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OVER-FISHING AND CONFLICT IN A TRADITIONAL FISHERY: A RESOURCE MANAGEMENT DILEMMA*

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I. INTRODUCTION

San Miguel Bay in Camarines Sur province of the Philippines is a major fishing ground on the country's Pacific coast. The bay is relatively shallow and very productive. While a great variety of fishes make up the aggregate catch, the most important in terms of economic value are the shrimps. Aside from its productivity (and consequently its economic relevance), the bay is instructive as a case study because it is a very well defined fishery where the patterns of population pressure and resource over-exploitation may be clearly identified.

In addition, the role of government intervention in increasing fishing effort and the introduction of non-traditional fishing techniques have triggered off instances

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of conflict which cannot be resolved in the current institutional context of traditional fisheries in the Philippines. This resource management dilemma arises because the formal institutional structure for resource management does not recognize the common property attributes of the fishery. The trend therefore is to treat the resource management problem merely as a case of enforcing fishery access rights in much the same way as conventional private property.

We will first present our data sources and describe the physical and technical characteristics of the bay fishery. The paper will then relate how government intervention and the introduction of new technology (specifically trawling gear) have brought about conflicts that go beyond the changes that may be expected from increasing population pressure in the area. Indeed, the process highlights the presence of a resource sustainability threshold beyond which transition is not gradual and is characterized by conflict.

Data Sources

San Miguel Bay is located in Camarines Sur province in Region V (Bicol) of the Philippines (refer to Figure 1). The primary data on this area is based on fieldwork in four municipalities of Camarines Sur that border the bay: Sipocot, Cabusao, Calabanga, and Tinambac. The major part of interviews were made during 1981, and more recently follow up fieldwork was done in 1984.

The basic objective of the choice of respondents was to focus on the important gear types and the complex of

institutional arrangements governing the utilization of these gears. These gears were therefore ranked according to popularity of use in the area based on the results of a major survey of the bay conducted by the University of the Philippines Institute of Fishery Development and Research (IFDR) and the International Center for Living Aquatic Resource Management (ICLARM) in 1980 and 1981. Please see Smith, et al., 1983, for a full description of this research. Thereafter the relative popularity of each of the ten gears in each of the survey villages was determined by dividing the number of a particular gear type by total fishing households in the barrio. The listing of the top ten gears and their relative popularity is presented in Table 1.

The primary technique used in the investigation was unstructured interviews of informants involved in the relevant fishing activity in each of the village, and the choice of the informant was based on their familiarity (as ascertained by barrio captains and IFDR-ICLARM field researchers) with the history, the operation, and the institutional arrangements pertaining to a particular gear Please see Appendix I for the list and description of respondents.

II. RESOURCE ATTRIBUTES AND FISHING TECHNOLOGY

The location of San Miguel Bay on the Pacific coast of Luzon island makes fishing activity in the bay markedly seasonal. From April to September, the period of the

Southwest Monsoon (amihan), the entire bay is fairly well-protected. However, very little fishing activity can take place (except along the Tinambac village side) during the Northwest Monsoon (habagat) from October to March.

The bay itself covers approximately 840 square kilometers with the modal depth being only less than 7.2 meters.[1] The bottom of the bay is generally muddy which makes it ideal trawling ground.

Consistent with the multi-species nature of the fishery, a great variety of fishes make up the aggregate catch. The most important in terms of total economic value are the shrimps. Other species are the croakers, anchovies, sardines, and mullets. Trashfish that are usually found are undersized slipmouths and goat fishes.

The resource is clearly renewable. The Bicol River, by introducing large quantities of freshwater into the bay, gives the fishery estuarine characteristics and very high productivity. It has recently been estimated that aggregate catch is 19,000 tons (Smith, et al., 1983) of which shrimps make up the most part (SCSP, 1978).

Exclusion is very difficult except along the river and the shore where the right to set fixed gears have traditionally been allocated by informal village resource managers called amoionadors.[2] While the fishing activity

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[1] Much of the discussion of the characteristics of the bay is taken from Jan Michael Vakily, The Exploitation of a Fishing Ground in the Philippines, (Kiel, Germany: Aus dem Institut fur Meereskunds an der Christian Albrecht-Universitut, 1980).

itself is essentially open, a potential exclusion point is at the fish landings since the catch, in the absence of ice storage in most of the boats, must be disposed of immediately, and there are limited landing areas (normally one per village).

Fishing Technology

A great variety of fishing gear is used in traditional small-scale fisheries. The diversity of techniques used is due to the different fishing environments exploited and to the presence of many different types of fish. Even within a household, more than one gear is available, at least for the different fishing seasons during the year.

The different locations of villages and the resulting variation in terms of occurrence of species and seasonality result in varying choice and use of gear. While variation is required by the resource environment, the prevailing techno-institutional context tends to impose some basic similarities that cut across the different gears. On the whole then gears are simple, usually constructed by the household. Accordingly, access to such technology is quite open for most members of the fishing community (see Table 2).[3] Such easy access to gears in terms of capital

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2The amojonador loosely translates as "the one who sets the boundary." See Part V for a detailed description of his functions.

3Before the entry of commercial fleets and government gear upgrading programs, very few boats were motorized, and consequently even these were inexpensive.

requirements is consistent with the generally low levels of accumulation that obtain in the fishing community. Another aspect of the prerequisite of consistency may be pointed out: with respect to the marketing channels for excess production, the low volumes of catch and the important species in the catch are associated with a particular type and level of development of product distribution and processing. Consequently attempts at innovation require a sensitivity to a much broader range of problems and potentials than is generally recognized.

This concept of techno-institutional consistency pointed out above allows us to group the variety of gears in use into two major types. From Table 2 we may note that the baby trawlers (medium and small), characterized by high energy use, large capitalization (relative to labor absorption), and a primarily market-oriented level of catch represent an essentially capital intensive technique of resource exploitation. On the other hand, the proliferation of all the other gears generally represents an extensification in resource use. The only reason why some of these traditional gears have recently risen in capital requirements has been due to the motorization of required boats (e.g., used for operation of gill nets, lift nets), the inflated costs of traditional construction materials (especially for stationary gear), and the substitution of synthetic for traditional materials (especially for nets). Thus the make of traditional gears has changed -- somewhat improving efficiency and output-increasing capacity -- but

their basic ability to exploit the resource has not changed. More importantly the techno-institutional context for their use is not characterized by the major linkage of the baby trawl system on input and output markets.

III. PERIODS OF RESOURCE EXPLOITATION

We have identified three periods of resource exploitation corresponding to conditions of relative abundance (before the 1950s), population pressure and resource circumscription (during the 1950s), over-fishing and conflict (since the mid-1970s).

In evaluating the conditions of population pressure and resource circumscription in our case study area, a major problem is the lack of direct information on the resource environment's ability to support settlement and expansion in Camarines Sur province in general and in San Miguel Bay in particular. One solution to this problem is to consider time-series data on population growth and density for San Miguel Bay, Camarines Sur, the Bicol region, and the Philippines to arrive at general patterns of population growth and the implications for resource availability. Against these we may then compare our observations on population pressure in the case study area.

Table 3 presents population growth rates for the Philippines, Bicol region, Camarines Sur, and the four villages in San Miguel Bay included in our primary survey. From the table, it is clear that there was increasing

population growth for the Philippines for the first five to six decades of this century. This trend is due primarily to improvements in medical technology which have significantly decreased rates of mortality (ESCAP,1978). A levelling off for the whole country occurred between 1960 and 1970 which reflects the long-term effect of resource circumscription -- e.g., the closing of the extensive frontier for agricultural growth (Crisostomo and Barker, 1973).

Relative Abundance (Before 1950s)

For the Bicol region, Camarines Sur province, and San Miguel Bay, population growth rates up to 1960 were generally above Philippine rates while after this period population growth in the former administrative units were much slower. The greater variance in growth for the smaller administrative units results from the increased importance of migration flows (in the sub-national regions) in amplifying growth trends based primarily on natural increase (as in the national case).

We may use this phenomenon to evaluate migration patterns (for which no long-term time-series information is available) in relation to the over-all population growth trends. First of all, we may conclude that the turning point in population growth for Camarines Sur and San Miguel Bay in the 1950s clearly precedes the decline for both Bicol region and the Philippines in the 1960s (see Figure 2). Secondly, after the 1960s the downward trend for population growth in Camarines Sur and San Miguel Bay was pronounced because of the national pattern of declining growth rates

and increase in out-migration (implied by the provincial and municipal rates being very much lower than national rates).

Advent of Population Pressure (1950s)

The pattern that emerges therefore is that Camarines Sur and (within it) San Miguel Bay experienced the closing of its resource frontier much earlier (in the 1950s) than the country as a whole.

With respect to population density, the four San Miguel Bay municipalities in our survey exhibit substantial variation in density measures within given years (see Table 3). Although their density is consistently lower than for Camarines Sur as a whole (reflecting the generally lower absorption capacity of a specialized fishery resource base), the two municipalities at the southern part of the bay (Cabusao and Calabanga) had consistently greater density than the two peripheral municipalities of Tinambac and Sipocot. The reason for this difference becomes immediately apparent when we consider the superior endowment of Cabusao and Calabanga in terms of fishery and agricultural resources and in terms of proximity to the important Naga City market (see Figure 3 on land use in the area).

Over-Fishing and Conflict (mid-1970s)

Standard over-fishing occurs when both increasing fishing effort and declining catch is observed in a fishery. This is based on Gordon-Schaeffer models of the relation between effort and catch. For multi-species fisheries, however, catch tends to level off beyond a certain effort

threshold (Larkin, 1982; Smith et al., 1983).

While the process of demographic pressure has led to increasese in fishing effort in San Miguel Bay, the problem has, since the mid-1970s, been compounded by technical change which has multiplied the effective effort being applied in the fishery. This is due to two specific developments. The first has been the program of the Philippine government to upgrade fishing technology by offering low-cost loans for motorizing fishing boats. In San Miguel Bay, 1,206 municipal fishermen received loans of about P4.5 million for this upgrading program (Smith et al., 1983).. At about the same time, an unusual form of technical innovation -- the baby trawl -- was introduced in the fishery. Capitalized at about P50,000 each in 1981, these are shallow-draft boats powered by diesel engines of 200 or more horsepower to allow them to pull trawl nets. The motivation behind the design was primarily to allow the boats to meet the small-scale classification (less than 3 gross tons) that will allow them to trawl within coastal waters. These two factors have substantially changed the level of resource exploitation and the pattern of distribution that has resulted in conflict in the fishery by the early 1980s.

IV. DECISION-MAKING ATTRIBUTES

Coastal fisheries in the Philippines have traditionally been characterized by open access exploitation. In San Miguel Bay, for the period of abundance, near-shore areas for fixed gear were allocated to specific families for exclusive use. As long as basic rights were respected (e.g., the right not to be disturbed once one's boat and gear have been set for the particular day's fishing), there was much room for individualistic decision-making.

For fishing villages in the bay, as with many other fishing communities, the degree of specific institutional controls on decision-making and interaction is quite limited. In comparison with rice farming communities -- where intra-village work is closely coordinated through exchange labor groups, irrigation associations and village councils -- the average fishing village exhibits relatively few instances of institutional control. In general, the organization of work in fisheries is characterized by less interdependencies among production units so that traditionally basic rules (e.g., versus the use of destructive fishing techniques) have sufficed for resource management.

The only operational rule that explicitly distinguishes the coastal fishery from open access conditions is the municipal jurisdiction over the gears that may be licensed to operate within three nautical miles from the shoreline. Additional depth limitations are set for the use of trawling

equipment: trawlers of more than 3 gross tons may operate only in waters more than 7 fathoms deep while the lighter ones may operate to as shallow a depth as 4 fathoms.

Now based on charts of the Philippine Bureau of Coast and Geodetic Survey, in the area of the 4 municipalities, maximum water depth in no instance exceeds 5 fathoms. In fact only very small portions of the area exeed 4 fathoms in depth (mostly off Cagliliog in Tinambac). Thus not even municipal trawling is legal in most areas.

V. PATTERNS OF INTERACTION

There are two important patterns of interaction that may be observed in the fishery. The first arises within the traditional fishery while the second reflects the relationship between the traditional and the trawl fishermen.

Of course in the period of relative abundance which antedates the entry of trawling interests, conflict as a pattern of interaction did not arise even with very limited external regulation from government. Even in the period of growing population pressure, within the traditional sector, interaction was characterized by mutual forebearance even in the face of declining average catch.

In fact, UPCF-ICLARM data show that even with the increasing pressure on resources and growing interdependencies, the majority of fishermen considered traditional techniques not destructive of the resource. Almost a quarter of all fishermen linked declining catch

with the growth of effort in the fishery. However, almost a third believed that the destructive activity was due only to the operation of trawlers in traditional grounds.

Informants in Castillo also claim that even with current conditions in their community, Mercedes based fishermen seasonally transfer to Castillo for the balao (tiny shrimp) season late in the year. No apparent conflicts have developed, suggesting the efficacy of traditional rules of access in coordinating these traditional activities.

However, there is a definite trend for increasing control of resource use through more formal means. Two examples became apparent during fieldwork in the area. First, the highly productive near-shore locations for fixed gear have been the subject of major changes over the years. Initially such sites were exploited informally, with fishermen respecting prior claims over resource use.

With increasing interdependence as the favorable sites filled up, and the potentials for interference increased, many communities evolved the function of the amoionador. According to informants, these were primarily respected elders in the community who had a good grasp of the history of family claims on fishing sites and whose primary duty was to regulate the entry of new gear so that least interference on the activity of existing gears could be assured. It was formally an unpaid position although the normal practice was for a small gift to be offered after the services of the

amojonador were rendered.

At present, the trend is for more regulation because with the decline in productive locations relative to population, there has been a tendency for the role of the amojonador to shift from informal coordination to formal regulation. In the bay, this function has been encompassed by the municipality, with an official being given the duty of licensing and coordinating fixed gear activity.

Our second example is perhaps the more important because it focuses on what is currently the major source of conflict in San Miguel Bay. The increasing encroachment of commercial trawing on traditional resources has resulted in the attempt by government to reserve the shallow, coastal grounds for traditional fishermen by requiring fishing to be licensed by the municipality. The widespread infraction of this rule has resulted in friction between the traditional fishrmen and the trawler operators.

VI. OUTCOMES AND IMPLICATIONS FOR MANAGEMENT

During the period of resource abundance, fishery catch was dependent primarily on the level of technology and not on differential access or endowments of rights to the resource (except for the case of near-shore fixed gear locations). Income distribution was therefore interesting only in terms of fishermen's access to technology and not in terms of resource endowment.

The growth of population pressure from the 1950s did not necessarily bring with it widespread dissatisfaction

with current resource management. While the over-all catch in the area might have been stable (or might have in fact slowly increased), there is no doubt that average catch started to decline in this period. The distribution of the catch according to traditional gears however did not significantly change. Indeed, the easy access to the different low cost gears must have been an important factor in stabilizing income distribution.

The sudden increase in effective effort coupled with the entry of the trawling fleet radically changed both overall catch and distribution conditions. Latest estimates for the fishery (by Smith et al., 1983) show that of the 19,000 tons total catch in 1981, the 5,000 or more small-scale fishermen caught only 60% of the total while the 95 trawlers in the bay got the rest. The situation they report is worse in terms of value of catch since the baby trawlers which represent only 3% of fishing units and employ only 7% of labor gets 42% of the P53.5 million worth of catch and over 50% of resource rents.

Because of the pace at which this transition has occurred (trawlers were introduced not more than 5 or 6 years before this estimate) and because of the unusual inaccessibility of this technology of fishing, this trend for resource over-exploitation and increasing concentration of the benefits of resource use has led to widespread dissatisfaction among traditional fishermen over the inability of the current institutional set-up to control trawling.

Inadequate enforcement of these regulations has fueled a growing discontent among traditional fishermen who complain not only of the indirect effect of trawling in terms of decreased catch but of numerous instances of destruction of nets and traps by illegal trawling. Cases of violent confrontations between trawlers and traditional fishermen have been reported. Also active organizational work among traditional fishermen is occurring especially in the communities in the eastern side of the bay where municipal leaders have tended to take the side of the small fishermen versus the owners of the trawlers.

Implications for Management

The program of fishery management for the bay needs to address the problem of growing interdependence (and conflict) due to: (1) a general increase in population levels leading to more potential conflict among traditional fishermen, and (2) a sharp increase in effective effort linked to the greater role of commercial trawlers in near-shore areas.

These two concerns point to the need for greater control and management of the fishery on the basis of techno-institutional and environmental considerations. With the growing interdependencies in fishing activity -- both among traditional fishermen and between the commercial and traditional sectors -- the community will be forced to evolve essentially new forms of cooperation for management of the resource -- forms that may require greater

interaction within the village level and more formal means of assuring access to resource use.

On an essentially technical level, what needs to be done is to demarcate near- from off-shore fisheries with the distinction being based on the technical capacity for resource exploitation of the traditional versus the commercial sector.

By reserving near-shore resources according to the capability for exploitation by the traditional sector, this approach not only allows the community a greater opportunity for internally generated adjustments, but it also helps decrease the potential for both recruitment and growth over-fishing in the coastal areas which principally arises from commercial intrusion. At the same time by limiting commercial fleets (primarily trawlers) to the off-shore areas that cannot be exploited by traditional techniques, capital will be channeled to the resources where the intensity of effort cannot be increased through the traditional fishery.

Because the determination of access to near-shore resources is tied to the capability of traditional techniques, such a program will be acceptable both in terms of historical access and current regional programs that implicitly differentiate access to fishing grounds by techniques used. Indeed, our approach may be interpreted as a rationalization of current trends. However this approach introduces the main advantage of providing a theoretical (vs. arbitrary) basis for the regulation of techniques of

capture.

It can be shown that this approach represents a rare case when the apparently conflicting national goals for fishery development in less developed countries of increasing production and promoting maritime community assistance (Emmerson, 1980) can both be adequately met. With respect to assistance, preventing commercial trawlers from exploiting near-shore resources will undoubtedly have beneficial implications for employment in the traditional fisheries. Although not as obvious, it is also the case that the limitation of technology in near-shore areas does not imply any long-term decrease in output potential but merely the imposition of a particular distribution of income.

The reason is that the maximum sustainable yield of the multi-species fishery is essentially fixed so that the real question is who can appropriate the catch. Given the presumption that without management the commercial fishery will not only monopolize the catch but deplete the stock as well, this program of management not only contributes to a viable fishery but assigns the problem of exploiting the more inaccessible grounds and adjusting to a smaller proportion of catch to the commercial sector. With the flexibility and resources that such adjustment requires, the commercial sector will be in a better position than traditional fishermen to make the investment or to find alternative income sources.

However, aside from the technical aspect the major problem remains the inability of municipal fishery officials to recognize the inadequacy of current institutions expected to govern the bay. In the current set-up, the common property attributes of the fishery and the potentials for interdependent decision-making and action cannot be exploited since the regulatory mechanism uses a licensing system dependent on centralized enforcement. Because such enforcement (given the extensive nature of the resource and the limited funds available to municipal authorities controlling the bay) will not work, there is a clear need to establish regulatory mechanisms that can utilize instead of ignore the common property attributes of the fishery. Indeed the growing interaction within villages and organizational efforts of local fishermen point to local participation that is just waiting to be harnessed.

Municipal governments therefore (while retaining their jurisdiction over current traditional fishing grounds) should increasingly formalize systems of village control over fishing grounds and fish landing sites. The specific form of organization should be determined from a detailed management study. On the one hand, the structure may require nothing more than a variation of cooperative organization. On the other hand, it may require separate legislation that will assign to the villages explicit legal rights and obligations for fishery management.

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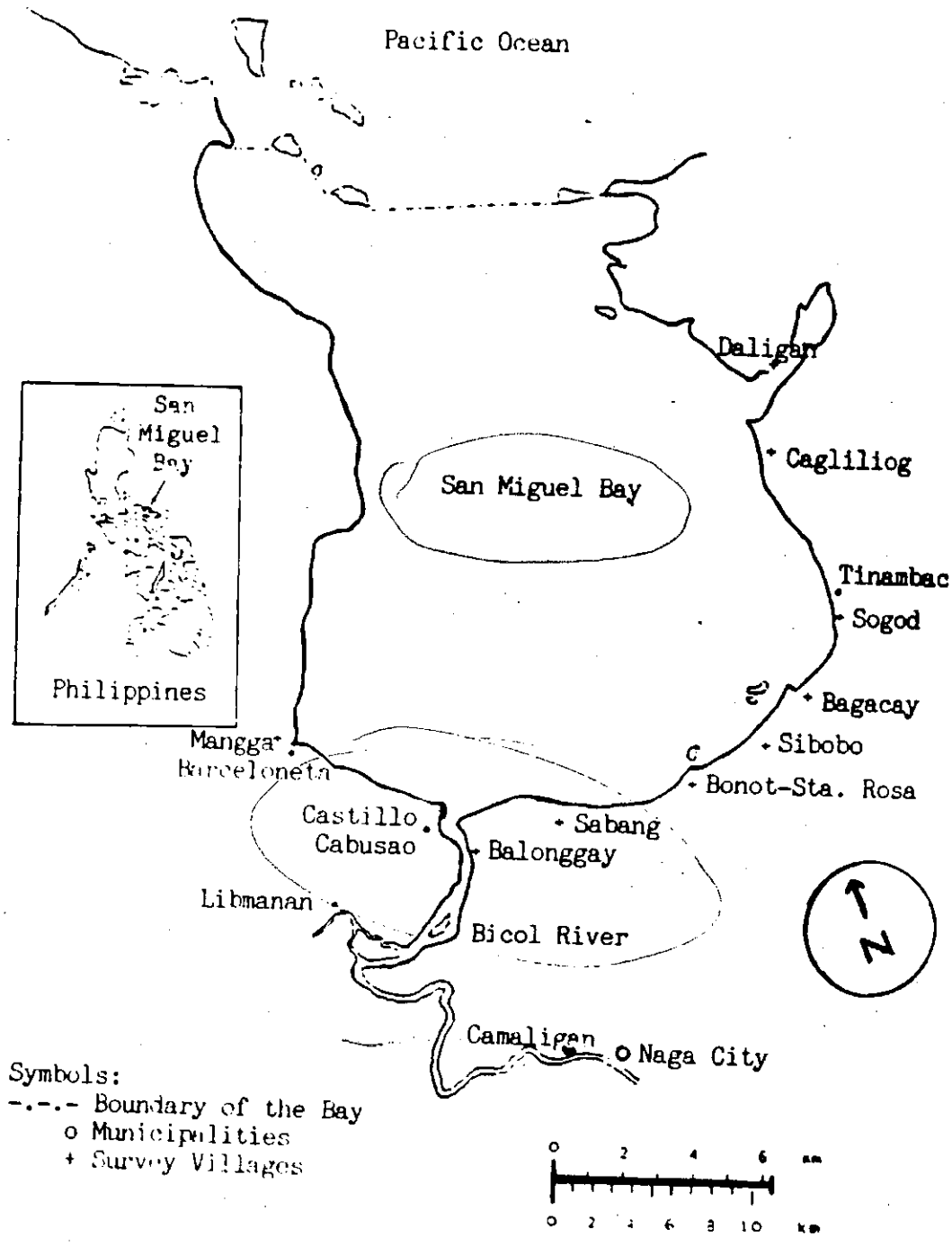


FIGURE I. San Miguel Bay

TABLE 1

Ranking of Gear Types and Their Relative Popularity in San Miguel Bay Communities

1980-81

	Rank of Gear 1	2	3	4	5	6	7	8	9	10
Gear[a]	Gill net	Sakag	Ban-wit	Baby trawl	Kit-ang	Boc-atot	Itik itik	Bubo	Sag-kad	Bia-cus
Number Used[b]	486	105	68	62	55	47	44	31	18	17
	Relative Popularity[c] (%)									
Sipocot Mangga	91	23				5			2	
Cabusao Castillo	71	71	2	1			29		1	8
Calabanga Sabang	37		1	27			44			
Balogsay	27	27	71		2				7	27
Bonot-Sta. Rosa	58	68	10		5	62	2	2	2	
Sibobo	81	53						12	15	
Tinambac Sogod	21		61			5	6			
Daligan	47		22		1			52		18
Bagacay		75		9						
Caglilog						52				

NOTES:

a. See Table 2 for a description of gear types.

b. Number of each corresponding gear reported in use in the bay from IFDR-ICLARM survey.

c. Relative popularity computed as number of particular gear divided by number of fishing households in the community; data based on IFDR-ICLARM community inventories.

Gill net 486 × 2 = 972

Sakag 105 × ? = 105

Barwit 68 × 2 = 136

Baby Trawl 62 × 5 = 310

Kitang 55 × ? = 55

Bocatot 47 × 5 = 235

Itik-Itik 44 × 2 = 88

Bubo 31 × 1 = 31

Sagkad 18 × 2 = 36

Biacus 17 × 2 = 34

972
105
136
310
55
235
88
31
36
34
2,002 employed in 1980-81
× 5 per family
10,010 beneficiaries, 1980-81
× 1/3
3,003 beneficiaries, 1937

52.4 (1939) = 1/3
168.1 (1975)

486
105
68
62
55
47
44
31
18
17
933

adj. for pre-1950's
1/3 × 933 = 311

TABLE 2. Gear Description and Requirements

Gear Type	Description	Capitalization	No. of Employed	Marketing
Stationary:				
Bocatot	A stationary lift net that works best in sheltered, shallow waters (characteristic of Caglilioq), requires a skilled :maestro: in the operation of lights and the lifting of the net	P6,400-P9,700	4-5	Specialized handling of significant volumes of anchovies
Biacus	A filter net set against a current thus requiring placement usually at the mouth of a river (characteristic of Daligan and Balonggay)	P2,200-P3,300	1-2	
Sagkad	A fish corral requiring shallow, sheltered water	P2,000-P4,000	1-2	
Net:				
Gill net	Drift or set gill net	P1,100-P3,800	2	
Trawl:				
Itik itik	A very small trawl usually powered by a 16 h.p. engine operates in shallow water	P4,300-P7,100	2	Specialized markets for balao
Baby trawl	A small trawler, usually around 3 G.T. in weight using a 190-240 h.p. engine	P44,500-P59,300	[illegible]	Large volume of catch to be marketed
Others:				
Banwit	Hook and line used for large fish species in rocky or coral-bottomed areas; requires knowledge of good fishing ground	P500-P3,200	1-2	
Kalikot	Hand operated scissors net used in shallow muddy water	P30-P50	1	
Bubo	Fish traps used for large fish species in rocky or coral-bottomed areas	P300-P3,400	1	

Notes:

1. Capitalization figures are approximate ranges for 1981 based on experience and observations of informants. Gill net, Bocatot cost includes motor boat (10-16 h.p. and 5-16 h.p., respectively). Biacus and sagkad cost includes non-motorized boat. The upper limits for Banwit and Bubo represent inclusion of small motor (about 5 h.p.)
2. Unless specified in marketing requirements column, specific gear needs no special marketing capability.

TABLE 3. Population Growth Rates and Density for the Philippines, The Bicol Region, Camarines Sur Province, and Four San Miguel Bay Survey Municipalities, 1903 - 1975.

Place	Annual Growth Rates 1903	1918	1939	1948	1960	1970	1975
1 Philippines		1.92	2.22	1.91	3.06	3.01	2.79
2 Bicol Region		1.75	2.38	2.21	3.13	2.25	1.48
3 Camarines Sur		0.81	2.74	4.10	3.72	1.47	1.54
4 Four SMB Municipalities		0.00	3.51	4.82	4.65	1.49	0.99

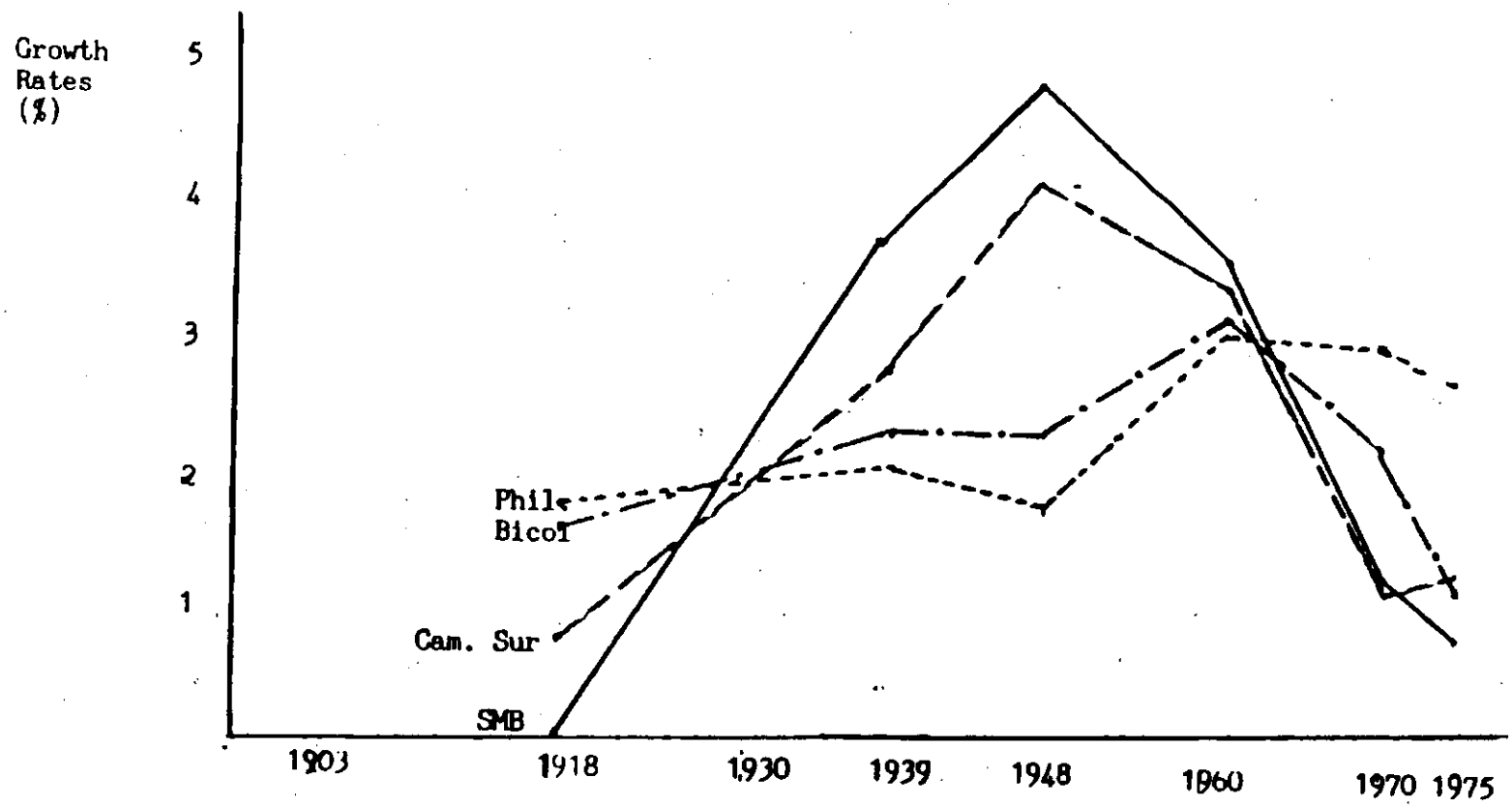
Place	Land Area (sq. km.)	Population Density 1903	1918	1939	1948	1960	1970	1975
Philippines	300,000	25.2	34.4	53.3	64.1	90.3	122.3	140.2
Bicol Region	17,632	36.5	47.6	76.4	94.5	134.0	168.3	181.1
Camarines Sur	5,267	36.8	41.6	73.2	105.1	155.6	180.1	194.4
Cabusao	47	66.1	54.4	100.9	109.2	170.6	193.2	219.1
Insistanga	164	43.6	48.5	92.0	132.9	173.6	211.7	233.7
Sipocot	212	13.2	12.9	37.4	85.3	172.9	180.0	191.8
7 Tinambac	416	16.8	17.4	34.6	44.6	91.5	115.1	108.9
Sum of (4) to (7)	739	25.0	25.4	52.4	80.0	138.1	160.1	168.1

Basic Source of Data: Philippines (Republic), Bureau of Census and Statistics, 1975.

1939: 5267 sq. km
× 41.6 people/sq. km.
31602
5267
21068
219072

1975: 5267 sq. km.
× 194.4 people/sq. km.

FIGURE 2. Population Growth Rates for the Philippines, the Bicol Region, Camarines Sur Province, and Four San Miguel Bay Survey Municipalities (1903-19)



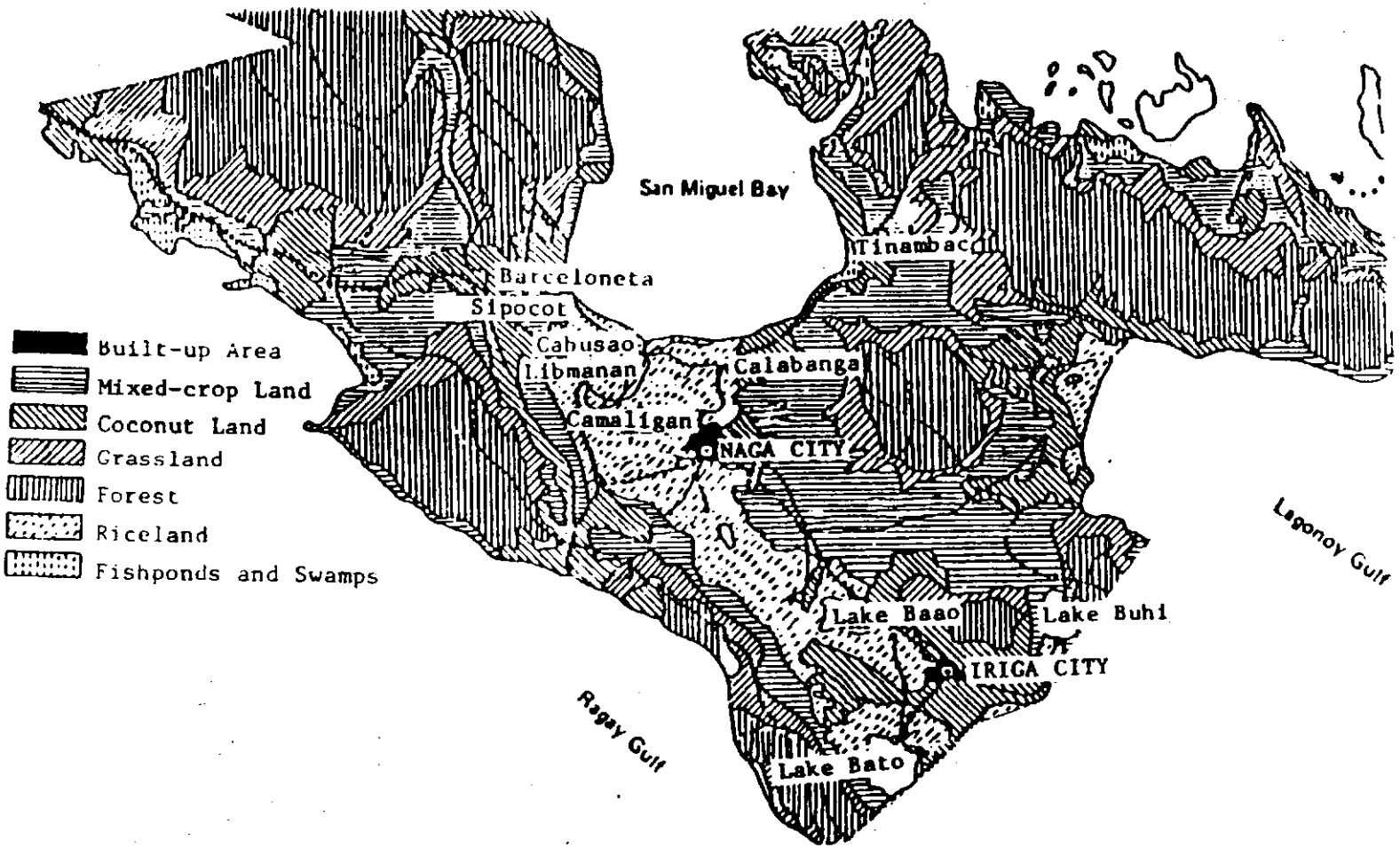


FIGURE 3. Land-Use Map of Camarines Sur

Source: Dennis A. Rondinelli, "Spatial Analysis for Regional Development: A Case Study in the Bicol River Basin of the Philippines," Resource Systems Theory and Methodology Series, No. 2, (The United Nations University), p. 11.

APPENDIX 1
Survey Areas, Sample Size, Description of Respondents and Topics Discussed

Location	n	Informant	Topic
Sipocot: Mangga	1	Pangke (gill net) operator	
Cabusao: Castillo	3	Municipal Development Officer	General Conditions of enforcement of fishing laws and problems of fishermen in Cabusao
		Fish Buyer	Systems of marketing and gill net fishing in Castillo
		Itik-itik (mini trawl) operator	
Calabanga: Sabang	12	Baby Trawl owner	History of trawling in San Miguel Bay: operation of gear
		Trawl net maker	Design, measurements of different trawl types.
		Kuto-Kuto (mini trawl, Itik-Itik) operator	
		Baby trawl operator	
Br[illegible]-Sta. Rosa		Bocatot (lift net) operator	
		Kalikot (scissors net, sakay) operator	
Sibobo		Pangke (gill net) operator	
		Sagkad (fish corral) operator	
		Bubo (fish trap) operator	
Balonggay		Banwit (hook and line) operator	
		Biacus (filter net) operator	
		Bintol operator	
Tinambac:	7	Acting Municipal Mayor	Lift net fishing conditions; trawler, gill net operation; conflicts
Sogod		Banwit operator	
Daligan		Biakus operator	
		Bubo operator	
Bagacay		Kalikot (scissors net variant) operator	
		Baby trawl operator	
Caglilog		Bocatot operator	

Notes: For the different gear operators, the interview guide (see Appendix 7.1) was used. These are detailed interviews; short interviews with minor informants are not listed here.