1.04	59.5
1965	303,930	328,245	1.08	45.5
1966	326,725	329,990	1.01	46.3
1967	351,229	403,914	1.15	47.1
1968	444,179	631,139	1.42	47.5
1969	477,492	709,557	1.49	50.8
1970	570,546	857,717	1.68	51.6
1971	542,904	1,123,811	2.07	53.1
1972	598,733	1,389,061	2.32	53.3
1973	639,795	1,599,487	2.50	53.1
1974	684,498	2,395,743	3.50	54.0
1975	731,725	2,561,037	3.50	54.7
1976	772,525	3,754,472	4.86	55.4
1977	874,934	4,374,670	5.00	58.0

[1]Remainder from commercial fisheries and from fishponds.
[2]Values from 1965 are computed at estimated wholesale prices.

[1]Summarized primarily from FIDC (1978). Papers and Proceedings, National Workshop on Municipal Fisheries Development, Dec. 1977, Cavite City, Philippines.

[2]For a complete discussion of the reliability of these statistics see Section II, p. 9.

Table 2. Production of municipal fishing craft and fishermen productivity by regions, 1976-1977. Catch data are from Fisheries Statistics of the Philippines, BFAR, Manila.

Region Marine	1976[1]	1977[1]	Estimated no. of fishermen[1]	Annual catch per fisherman[1]	Estimated no. of vessels[1]	Percent motorized
I	16,432	13,487	43,553	.34	13,018	47
II	3,834	6,099	11,793	.42	2,759	27
III	15,416	4,299	36,595	.27	24,926	95
IV	89,129	2,904	66,026	1.49	24,369	
IV-A		105,019				60
V	136,642	135,732	63,912	2.13	26,409	38
VI	52,319	87,040	35,865	1.94	14,506	28
VII	65,436	38,714	67,147	.78	52,770	39
VIII	73,724	73,635	46,549	1.58	18,661	48
IX-A	32,275	97,730	44,111	1.71	15,434	33
IX-B	21,020					
X	59,461	49,728	29,419	1.86	22,253	28
XI	40,303	84,795	42,536	1.47	18,158	62
XII	13,154	13,332	13,159	1.01	10,326	9
Subtotal marine:	619,145	712,514	500,665	1.33	243,589	46
Inland[2]	153,380	162,420	unknown	unknown	unknown	unknown
Total:	772,525	874,934				

[1]Estimated numbers of fishermen and vessels from BFAR Expanded Fisheries Development Program, 1977. Annual catch per fisherman is derived by averaging regional catch for 1976 and 1977 and then dividing by the number of fishermen.

[2]Excluding fishponds, but including production from Laguna de Bay fishpens.

B. PROBLEMS OF MUNICIPAL FISHERMEN

The coastal and inland fisheries exploited by municipal fishermen are "open-access" in nature; that is, the resource belongs to the fisherman who harvests the catch. When entry to fishing is not restricted or controlled, it is possible to predict the inevitability of overexploitation of the resource and overcapitalization of the fishing industry. International literature abounds with both theoretical and empirical examples of these phenomena.[3] The resulting economic and biological overexploitation leads to dissipation of rent from the resource and lower returns than could have been obtained with reduced numbers of fishermen. Even underexploited resources, such as exist in certain parts of the Philippines (primarily Palawan and Sulu), will produce low returns for the fishermen if they are so geographically isolated that the catch cannot readily be transported to markets. The "open-access" nature of the resource and the extreme perishability of the catch thus combine to create a situation where fisherman incomes are likely to be low.

The concern that President Ferdinand E. Marcos has shown for the small fisherman has brought to the forefront the extremely low levels of income of most municipal fishermen and the low standards of living that most of them enjoy. Results of recent socioeconomic surveys indicate annual per capita income levels of slightly more than ₱700 (see Section V). With an average household size of 6.3, annual household incomes average about ₱4,500. In 1974 the Development Academy of the Philippines (DAP) Social Indicators Project established a total threshold of ₱7,738 for a six-member household that "states the barest minimum by which subsistence can be theoretically achieved" (Abrera 1976, p. 244). Inflating by the cost of living index from Table 3 ("All items"), a threshold of ₱10,621 would be necessary for a six-member household in 1978. Average fishing household incomes, not counting household-produced items that are consumed by the household, thus appear to be approximately one-half of the threshold level. Of course, one can always argue about the establishment of poverty thresholds (see Abrera 1976 for a discussion of alternatives), but there seems little doubt that munic-

[3]See, for example, Chrsity and Scott (1965), Lawson (1975), Marr (1976), Yap (1977) and Smith (1979a). Copes (1970) introduces the effect of demand on levels of resource exploitation, without which any economic analysis of the fishery would be incomplete.

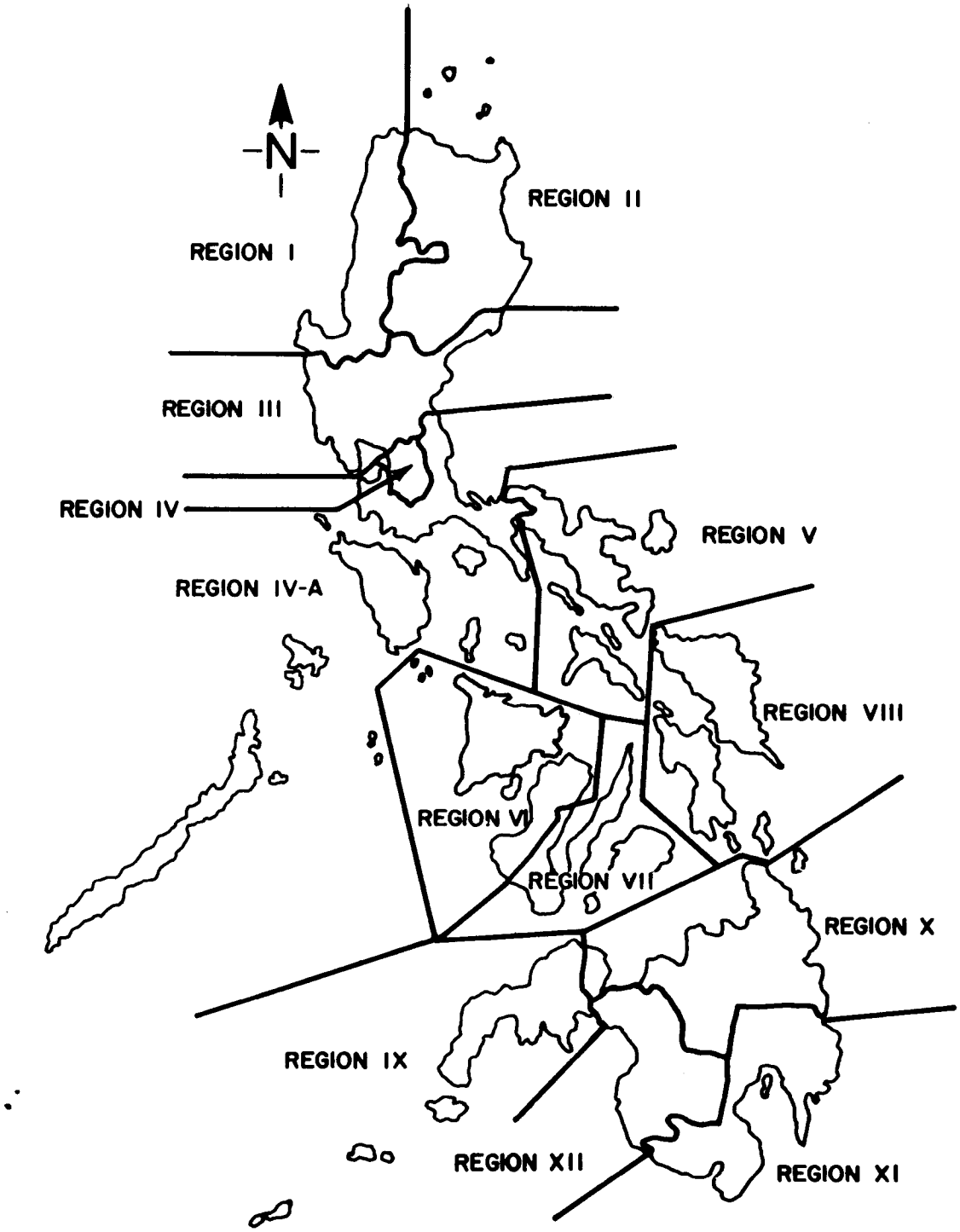

Fig. 1. The 13 administrative regions of the Philippines.

ipal fishermen are among the poorest of the poor.

One of the major causes of these low income levels appears to be the low productivity of the fishing activity. As shown in Table 2, although productivity varies from one region to another, it is uniformly low, averaging on a nationwide basis only 1.33 mt per fisherman annually. Coupled with the relatively low prices received by the fishermen (estimated to be ₱1.50 to ₱2.50/kg), income derived from fishing is low. Moreover, with the exception of baby trawls that catch shrimp and of fishermen who catch tunas, the municipal catch is composed primarily of the lower grade, and hence lower priced, species.

Incomes within fishing communities vary, however, depending upon ownership of productive assets. As further discussed in Section V, there is considerable variation in fishing incomes between boatowners and nonboatowners, and between owners of motorized boats and owners of nonmotorized boats. The ratio of municipal fishermen to boats is approximately 2:1; thus, many own no boat at all. Slightly less than half (46%) of municipal fishing craft are estimated to be motorized.

Many fishing families apparently supplement their income from other agricultural and service activities. However, "for very poor rural families (those reporting annual incomes of ₱1,000 or less), who accounted for 22% of the total in 1971, fishing activities are a more important source of income than either agricultural or nonagricultural wages" (World Bank 1976, p. 96).

A further contributing factor to the low standards of living of most municipal fishermen is inflation. While retail prices of fish have more than tripled since 1972 (see Table 3), it is unlikely that prices received by fishermen have increased three-fold in the same period. On the other hand, retail prices of food and clothing approximately tripled since 1972. Most importantly, fuel that is required by almost 50% of municipal fishing vessels had more than tripled by the end of 1979, and a further 50% increase went into effect in February 1980. The cost of regular gasoline required for the Briggs and Stratton engines used by municipal fishermen is now ₱4.30 (US$.59) per liter. Due to transport costs, the net effect of these price changes has probably been to leave the poorest rural families dependent upon fishing worse off in 1980 than they were in 1972. This conclusion is supported by a recent study of the Asian Development Bank (1977, p. 53) that observes: "there is evidence of a decline in real wages . . . brought about by the runaway inflation in the 1972-1974 period," and by Abrera (1976, p. 260) who concludes that "poverty is clearly on the rise."

Three fishing community workshops held in 1978 as a follow-up to socioeconomic research studies conducted in the same communities (see Section IV) produced a listing of problems from the perspective of the fishermen themselves. Problems raised by the fishermen include those related to the resource, to technology, to marketing, and to social conditions. As such, they are really "symptoms" of the underlying dependence of municipal fisherman on an open-access resource which is highly perishable once caught, and of the lack of or difficulty in taking advantage of alternative sources of income in communities that are geographically isolated and/or socially disadvantaged.[4]

Table 3. Price indices of selected items, 1970-1978 (1972 = 100). Data are from Central Bank of the Philippines.

Year	All items[3]	Food[3]	Clothing[3]	Fuel[2]	Fish[2]
1970	78.3	71.6	81.6	66.2	64.5
1971	90.1	87.6	92.8	84.3	86.7
1972	100.0	100.0	100.0	100.0	100.0
1973	117.0	115.8	115.7	109.3	106.4
1974	157.0	155.1	172.3	161.4	152.5
1975	167.3	163.2	186.1	186.5	169.7
1976	183.5	178.7	195.6	210.1	186.4
1977	202.4	196.3	217.2	217.7	201.6
1978[1]	217.0	208.2	237.1	221.2	221.9
1979	252.1	238.5	277.2	275.9	279.5
1980[1]	277.0	258.2	310.8	321.3[4]	340.8

[1]Thru January 1980.
[2]Retail price index in Metro Manila.
[3]Consumer price index for all income households in areas outside Metro Manila for 1972-1978. 1970-1971 is consumer price index in Metro Manila of the commodity chiefly of domestic origin (not using imported inputs).
[4]Fuel prices increased by a further 50% in February 1980.

The following problems were identified by fishermen in the three communities:

1. Related to the resource
   a. Low volume of catch thought by fishermen to be caused by overfishing, dynamite fishing, use of fine mesh nets, nonenforcement of the 7-km ban on commercial trawlers, and pollution.
   b. Competition between traditional fishing methods, e.g., fish corral, and more advanced methods, e.g., baby trawl; also loss and destruction of crab traps.
2. Related to technology
   a. Lack of gear and motorized vessels, due in part to lack of capital.

[4]In other words, the fisherman's opportunity wage (that which he could earn in the next best alternative activity) is low. The implication, which is really quite straightforward, is that fishing income could be raised, on the average, if the opportunity wage could be increased, and some fishermen thus encouraged to give up fishing (see Munro and Loy 1978 for a theoretical exposition on this point).

b. High prices of fishing equipment and inputs, especially fuel.

3. Related to marketing
   a. Fish landing area diminishing in size due to competing shore-based activities.
   b. Difficulties in preserving fish catch; spoilage.
   c. Lack of transport to market.
   d. Price uncertainty; no information on supply and prices from nearby markets; fish prices controlled by middleman.
4. Related to social conditions
   a. Unemployment and underemployment of fishermen; no alternative income sources.
   b. Catch sharing system resulting in low income to fishing laborers who own neither vessel nor gear.
   c. Poor sanitation and malnutrition; insufficient potable water; nursery schools discontinued for lack of funds.
   d. Nonownership of land; limited barrio site (squatting only).
   e. Theft and damage of gear by transients.

The workshop reports also named "lack of cooperation among fishermen" and "large families" as problems from the fisherman's perspective, but it would appear that these are more likely to reflect the points of view of government officials who were also in attendance. The National Media Production Center (NMPC) recently staged educational skits written by teenage children of fishermen in several coastal fishing communities. Of the themes chosen by the teenagers, one dealt with alcoholism; another depicted the deteriorating image of fathers in fishing households.[5]

In attempts to alleviate these problems, municipal fisheries development programs of the Philippine government have been primarily directed towards motorization of boats (bancas) and improvements in fishing gear. Programs to improve marketing and encourage alternative income sources for municipal fishermen are recent additions to the list of potential solutions.

Municipal fisheries must be viewed as part of the larger, particularly rural, economy. The World Bank (1976) points to an "increasingly important structural transformation in rural areas in the Philippines. The quick growth of (rural) service employment has clearly eased the pressures of migration in major urban areas . . . Rapid expansion of the rural nonfarm population will probably continue, thus raising the policy issue of employment prospects for this group" (p. 106). Moreover, if a reverse urban-rural migration trend is becoming established, coupled with an already rapidly growing rural population,[6] the implication is for increased numbers of households engaged in fishing. This means, then, continued strong pressure on the "open-access" fishing resource and continued low incomes, as average productivity remains low. This transformation and slowing down of rural-urban migration suggests that solutions to the poverty of municipal fishermen must be found in development programs aimed at the rural sector as a whole.

The following discussion of the resources, fishing technology, and socioeconomics of production and distribution examines each category in detail, maintaining that such an interdisciplinary approach is necessary to understanding the problems and potentials of municipal fisheries.

[5] R. Pestaño, National Media Production Center (pers. comm.).

[6] Between 1948 and 1975, rural population doubled from 14.9 million to 30.2 million (World Bank 1976).

Municipal Fisheries Resources

A. MARINE MUNICIPAL FISHERIES

An overview of total marine production is necessary to ascertain the potentials for expanding municipal fisheries production. Several attempts have been made within recent years to provide estimates, on the one hand, of Philippine marine fisheries production or levels of exploitation and, on the other hand, of maximum sustainable yield of demersal and pelagic species from Philippine waters. Taken together, these two estimates would show how close Philippine marine fisheries are to being fully exploited.

1. Levels of Exploitation

A useful assessment of the fisheries statistical base has been published by Juliano and Yutuc (1977a). The annual municipal fisheries production figures published by BFAR have long been thought to be understated. The figures reported through 1975 were based on a 1951-1958 survey in six municipalities, from which an annual production growth rate was projected. The extreme practical difficulties and costs of collecting data at the municipal level precluded any effort to improve these statistics until 1976 when, with the assistance of the South China Sea Fisheries Development and Coordinating Programme (SCSP), a more complete and representative sampling frame was designed (see Chakraborty et al. 1977). The resulting BFAR data for 1976 and 1977 (see Table 4) indicate a higher level of municipal fisheries catch than hitherto supposed. Total catch estimates of BFAR continued their steady upward climb (see Table 5).

However, using the alternative approach of estimating production by working backwards from fish consumption data implies that the improved BFAR statistics may still be understating present catch levels. The first group to estimate catch by extrapolation from consumer surveys was the NORCONSULT A.S. and IKO consulting group (1975). The NORCONSULT/IKO municipal catch estimate consisted of the residual after subtracting commercial catch and fishpond production from the estimated consumption figure, adjusted for waste in distribution and for imported marine products. Most researchers place fair confidence in the commercial catch data published by BFAR, based as it is upon adjustments (raising factors) to figures derived from enumerators' reports on fish landed and boat operators' reports of their catches. Subtracting the BFAR commercial catch data from consumption data in the manner of NORCONSULT/IKO thus appears reasonable. Somewhat less confidence can be placed in the BFAR fishpond statistics, because they do not cover freshwater ponds and because recent estimates of productivity increases from brackishwater ponds appear to have been made arbitrarily (Juliano and Yutuc 1977a). In any case, the NORCONSULT/IKO approach also resulted in a municipal catch estimate that exceeded previous estimates. However, NORCONSULT/IKO estimates show declining total production between 1970 and 1974.

In addition to the NORCONSULT/IKO report, the Philippine Food Balance Sheet, published by the National Economic and Development Authority (NEDA) since 1953, also indicates a higher level of fish supply than is estimated by BFAR. NEDA adds estimates of production from inland waters, and of crustaceans and molluscs, to marine estimates, to reach their estimated fish production figure of 2.0 million t in 1976. Comparisons of the BFAR, NORCONSULT/IKO, and NEDA estimates are shown in Table 5.

Juliano and Yutuc were quite rightly suspicious of the NORCONSULT/IKO calculations that implied declining total production. Using essentially the same approach as the NORCONSULT/IKO study, their work was conducted as part of a study entitled "Population, Resources, Environment and the Philippine Future" (PREPF 1977), conducted jointly by the DAP and the University of the Philippines School of Economics, and the U.P. Population Institute. They examined the extent to which the BFAR statistics could be used as a benchmark from which projections of the fisheries situation to the year 2000 could be made. The PREPF study, like the NORCONSULT/IKO study that preceded it, made use of consumer surveys conducted by the Marketing Research unit of the National Food and Agriculture Council (NFAC), but adjusted the consumption data to reflect an average figure for the 1973-1975 period. The PREPF study also concludes that the BFAR figures are understated for the 1970-1975 period (see Table 5) and suggests that an average annual production figure of 1,539,400 mt (net catch after deducting spoilage and waste) should be used as the benchmark for discussions that relate present production levels to estimates of maximum sustainable yield. For this suggested figure of 1,539,400 mt, Juliano and Yutuc estimate the following breakdown:

Aquaculture	156,700	mt or 10.2%[1]
Commercial Fisheries	437,300	mt or 28.4%
Municipal Marine	866,300	mt or 56.3%
Municipal Inland	79,100	mt or 5.2%
Total	1,539,400	mt

[1] BFAR estimate of production from brackishwater aquaculture is approximately 115,000 mt for the same period. The higher PREPF estimate includes brackishwater harvest of other species besides milkfish, such as shrimp and crabs, and also includes harvest of tilapia from freshwater ponds.

Table 4. Production of municipal fisheries (marine) by major groups, 1976-1977. Data are from the 1976 and 1977 Fisheries Statistics of the Philippines, BFAR, Manila.

ISCAAP Group No.[1]	Species group	1976	1977
24	Shads, milkfish	2,860	910
31	Flatfish (kalangkao, dapa, palad)	867	1,071
33	Perches, breams, snapper, eels, etc.	143,866	138,633
34	Jacks, scads, mullets, garfish, etc.	125,909	135,311
35	Herrings, sardines, anchovies, etc.	143,196	177,779
36	Spanish mackerel, tuna, billfish	102,271	165,462
37	Mackerels, hairtails	32,032	37,482
38	Sharks, rays	8,849	8,796
39	Miscellaneous marine fish	797	101
42	Crabs	8,402	9,122
43	Lobsters	153	489
44	Shrimps, prawns	27,812	17,187
47	Miscellaneous marine crustaceans	207	99
52	Molluscs	28	9
53	Oysters	-	33
54	Mussels	415	1,697
55	Scallops	4,894	4
56	Clams, cockles, and shells	631	3,030
57	Squids, cuttlefish, octopus	15,824	14,868
72	Marine turtles	57	268
75	Sea urchins, etc.	12	8
76	Miscellaneous aquatic invertebrates	4	5
94	Seaweeds and miscellaneous aquatic plants	59	150
	Total:	619,145	712,514

[1]ISCAAP grouping–includes species of fish belonging to same group and sub-class.

Table 5. Philippine fisheries production estimates (000 mt). Data are from Fisheries Statistics of the Philippines, BFAR, Manila; NORCONSULT/IKO; and PREPF as reported in Juliano and Yutuc (1977a).

Year	BFAR	NORCONSULT/IKO	NEDA	PREPF
1970	984	1,877	1,360	1,443
1971	1,023	1,907	1,405	1,457
1972	1,122	1,657	1,516	1,536
1973	1,205	1,684	1,614	1,599
1974	1,268	1,545	1,684	1,631
1975	1,337	–	1,977	1,569
1976	1,393	–	2,008	–
1977	1,509	–	–	–

Note: These estimates include commercial, municipal inland, municipal marine, and aquaculture. The NEDA production estimates of "salt water fishes, big shrimps, crabs, and squids were obtained from the BFAR. Additional data on the production of fresh water fishes, snails, clams, oysters, and other species of shrimps and crabs, as well as on other kinds of marine products that are not included in BFAR's report, were estimated on the basis of nutrition survey results conducted by the Food and Nutrition Research Institute (FNRI)" (NEDA 1979, p. 48).

NORCONSULT/IKO had concluded that total production was levelling off. Since production from commercial fisheries and aquaculture was increasing during this period, the inference is that municipal fisheries production, though averaging 866,300 mt, was declining.

Because the Juliano and Yutuc procedure appears to greatly understate the amount of spoilage and waste after catch, their estimate of total production is probably low. Their estimate of spoilage is 15,000 mt, which is less than 1% of the total catch. Although no exact measurement has been made of waste in the Philippine fisheries, estimates made elsewhere in the tropics have ranged as high as 20-40% of catch (Craib and Ketler 1978; Campbell 1975). If only one-half of this level is introduced to the Juliano and Yutuc calculations, the resulting estimate of total catch approaches 1.8 million mt.

The improved BFAR statistics for 1976 and 1977 are, nonetheless, much closer to the earlier estimates of PREPF and NEDA. One important finding of the PREPF study is that the Philippine fisheries catch remained relatively unchanged over the 1972-1975 period.

Increases in production from the commercial and aquaculture sectors were offset by a decline in marine municipal fisheries catch. Although a downward trend is not yet convincingly apparent, Juliano and Yutuc conclude that "there is possible overfishing in our coastal waters by municipal fishermen, as reflected in the declining production from this sector" (p. 1232). This levelling off of catch is generally attributed to the concentration of fishing effort by both municipal and commercial fisherman in the traditional fishing grounds near the coasts. As pointed out by Dela Cruz and Yutuc (1977), over 90% of the larger commercial vessels were used second-hand boats bought from other countries. Due to the antiquated condition and generally small size therefore of most of these commercial vessels, the fishermen tend to concentrate their fishing activity in the coastal areas inside the 100-m mark.

In summary, then, estimates of total production from all fishery and aquaculture sectors cluster in the 1.4-1.8 million mt range. Municipal fisheries catch, which is estimated to provide approximately 55% of the total, would therefore be 770,000-990,000 mt and total marine catch would be in the range of 1,162,000-1,500,000 mt. The next step is to compare this estimate with estimations of maximum sustainable yields from Philippine waters.

2. Estimates of Maximum Sustainable Yields[2]

To estimate the maximum sustainable yields (MSY) of Philippine marine waters, two different approaches have been used. One approach derives estimates of potential productivity per square kilometer of continental shelf and deeper waters and then multiplies these estimates by the total area. The second approach examines catch and effort data by species, where it is available, and attempts to estimate whether the MSY for specific species has yet been reached or surpassed. Yutuc and Trono (1977), and Juliano and Cerdena (1977), both as part of the PREPF study, and the FIDC (1977b) have brought together information from both approaches which can be summarized and critiqued here.

Estimates of average productivity per unit area for the Philippines will also be compared with estimates made for tropical waters elsewhere in the world. For comparison purposes, three variables must be considered: 1) average productivity per square kilometer; 2) area considered; and 3) mean depth of area considered. All three variables are tabulated for all MSY estimates in Table 6. Average productivity per square kilometer is plotted against mean depth of area considered in Figure 2. As will be shown, there is a consistency to average productivity estimates by depth against which recent Philippine MSY estimates can be compared.

To estimate potential yields from Philippine coastal waters, using the first approach, one needs to know 1) productivity per square kilometer of continental shelf and 2) the continental shelf area. In the Philippines, there has been considerable disagreement over both. Kvaran (1971) estimated MSY from marine waters to be 1.65 million mt by adding separate estimates of demersal and pelagic MSY from continental shelf area, and of pelagic fish MSY from deep waters. His estimate of continental shelf MSY (both demersal and pelagic) was 1,350,000 mt. By assuming that municipal fisheries can catch 55% of total production (compared to 28% from the commercial sector), and thus two-thirds of demersal and pelagic species from the shelf area, municipal fisheries MSY would thus be approximately 895,000 mt or the mid-point of the estimated range of current municipal catch established in the preceding section. Kvaran's estimates were based on a shelf area (0-200 m) of approximately 200,00 km,^{2} and translated into an average productivity of 3.5 t/km^2 (demersal) and 3.25 t/km^2 (in-shore pelagic), or a total average productivity of 6.75 t/km^2 for the continental shelf area to 200 m. Kvaran's estimate of MSY from deeper waters (300,000 mt) beyond the continental shelf was based on an assumed productivity of 0.2 t/km.^{2}

Kvaran's estimates were followed by those of Menasveta et al. (1973) and Aoyama (1973). Based on Gulland's (1971) formula,[3] and comparison with other South China Sea areas, Menasveta et al. estimated Sulu Sea pelagic productivity and continental shelf demersal productivity at 0.5-.65 t/km^2 and 2.75 t/km,^{2} respectively. MSY for Philippine fisheries was estimated at 1,024,000 mt, comprising 604,000 t pelagic and 420,000 t demersal.

NORCONSULT/IKO (1975), using a slightly smaller area of continental shelf than Kvaran (185,000 km^2) but a much higher average productivity (20 t/km^2), estimated MSY for Philippine waters to be 3.7 million mt. The NORCONSULT/IKO productivity estimate was based upon an approximate 10 t/km^2 catch level (1975) and the very arbitrary assumption that improved technology would double productivity to 20 t/km^2. They failed

[2] The advice of Dr. Daniel Pauly of the ICLARM staff was extremely helpful in preparing this subsection.

[3] ($C_{max} = .5M \circ B_o$), where C_{max} = maximum sustainable yield; M = natural mortality; B_o = virgin biomass. This formula implies that the maximum yield is taken when the biomass is fished to approximately half its virgin size.