POPULATION, RESOURCES, AND PATTERNS OF TECHNOLOGICAL CHANGE: THE CASE OF PHILIPPINE FISHERIES

TOMAS VERGEL C. JAMIR

MARINE RESOURCE MANAGEMENT PROGRAM
OREGON STATE UNIVERSITY
CORVALLIS, OREGON 97331

1988

POPULATION, RESOURCES, AND PATTERNS OF TECHNOLOGICAL CHANGE: THE CASE OF PHILIPPINE FISHERIES

by

TOMAS VERGEL C. JAMIR

RESEARCH REPORT

SUBMITTED TO

MARINE RESOURCE MANAGEMENT PROGRAM
COLLEGE OF OCEANOGRAPHY
OREGON STATE UNIVERSITY
CORVALLIS, OREGON 97331

IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE
DEGREE OF

MASTER OF SCIENCE

SEPTEMBER, 1988

In memory of DAVID CAIMOL JAMIR (1918-1986)

... a true fisherman by heart, the people's respected maestro, and a good and loving father.

ACKNOWLEDGEMENTS

I would like to extend my sincerest thanks to the following: Dr. William Pearcy for his patience, constructive criticisms and guidance throughout my stay in the program; to the other members of my final examination committee, Drs. Jefferson Gonor and Bruce deYoung for the valuable time and critical insights/comments that they provided while reviewing this paper; to Prof. James Good, Kathryn Howd, and Donna Obert for their generous help and encouragement; and to Drs. Gordon Matzke and Charles Warren for providing me with a fresh and radically different perspective of looking into Philippine fisheries.

My deepest gratitude also goes to the Gonzales family for their kindness and moral support, most especially to Dr. Manolette Gonzales for serving as my informal mentor and primary "testing ground" for my ideas; to Dr. Kevin Hopkins and Margarita Hopkins for providing me with a lot of useful materials and references on Philippine fisheries; to Dr. Magdalena Giron and Miriam Gonzales for their superb Filipino cooking; to Dr. Flerida Cariño, Mr. and Mrs. Crisostomo de Guzman, John Jamerlan, and Helena Molina for their companionship and for some of the "crazy" things that we did which added spice to my stay here in Corvallis; and to my other Oceanographer and MRMer friends who are too many to mention.

My appreciation also goes to my family, both here and in the Philippines: my mother and sister for their unending support and encouragement; to the Aligaen family, Luz Reyes, Vic Sambilay, and Greg Hermosa, Jr. for serving as my connecting link between the University of the Philippines and OSU; to my relatives in California for making me "at home while away from home"; to my other collegues from UP who are also here in the USA as exchange students; and to Carol Villanueva and Martha Rowan for providing a welcome respite to my sometimes monotonous life as a graduate student. Thanks and praise is mostly due to HIM for whom all of these things became possible.

My study grant came from the Philippine government's fishery loan project with the World Bank through the College of Fisheries, University of the Philippines in the Visayas.

27-IX-'88

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

POPULATION, RESOURCES, AND PATTERNS OF TECHNOLOGICAL CHANGE: THE CASE OF PHILIPPINE FISHERIES

TOMAS VERGEL C. JAMIR

INTRODUCTION:

It has been a year now since I started on this MRM project - initially with just the idea of looking into the applicability of the U.S. Fishery Conservation and Management Act to Philippine fishery conditions. However, the deeper I searched the literature, the more I realize the complexity of the problem and the need to limit the scope of my topic. After studying a multitude of "expert" opinions and ideas (often piece meal and conflicting with each other) on how to approach third world fishery problems, I finally selected a few promising ones for further development and testing. After months of tinkering with each possible approach or strategy I realized that most of them actually follow the same general pattern or paradigm and lead to a similar analyses of the problem and similar set of solutions. The low success rates of fishery projects attest to the inadequacy of these approaches.

While the numerous failures and slow progress of fishery development programs in the Philippines and other Asian countries have been fairly well documented and a number of empirical studies conducted on the subject (see for example: Emmerson, 1975, 1980; Baum & Maynard, 1976 a-d; Smith, et al., 1980; Marr, 1982; Librero, et al., 1982; Yater, 1982; Smith & Mines, 1982; Spoehr, 1984; Samson, 1985), what seems to be lacking is a sound theoretical framework that will integrate and provide a clear meaning to the present mass of data. For example, a number of intriguing puzzles still remain unsolved, such as:

* Why have motorization of fishing boats or modernization of fishing techniques and aquacultural methods spread fairly rapidly in restricted pockets of the country but left neighboring regions virtually untouched?

* Why have attempts of government and donor agencies to bypass "primitive" fishing or aquaculture methods for more advanced techniques through various development projects and programs repeatedly failed?

* Why has the spread of mechanization/modernization in the Philippines been slower in areas where there is an abundance of resources and lower population density as compared to areas where labor is abundant, wages are low, and resources are supposedly overfished when historically, the rapid spread of mechanical equipment and technology has been associated with an abundance of resources?

When existing observations such as above do not correspond anymore to standard theories or explanations, a "paradigm crisis" develops (Kuhn, 1962) which can be solved only through the emergence of a new theoretical framework or paradigm. This calls for a re-assesment of our assumptions, present beliefs, and traditional ways of thinking and viewing things. As Kuhn himself stated, " ... *when paradigms change, the world itself changes with them. Led by a new paradigm, scientists adopt new instruments and look in new places. Even more important, during revolutions scientists see new and different things when looking with familiar instruments in places they have looked before.*" This is what this paper seeks to explore.

Therefore, the objectives of this paper are the following:

· to identify more clearly the conditions under which Philippine societies evolve from seafood gatherers to commercial fishing or intensive aquaculture,

· to analyze the way environmental, geographic, institutional, and infrastructural constraints accelerate or retard this evolution of fishing/fishfarming systems,

· to explain why despite repeated extension efforts, a number of fishermen/fishfarmers persist in using traditional fishing/farming system,

· to evaluate the policy-planning and project framework within which to promote the future growth of fishery modernization in the context of Philippine national development.

This paper owes important intellectual debts mainly to the evolutionary perspective and radical ideas of Ester Boserup. In *Conditions of Agricultural Growth* Boserup (1965) provides an evolutionary hypothesis and framework for analyzing the relationship between population density, market access, and the evolution of farming systems from hand-hoe-based long fallow systems to permanent plow-based cultivation systems. In her later book *Population and Technological Change: A Study of Long-term Trends* , Boserup (1981) broadened and deepened her theory to encompass other population-linked technologies (for instance, agricultural methods, sanitary methods, administrative techniques, and literacy). Among the various researchers who tested Boserup's theory, the work of Pingali, et al. (1987) coupled with those of Szanton, D., (1971); Szanton, M.

(1972); Librero, et al. (1982) and Spoehr, (1984) have also been very helpful in providing me with a framework and some data by which to explore and apply Boserup's theory in the context of Philippine fisheries.

METHODOLOGY:

This paper was based primarily on an extensive review of the literature on fisheries development in the Philippines and in other third world countries as well as from my own experiences and observations in the field. However, since the literature contains many gaps and omissions in their data, analyses will be confined primarily to qualitative descriptions of the spatial and historical patterns that will emerge.

For the purpose of this paper I propose the use of a four-fold classification system to categorize present-day Philippine fisheries. This system is a modification of the classification scheme proposed by Spoehr (1980), Apud, et al., (1985), and PCARRD (1983 a & b) and is based on both technical and socio-economic criteria (the latter to include the nature of the organization of production, levels of capitalization of fishing units, and the manner of income distribution) as shown below:

LEVEL I. SEAFOOD GATHERING STAGE - resource gathering along or near the shore with or without the use of manual tools, use of "*tambak*" type of fish pond or enclosures; "*sabog*" or broadcast method of seashell farming, low capitalization or none at all, about one to two croppings per year.

LEVEL II. SMALL-SCALE/ARTISANAL FISHERY STAGE - small-scale fishing conducted by a single fisherman or a small group sharing the returns, with a low capital investment per fishing unit, low energy use, and fishing radius limited from about 3 to 7 nautical miles from the home base; use of extensive methods of fish/invertebrate culture, complete dependence on natural food propagated in ponds with or without fertilization and on tidal water replenishment, low capital investment per hectare, and from two to three croppings per year.

LEVEL III. MIDDLE-SCALE FISHERY STAGE - fishing is conducted by a fishing outfit consisting of a crew under the direction of a master-fisherman and employed by a non-fishing owner-operator, capital investment can be as much as ten times more than in level II, share system is followed, fishing boat may be less than 3 metric tons but if combined into a small fleet or as components of a method requiring several boats the operation is middle-scale; semi-intensive aquacultural system on a higher level is used, requires supplemental feeding aside from natural food production, use of water pumps in addition to tidal water exchange, and progressive or modular system of stocking employed which allows six to eight crops per year.

LEVEL IV. LARGE OR COMMERCIAL SCALE FISHERY STAGE - fishing is conducted by trawlers and purse seiners or by a few other methods owned by non-fishing operators or incorporated business firm, crews work for wages, capitalization may be in excess of US $ 100,000, work organization is much more complex than in small and middle-scale fishing, vessels are highly mechanized and capable of extended operations in open waters; intensive culture methods almost completely independent of nature with high stocking densities made possible only through major inputs of formulated feeds mostly in the form of pellets, water exchange through pumps and aeration facilities, smaller pond sizes (1,000-5,000 sq. m) lined with concrete or bricks, high capitalization (may run to as much as 20 times or more of level III) and energy requirements.

THEORETICAL AND CONCEPTUAL FRAMEWORK:

A. RESOURCES AND SCARCITY

Perhaps the most important (and yet taken for granted) concept that needs to be understood by anyone working along the area of resource management/development is the idea of *resources* itself. Among resource specialists and geographers the classical definition of resources by Zimmerman (1933) takes the lead. In this functional view, the world's environment is regarded as "neutral stuff" until a human appraisal defines some element of it as useful for attaining a given end. This step is what transforms a portion of the "neutral stuff" into a resource. Therefore, the mere physical presence of substances is insufficient grounds for ascertaining the existence of resources, rather, it is only when the substances are recognized as useful and meet some criterion of availability can they make a contribution to determining the conditions of human beings. In Zimmerman's words, " *Resources are not, they become;* they are not static, but expand and contract in response to human wants and human actions ... knowledge is truly the mother of all resources."

In summary, natural resources are defined by mankind's perceptions and attitudes, wants, technological skills, legal, financial, and institutional arrangements, as well as by political customs (Mitchell, 1979). What is a natural resource in one culture may be "neutral stuff" in another, hence, resources are subjective, relative, and functional (Newman & Matzke, 1984).

Another familiar concept often associated with resources (and which often emotes a feeling of panic) is *scarcity*. A good way to look at scarcity is through the eyes of economists and consumers who are interested in the *particular services that resources yield* (e.g., ability to conduct electricity, energy to fuel motors, food calories) *and not in the resources themselves* (Simon, 1981). According to this view, the supply of services will be scarce or abundant depending on which raw materials can supply that service with the present technology, the availability of these materials at various quantities, the cost of extracting and processing them, the amounts needed at the present level of technology to supply the services we want, the extent to which the previously extracted materials can be recycled, the cost of recycling, the cost of transporting the raw materials and services, and the social and institutional arrangements in force (Simon, 1981).

Tietenberg (1988), in his review of the issues surrounding resource scarcity, arrived at these revealing conclusions: i) the problem is not whether or not we will run out of resources or their existence but whether or not we are willing to pay the price to extract and use those resources, and ii) the evidence suggests the likelihood that localized (as opposed to generalized) scarcity will be experienced by some resources (e.g., certain types of fish) such that within the next 50 years we may encounter extraction costs which shall cause the rate of consumption of those resources to decline.

The findings of Barnett & Morse (1963) and Barnett (1979) also conclude that no increasing scarcity was apparent and the unit extraction cost, measured as labor per unit output, declined over all time periods, all countries, and all commodities. The explanations they offered for the absence of any evidence of scarcity in the face of increasing demand and a "finite" resource base are: i) historically, when high-grade resources were exhausted, lower-grade resources became available in even greater abundance; ii) as the possibility of scarcity emerged, resource users began to switch to other less scarce resources; and iii) as prices rose, exploration for new resources was encouraged and this exploration was remarkably succesful.

B. IDEAS OF CARRYING CAPACITY

From the biological sciences, geographers and resource specialists borrowed the concept of *carrying capacity* defined as an upper limit placed on a population by its environment (i.e., resources) which cannot be exceeded (Figure 1a. illustrates this concept). The results of exceeding the carrying capacity can be manifested in several ways (Newman & Matzke, 1984) such as:

i) if the environment is not affected, the population will suffer a decline imposed by resource limitation until it is temporarily lowered below carrying capacity (Figure 1b.);

ii) if there is destruction of the environment or the resource base, both the population and the carrying capacity will be affected and show a decline(Figure 1c.); and

iii) if we consider humanity's ability to transform formerly neutral matter into resources which loosen's the constraints placed on human populations by resource-based limiting factors, both the population and the carrying capacity will be affected and show an increase (Figure 1d.). The changed carrying capacity may be a result of technological improvements or equally important, by changes in human potential and social organization.

Conceptually it is useful to think of the environment as a *resource complex* where resources are not fixed in their capacity to support but make available materials that can be manipulated in various ways to provide a wide range of population outcomes (Newman & Matzke, 1984). Hence, for populations using naturally occurring resources, the environment provides a more predictable carrying capacity than it does for humans capable of combining, manipulating, and transforming resources.

C. DISASTER AND DEVELOPMENT SCENARIO

What happens when the population level reaches and exceeds the present carrying capacity of the resource? It may be possible that the added population will be a burden that initiates a deterioration of the resource base (Malthusian perspective or disaster scenario), but it is equally possible that it will act as a stimulus, initiating a cultural change that results in a redefinition of the carrying capacity through new modes of resource use (Boserup's theory or the development scenario).

The Malthusian point of view emphasizes the importance of food, or other resource limitations as controls on population growth whereas the Neo-Malthusian point of view emphasizes the immediacy of a need for strong population growth control measures before world resource limitations are reached (Newman & Matzke, 1984). This reasoning is based upon the idea that food supply is inherently inelastic, and that *this lack of elasticity is the main factor governing the rate of population growth* (Boserup, 1965).

Focusing, like Malthus, on the tension between population and food supply, Boserup (1965; 1981) arrived at a diametrically opposite conclusion. Whereas Malthus treated population growth as a dependent variable determined by preceding changes in agricultural productivity (which in turn are explained as the result of extraneous factors such as the fortuitous factor of technical invention and imitation, or the "technological pull" on population), Boserup on the other hand believes that the main line of causation is in the opposite direction, i.e., population growth is regarded as the independent variable (assuming infinite resources or technical ability) which in turn is a major factor determining agricultural developments (or the "population/demand push" on technological innovation).

In essence, Boserup's thesis state that the growth of population is not the cause of poverty through an outstripping of food supplies but the mechanism that stimulates the intensification of land use, leading to increased production in the rural sector. Given the labor optimizing nature of farmers, an increasing density of population, and a decreasing quantity of available agricultural land and labor, Boserup (1965) argues that the pattern of agricultural intensification follows these stages: gathering, forest-fallow cultivation, bush-fallow cultivation, short-fallow cultivation, annual cropping, and multi-cropping (i.e., shifting from more extensive to more intensive systems of land use).

Considering the conditions facing world agriculture today, increases in food production are highest in those countries with the highest rates of population growth. Moreover, contrary to Malthusian assumptions, "most of the expansion of food production was obtained by traditional methods, based upon use of human and animal muscle power with little industrial and scientific inputs" (Boserup, 1981). This scenario assigns an importance to population growth as an action-forcing agent in the development of rural areas (Newman & Matzke, 1984).

Newman & Matzke (1984) also noted that when impressive gains in production were not achieved, population excess was not the explanation, instead, the common roadblocks to agricultural enhancement include:

i. a depressed demand for local production because of cheap imported food subsidized by the agricultural policies of industrial countries,

ii. the decision to divert labor, capital, or land to purposes other than food production when rich natural resources were plentiful, and

iii. an inept ruling class that fostered war, ill-conceived land reform, or disruptive economic and political conditions that were maladapted to fostering agricultural improvements under conditions of rapid population growth.

While there is no empirical evidence in the literature to support the Malthusian perspective, a host of historical records and recently concluded researches lend adequate support to Boserup's theory (Matzke, pers. comm.). Figure 2 graphically summarizes the "disaster and development" scenarios of agricultural population growth. In this paper, I will try to look into the patterns of technological development in the Philippines in the context of Boserup's theory.

FINDINGS:

A. BACKGROUND INFORMATION

The Philippines is a developing country in Southeast Asia (Figure 3) with a territorial area of 300,000 sq. km and an extended jurisdictional area of 551,400 sq. km (Morgan & Fryer, 1985). Being an archipelagic country of 7,700 islands, the Philippines has a coastline of 22,540 km lined with 1,060 sq. km of mangrove forests and 33,080 sq. km of coral reefs (Valencia, 1985; Umali, 1980; Murdy & Ferraris, 1980). Despite its long coastline, the insular shelves are very narrow, (only 12% of the total water surface area) thereby delimiting its demersal fisheries potential.

The Philippine population of 55 million is broken down into 111 cultural and linguistic groups (Agoncillo & Guerrero, 1986) living mostly on the two major islands of Luzon and Mindanao. The Philippine economy is primarily based on agriculture, fisheries, mining, and forestry. The major import items consist essentially of rice, wheat, machinery, fuel, metals, and vehicles (Cheetam & Hawkins, 1976). The GNP per capita in 1981 is US $ 790 with marine fish production constituting 4.8% of the GNP (valued at US $ 1.4 billion) and fishery workers comprising 6.3% of the total labor force of 14 million (Valencia, 1985).

Based on Presidential Decree No. 704 (PD 704), Philippine fisheries is arbitrarily classified into commercial (those using boats of 3 gross tons or over) and municipal fisheries (those using boats < 3 GT or none at all). About 500,000 full- and part-time municipal fishermen live in some 10,000 fishing communities in the country contributing around 60% to the annual fish production (Smith, et al., 1980). These fishermen generally use traditional craft (dug out canoes called *bangka* or banca, often with bamboo outriggers). The number of municipal fishing craft increased from 258,600 in 1977 to 312,500 in 1979 (10% per year). About half of these are not motorized and must operate near the shore and only during good weather (Cheetam & Hawkins, 1976; Samson, 1985). The national annual average productivity of each fishermen is only 1.5 mt which is very low, largely at subsistence level. The catch of the municipal fisheries sector is either consumed fresh by the household, salted or dried, or sold fresh to retailers or wholesalers (Librero, 1985). Despite the fact that municipal fisheries catch comprise 60% of the total fisheries production, its cash value amounts to only 40% of the total sales of fishery products due to the predominance of low-market value species in the catch, poor quality of the product, consumption be fishermen, and limited acces to major markets (Smith, et al., 1980; Librero, 1985).

The number of commercial fishing boats was 2,571 in 1976, dropped to 2,269 in 1977, and then increased again to 2,993 in 1980 primarily due to a marked increase in the number of tuna purse seiners (Samson, 1985). The commercial fleet is operated by about 1,500 owners with around 47,000 licensed fishermen. Fishing activities are restricted mainly to waters 12 miles beyond the coast or 7 fathoms deep with the fleet based primarily near the Manila area and around Visayan Sea (Cheetam & Hawkins, 1976) except for the large tuna purse seiners whose main area of operation is around the waters of Mindanao in the south.

Inland fishponds currently produce only about 10% of the total output, however, between 1965 and 1970, fishpond production increased by over 50% as a result of the extension of fishpond areas and higher yields (Cheetam & Hawkins, 1976). Annual production has been estimated to be about 170,000 mt, 90% of which are from milkfish, *Chanos chanos* Forskal (PCARRD, 1983a). Pond productivity has been historically low, with the national average tagged at only 870 kg/ha/yr using extensive methods as compared to Taiwan's 2,000 kg/ha/yr achieved through intensive methods (Smith, 1981).

While the potential for fishpond expansion in Taiwan is very limited, the potential for expansion in the Philippines is not. At present, about 125,000 ha of mangroves and estuarine areas are technically feasible to develop for expansion, although not necessarily so for ecological or financial reasons. Of the 175,000 ha registered fishponds in the country, half are leased from the government under long-term arrangements (up to 25 years and renewable for another 25 years) while the rest is privately owned. Freshwater cultivation is not yet common in the Philippines, nor is the technical base for management as well developed as for brackishwater ponds (Cheetam & Hawkins, 1976). Encouraged recently by the large Japanese market demand, prawn culture (Penaeidae family) is currently a booming industry in the country.

Foreign trade in fish grew impressively during the last decade. Between 1977 and 1979, the volume of fish traded doubled reaching US $ 98 million in 1979 (Figure 4) while imports remained at US $ 25 million. In 1980, 47,300 mt of tuna was exported at a value of US $62 million (62% of total volume) followed by dried seaweeds at 15,700 mt (21%), and frozen shrimp at 2,633 mt (4%). 99% of the total volume of fishery products imported in 1980 was made up of fish meal (2,633 mt) and canned fishery products (28,760 mt). Although the total volume of imports steadily rose until 1974, the volume of canned fishery products is currently levelling off due to government restrictions on its importation. This in turn resulted in greater utilization and development of local canneries to supply domestic needs (Samson, 1985).

B. ENVIRONMENTAL FACTORS

Climate is among the important physical factors that have a major influence on the life in the islands. There are three "seasons" observed in the region: the northeast monsoon or *tag-lamig* (occurs from November to March) characterized by strong, cool, and dry northeasterly winds called *amihan* and fine weather; the southwest monsoon or *tag-ulan* (occurs from July to as late as November) characterized by frequent typhoons, cloudy and rainy weather associated with the inter-tropical convergence zone (ITCZ), and winds generally coming from the southwest called *habagat*; and the inter-monsoon season (the tropical "summer" months or *tag-init* from April to June and the doldrums between October and November) characterized by long periods of calm, warm temperatures, and occasional trade winds or *hanging sabalas* (Dickerson, 1928). The mountain ranges that lie accross the eastern and western seaboard of the Philippines not only help decrease the destructive effects of the numerous typhoons (about 20 per year) that pass by the country (Figure 5) but are also instrumental in creating a wide diversity of rainfall patterns and climatic zones (see Figure 6).

This regional climatic pattern also influences the oceanographic conditions of the southeast Asian waters. The characteristic wind and precipitation patterns brought about by the monsoons also result in similar seasonal patterns of ocean water circulation (Figures 7 a & b) and mixing. However, given a thick thermocline and deep mixed layer, the productivity of the oceanic waters around the Philippines is generally low except for the shallow central seas of the country and some pockets of extensive localized upwellings resulting from the "island effect" (Wyrtki, 1961; Weber, 1976).

The most productive or "peak" fishing season of the year (based on the availability of high market quality fishes) corresponds to the summer months when optimum environmental conditions for fishing, plankton growth, fish feeding and reproduction exist while the "lean" season occurs during the stormy southwest monsoon months (Navaluna, 1983; Pauly & Navaluna, 1983). However, for farmers relying on rain-fed agriculture, the southwest monsoon signals the start of the planting season while the fields lay fallow during the dry summer months. As a result it is not unusual to find part-time fishermen-farmers in coastal areas where traditional agriculture prevail (Spoehr, 1984).

C. POPULATION FACTORS

The Philippines is subdivided into twelve regions (Figure 8) for political and administrative purposes, with Metropolitan Manila designated as the national capital region (NCR). Starting with a widely dispersed population of less than half a million during the late proto-historic period (Reed, 1967), the Philippine population was about 750,000 by the time of the Spanish conquest in 1591 (Constantino, 1975). Each *barangay* or village was usually small, composed mainly of about 30 to 100 houses of only about 100-500 persons, Manila being an exception with about 2,000 inhabitants (Constantino, 1975). Most Visayan villages fringing the coasts consisted of no more than 8-10 houses. Settlements were far from each other and are usually coastal or riverine in orientation. A system of subsistence agriculture called *kaingin* or slash-burn/forest fallow cultivation providing barely enough to eat was practiced in the upland areas while wet-rice agriculture is practiced in more advanced lowland villages (Constantino, 1975; Agoncillo & Guerrero, 1986).

In general, the societies encountered by Magellan and Legazpi in 1521 were primitive economies where most of the production was geared to the use of the producers and to the fufillment of kinship obligations. By 1650, the population of Manila grew to 42,000 which by the standards of that time and of the region qualifies it as a major city. In 1800, the country's population was about 4 million and by 1850, Iloilo and Negros rose to prominence to join Cebu, Manila, and Zamboanga as important centers of trade. With the increase in population to 6 million in 1885, improvement of the means of communication, opening of the Suez canal and the rising economic demands of the Crimean War (1854-1865), agricultural production was stimulated resulting in the widespread cultivation of idle lands and the introduction of machines in agriculture (Constantino, 1975).

Despite the traditional high birth rate, the Philippine population grew to only 6.6 million by the end of the Spanish era due to high mortality rate (30.5% per 1000 people) brought about by the uncontrolled ravages of cholera, small-pox, malaria, tuberculosis, and other deadly diseases (Constantino, 1975; Agoncillo & Guerrero, 1986). After World War II, the population grew to 19.2 million in 1948 and from then on has been growing rapidly (Figure 9) at a rate of about 3% per annum (27 million in 1960, 38 million in 1970, and 55 million in 1985), due primarily to the persistence of high birth rates and rapidly declining death rates brought about by improved public health measures, the eradication of epidemic diseases, and enhanced standards of living (Cheetam & Hawkins, 1976; Standing & Szal, 1979; Agoncillo & Guerrero, 1986). However, the demographic distribution of population is far from even across the country nor across cities but appears to have been greatest in a few of the large urban centers (Figure 10). The primacy of Metro-Manila is clearly illustrated by the fact that it accounts for almost 60% of the total urban population while the cities of Davao and Cebu accounts for only 6% each and the cities of Iloilo, Zamboanga, and Bacolod each account for 3%.

Using the population data from 1903 to 1970, Pernia (1977) conveniently and instructively classified the regional urbanization pattern of the country's twelve regions into metropolitan, more urbanized, less urbanized, and frontier regions (see Figure 11). The results of his research is summarized as follows:

i) the metropolitan (Manila) region which started out early in Philippine history than all the other regions urbanized very rapidly making it an urban "island" in a predominantly rural "sea,"

ii) the more urbanized regions, comprising Central - Southern Luzon and Western - Central Visayas, started out at a level less than the less urbanized groups but proceeded rapidly, particularly after 1939, to reach its present level,

iii) the less urbanized regions of Ilocos, Bicol, and Eastern Visayas urbanized extremely slow throughout the entire period of study. This group of regions is characterized by consistently severe net out-migration and incomes even lower than those in the frontier regions,

iv) the frontier regions of Cagayan and Mindanao were the least urban in 1903, urbanized most rapidly up to 1939, but diminished in speed thereafter, remaining the least urban in 1970, and

v) when the metropolitan region is excluded from the analysis, the national urbanization levels are considerably lower and the tempos slower.

The Philippines remains a predominantly rural country where 70% of the population live in the rural areas. Because of the over-valued exchange rates and low interest rates after World War II, industrial development policies followed a highly capital-intensive path. The over-all result of these policies was a badly distorted industrial mix, the concentration of economic activity in the hands of a few, and the concentration of industries around Metro-Manila (Standing & Szal, 1979). This capital bias had most probably been a major cause of the problem of employment and income distribution, which, coupled with the long-term problems of maldistribution of land and rampant inflation, resulted in an enormous rural-urban migration (Cheetam & Hawkins, 1976; Pernia, 1977; Standing & Szal, 1979).

D. THE RESOURCE BASE

The geographic distribution of most commercially important fishes in the Philippines (whether demersal or pelagic) is generally wide, however, the areas where they are presently known to abound (usually also the main fishing areas) are limited to only a few coastal zones where substantial insular shelves exists (Chullasorn & Martosubroto, 1986) (see Figures 12-15). A major characteristic of tropical demersal fisheries is its multi-species composition (see Table 1) which makes the analysis and management of the stocks very difficult (Larkin, 1982; Gulland, 1982; Pauly, 1982). Although pelagic fishes consist mostly of only a few stocks per haul, their assessment and management also present considerable trouble because of their migratory nature while some are even believed to be trans-oceanic and are therefore shared by many states and deep sea fishing nations of the world (Ronquillo, 1978; Pauly, 1982b).

Smith, et al. (1980), in their review of the resources, technology, and socio-economics of the Philippine municipal fisheries sector, estimated the maximum sustainable yield (MSY) for Philippine fisheries to be around 1.5 to 1.8 million metric tons of which 50-55% is accessible to municipal fishermen. During that period, the Bureau of Fisheries and Aquatic Resources (BFAR, 1979) estimated the total fish catch landed by municipal fishermen to be 712,500 mt for marine and 162,400 for inland fisheries for a total of 874,900 mt. The Development Academy of the Philippines (DAP, 1977), using consumption surveys conducted from 1970-1975 arrived at an estimated total fish production of 950,000 mt and also noted that the municipal fish catch is levelling off. Of the 488,000 mt landed by the commercial fishery sector, 34% was caught by trawl, 33% by purse seine, and 22% by bag net (Samson, 1985).

Given these estimates, it seems that the MSY is already being approached or may have already been reached for most traditional fishing grounds (see Figure 16 for the areas identified by BFAR as exhibiting a decrease in fish yield or are believed to be overfished) except perhaps for some of the relatively unexplored areas of Palawan, northern and eastern Luzon and southwestern Mindanao.

Production of demersal fishery, primarily using trawls, has declined steadily from 396,000 mt in 1976 to 349,400 mt in 1980 presumably due to the depletion of demersal fishery resources in the soft bottom, trawlable areas such as the Visayan Sea, San Miguel Bay, and Manila Bay (Samson, 1985) although it may also be due to a decrease in the number of trawlers still fishing after the 1975 oil crisis. The potential for increased demersal fisheries is projected to come from the deeper or hard bottom areas and from coral reefs using passive gears.

It is generally believed that pelagic fishes in a number of traditional fishing grounds can be further exploited, especially for small pelagics (e.g., anchovies) whose production of 456,800 mt in 1980 was far below the estimated potential yield of 600,000-1,000,000 mt (Samson, 1985). The latest and most significant development in marine fisheries has been the development of the tuna fishery whose production increased from 138,000 mt in 1976 to 218,000 mt in 1980 due to the introduction of large purse seiners and locally developed fish aggregating devices called *payaw* or *payao* (Murdy, 1980; Samson, 1985). A *payaw* is a bouy system composed of bamboo floats, synthetic rope connections, anchors made out of empty oil barrels filled with rocks and concrete, and fish shelters made out of nipa or coconut leaves.

Using catch and effort data from commercial fishermen, BFAR and the South China Sea Program (SCSP) conducted a series of workshops to make rough estimates of MSYs for the major fishing regions of the country. Their findings are summarized below:

* Visayan and Sibuyan Sea (SCSP, 1976). Almost half of the present Philippine fishery catch comes from these two seas in central Philippines (Figure 17). Estimates indicate scope for further increases in the catches of demersal and pelagic fishes and shrimps in the general area but showed clear evidence of overfishing of demersal fishes and shrimps off Samar (Region VIII) and of anchovies off Tayabas Bay and Marinduque (Region IV).

* Sulu Sea, Bohol Sea, and Moro Gulf (SCSP, 1977). Findings indicate slight potential for increasing catches of demersal fishes but fishes on hard bottoms and coral reefs may not yet be fully exploited (Figure 18). Pelagic species (e.g., yellowfin tuna, skipjacks, round scads, big-eyed scads, chub mackerels, and anchovies) are generally underexploited except for anchovies in Sibuco Bay, Zamboanga del Norte.

* Pacific Coast (SCSP, 1978). Only the fin fishery of San Miguel and Lamon Bays were judged to be fully exploited (Figure 19). Shrimp fishery was estimated to be capable of yielding 13,000 mt annually. However, among the constraints identified to the full exploitation and development of the fisheries of the area were the strong northeast monsoon winds and numerous typhoons which limit the effective fishing season to just 6 months per year and poor infrastructure and support facilities like roads, fish ports, and marketing facilities.

* Mackerels and Round Scads in the South China Sea (SCSP, 1979). Estimates indicate that the mackerel stocks in northern Palawan area may be fully or almost fully exploited. Insufficient data preclude a decision on the status of mackerel stocks in the waters of Luzon and Visayas, however, for round scads, the MSY could be more than 400,000 mt in the Philippines and around the northern coast of Sabah, Malaysia.

E. TRANSPORT AND MARKETING SYSTEM

In his detailed study of the economics of milkfish fry and fingerling industry of the Philippines, Smith (1981) noted that the market system can range from a two-level to a hierarchical structure. The two-level structure, characterized by commodities moving from the producing to the consuming center with no exchange of title between the two, is predominant in areas with localized, self-sufficient markets dependent upon a small supply hinterland. An example of this would be a fisherman/fishfarmer who sells his own catch/produce at nearby markets and where middlemen play no role. At the opposite end is the hierarchical structure where middlemen, who handle the bulking and redistribution of the fishery commodity, play a major and important role. With substantial intra- and inter-regional trade, Smith (1981) found the fry industry to be essentially hierarchical and follows Loschian (1954) central place theory as modified by the island's geographical setting and associated transportation and communication networks (e.g., Figure 20).

BFAR lists 76 commercial fishing ports distributed in the 13 administrative regions of the Philippines. Of all the landing sites, the Navotas Fishing Port and Fish Market is considered the largest and most modern in terms of facilities and services. Constructed in 1973, harbor and market operations started in 1977 serving some 350 commercial fishing vessels unloading an average of 521 mt per day (FIDC, 1980). On an annual basis, the port absorbs about 40% of the total commercial landings in the country.

Starting at the landing site, the distribution channels follow the usual marketing chain of brokers, middle men, wholesalers, and retailers. There are 10 major fish marketing centers (Figure 21) in the country: Navotas and Divisoria in the Metropolitan Manila area; Baguio City in Northern Luzon, Dagupan City in Central Luzon; San Pablo City in Southern Tagalog; Iloilo City, Bacolod, and Cebu City in the Visayas; and Davao City and Zamboanga City in Mindanao (FIDC, 1980). Fish flow from these centers to other inland markets. Generally, the biggest percentage of the fish supply is handled by brokers stationed at the landing areas where initial trading takes place. The product is largely disposed of in trading centers within the province although Metro-Manila markets are a common destination in inter-regional trade (PCARRD, 1983a). Figure 22 shows an example of the inter-regional trade flow pattern of fishery products in the Philippines, in this case, of milkfish fry.

In the Philippines, fishery products are being transported in a variety of ways (Figure 23). Inter-regional trade within the island of Luzon is primarily handled by surface transport facilities (using trucks, jeeps, bus, train, and even "tricycle," a motorcycle with a sidecar) because of the existence of good and fairly adequate road network (Table 2). For interregional trade within the Visayas and Mindanao, both sea and land systems are used extensively. Private planes, including

DC-3's, and smaller twin-engined planes are occasionally chartered for large shipments from Visayas or Mindoro to Manila while commercial jets and turbo-prop planes of the Philippine Airlines, Ltd. (PAL) are commonly used for the transport of high value fishery products throughout the country. Lower value products and processed goods are usually transported via domestic inter-island shipping.

For commercial fishing vessels, sorting, icing, and stacking of the catch in metal tubs, called *bañera,* are all done on board. Manila-based fishing fleets are in constant radio communications with the home port to keep track of the market conditions as well as to report their catch situation. Fish carriers either stay close to the mother boat in the case of purse seining fleets or called in once the fish hold is close to full capacity, especially for trawlers. These fish carriers serve a variety of purpose: to replenish catcher boats with ice and supplies, to transport the catch to the landing points, and as additional "light boats." Small-scale fishermen whose range of operation is limited to the immediate vicinity of their home village usually do not use any mode of preservation. Municipal fishermen land their catch fresh on some commercial ports but most unload in open beaches along some 10,000 fishing villages scattered all over the country (Pelayo, 1983).

For small villages and towns, markets are usually periodic (Thursdays, Saturdays, or Sundays) for the maximum benefit of the general producers and consumers. For the retail market such as this, fish pricing depends highly on the market power of the participants, i.e., the purchasers and sellers haggle openly for prices to be paid. However, at the fish landing sites where fishes are being unloaded daily, the catch are auctioned and sold by fish brokers to middlemen, wholesalers, and retailers (either by weight or volume) through the closed bidding system called *bulungan* or "whispering." Transactions are largely on a cash and carry basis while those on consignment usually pay after the day's transaction.

Because of the high risks involved in the transport of this highly perishable product (this is even more critical when fish fry or lobster are concerned), time is therefore of the essence. Unscheduled delays, diverted flights, or off-loadings can present serious problems to shippers. For the system to work smoothly, close cooperation between shippers, agents, and consignees is essential. This can be achieved only through the presence of a good communications network (Smith, 1981). The presence of adequate air and marine ports and facilities, road network, and population or economic centers are all important to make the transport and marketing system of Philippine fishery products viable (Cheetam & Hawkins, 1976; Smith, 1981).

F. THE PRODUCTION TECHNOLOGY

* THE AQUACULTURE SECTOR

i. Milkfish Culture:

Milkfish (*bañgus*) is the most important of the cultured species in brackishwater ponds of the Philippines. Milkfish farming probably originated in Indonesia where saltwater farming has been practiced for over 500 years (Bardach, et al., 1972). After initial development in Java, the practice spread to the Philippines in 1863 (PCARRD, 1983a). However, despite the suitability of large areas of the Philippines for fishpond cultivation (i.e., regions with types I and III climates, see Figure 6), early fishponds were concentrated around Manila Bay. In 1929, Herre & Mendoza (1929) reported 3,193 ha in Rizal province; 16,700 ha in Bulacan; 14,200 ha in Pampanga; and 4,000 ha in Bataan, similar to today's totals. The town of Malabon just north of Manila earned the early reputation as the area with the highest skill in raising milkfish to marketable size.

Rapid growth of fishpond areas occurred only recently (28% in the past decade) as the industry spread to other areas of the country, particularly to the Visayas and Mindanao (Smith, 1981). At present, fishponds are concentrated in the provinces of Iloilo (17,373 ha), Quezon (16,173 ha), Bulacan (16,173 ha), Capiz (11,240 ha), Negros Occidental (10,621 ha), Pangasinan (9,544 ha), and Pampanga (9,209 ha) (Figure 24).

After almost a century of fishpond culture, low productivity continues to plague the industry. At present, the national average yield is only 870 kg/ha/yr, although some level III fishfarms, i.e., those in Pangasinan, Bataan, Pampanga, Bulacan and Rizal provinces in Luzon, and in Iloilo province in Western Visayas (Table 3, Figure 25) have reached yield levels of at least 1 ton/ha/yr (Smith, 1981; PCARRD, 1983a). However, even the latter compare poorly with Taiwan, the regional leader, with a yield of 2 tons/ha/yr using level IV technology. On the whole, fishfarming is not intensive enough (most farms are in level II technology) prompting the government to issue policies designed to increase the average production of bangus fishponds. The widespread use of extensive methods were partly due to the vast area of aquacultural land still available for bangus production in the Philippines. Understocking and minimal use of input are prevalent despite efforts exerted by BFAR extension workers (PCARRD, 1983a). A large percentage of acquired fishpond areas also remain undeveloped or are in states of disrepair. However, as competition for land and water resources continue to increase, intensification of production in existing fishpond areas is being expected by the government to also rapidly take place (PCARRD, 1983a).

Early in 1970, an alternative method of rearing milkfish was developed when the first fishpens were established in Laguna de Bay, southeast of Manila (Figure 26). In 1974, fishpens were being stocked with an average of 35,500 fingerlings per hectare giving average annual yields of almost 4 tons/ha (Nicolas, et al., 1976). Owing to its early success, many Manila businessmen entered the industry resulting in the rapid increase in fishpen area devoted to milkfish production. The highest hectarage (7,000 ha) was reached in 1975 but was followed by a large decline (3,000 ha) in 1977, apparently due to the weeding out of inexperienced entrepreneurs. The number of fishpen areas started to pick up again starting in 1979.

ii. Oyster and Mussel Farming:

Oysters are considered as staple food and bring no higher price than some of the common food fishes in Southeast Asia. Until about 1936, all oysters eaten in the Philippines were gathered from the almost ubiquitous wild population (Bardach, et al., 1972). Early farms were set up in Bacoor Bay, south of Manila, where the *sabog* or broadcast method was employed. In 1931, scientific oyster farming using bamboo stakes clipped with oyster shells and bamboo lattice was started at the experimental station of BFAR in Hinigaran River, Negros Occidental. Later on, in 1935 the Binakayan Experimental and Demonstration Oyster Farm was established by BFAR in Bacoor Bay, right in the midst of the commercial farmers in order to impress upon them the potential for improvement in their techniques. Progress during that period was, however, very slow (Bardach, et al., 1972). Then, over the last three decades, there was a rapid increase in commercial oyster farming along the coasts of various provinces in the country (Table 4). The early leaders in commercial oyster production like Bulacan, Capiz, Cavite, and Pangasinan are now largely at production level III while the rest of the farms in the country are in production level II (PCARRD, 1983b). Studies show that a vast potential still exist for the expansion of oyster farming all over the country as shown in Table 5 (PCARRD, 1983b).

Mussels are known to exists in bays and inlets along the northern coast of Panay from Tinagong Dagat, President Roxas to as far as Makato, Aklan; to a very limited extent in Banate Bay, Iloilo; in several places from Banago port, Bacolod to Himamaylan in Negros Occidental; in Manila Bay; and in Maqueda Bay, Samar (PCARRD, 1983b). Mussels were originally regarded as pests by oyster farmers and bamboo fish-trap operators in Bacoor Bay because they compete with oysters for food and foul and destroy the bamboo traps. It was only in 1950 that they were recognized as a primary crop by BFAR technologists and biologists at the Binakayan Station. In 1955 a 300 sq. m commercial farm using bamboo stake method was established in Bacoor Bay followed by a second one in 1959. Starting in the early 1960's, mussel farming became a booming business especially in Bacoor Bay where approximately 1,350-2,000 ha has been devoted to mussel farming yielding an annual production of about 13,000 tons of live mussels. With the reduction of the available farming area in Bacoor Bay to just 70 ha in the 1970's following a land reclamation project, farmers adopted the new, more intensive rope-web method that was successfully tried in BFAR's experimental farm in Sapian Bay, Capiz in order to meet the increasing demand for mussels by the local and Manila markets (PCARRD, 1983b). At present, the other areas being farmed using the stake method are located in Maqueda Bay, Samar (about 200 ha), Capiz (15 ha), Manila Bay (10 ha), Negros Occidental (2 ha), and in Romblon (2 ha). Like oyter farming, vast areas still exist for future development of the industry (Table 6).

iii. Prawn and Shrimps:

Prawn/shrimp aquaculture is a new and relatively booming fishery industry in the country today. In the past, prawn culture was not popular or developed in the Philippines due to its low domestic market demand (it is considered as a luxury food item) and high technological input and capitalization requirements. However, with the recent increase in demand for prawns in the international market (mainly from Japan), prawn farming suddenly became a very lucrative business. This motivated many established fishfarmers to convert their existing milkfish ponds to prawn culture using level III technology, and for new investors to open up partially or fully developed brackishwater fishponds for level II or level III operations (Apud, et al., 1985). Targetting the large Japanese market, giant Philippine corporations like San Miguel, Purefoods, and Robina Farms recently joined the frenzy by establishing level IV farms in some selected areas of the country. So far, there are only two prime prawn-growing areas in the Philippines today - Northern Panay provinces of Capiz and Aklan with at least 10,000 ha and Bataan-Pampanga-Bulacan areas in Central Luzon and Metro-Manila with some 5,000 ha, all using level III technology (Apud, et al., 1985).

* THE MARINE FISHERIES SECTOR

i. Commercial Fisheries:

Metro-Manila serves as the home base for most commercial trawlers and purse seiners (level III and IV), fishing the waters off northern and southern Palawan near the Bornean boarder, western and eastern Luzon, and central Philippine waters. A number of purse seiners targetting the migratory species of tuna around Mindanao and Papua New Guinea waters (level IV) use Zamboanga and Davao City as their home ports due to their distance from the fishing grounds. The rest of the middle-scale (level III) fishing operators are based all over the different regions of the country nearest to their area of operation and market outlet (Table 7). All in all, the NCR has the most number of commercial fishing vessels followed by Southern Tagalog, Western Visayas, and Western Mindanao regions. The regions with the least number of commercial fishing vessels include Ilocos, Cagayan Valley, Eastern Visayas, and Northern and Southern Mindanao. It is interesting to note that the Ilocos, Cagayan Valley, Central Luzon, Eastern Visayas, and Southern Mindanao regions do not have (or just have a few) commercial purse seiners considering that the fishing grounds off their coasts are along the migratory path of tuna and are still considered to be minimally exploited at present.

Due to the vagaries of the weather and to some extent the nature of the target species, commercial purse seine and *basnig, basnigan* or bag net (a fishing technique that utilizes light to attract and aggregate pelagic fishes which are then caught using a box-shaped net) operators fish the waters off eastern Philippines for tuna and tuna-like species during the southwest monsoon season and then transfer to Sibuyan Sea, Tayabas Bay, Northern Palawan, and off western Luzon waters during the northeast monsoon season. Catch is usually sold to the nearest fish landing site in the case of level III operations (e.g., bag nets) while for level IV fishing operations, carrier ships usually transport the catch to Manila on a regular basis.

ii. Small-Scale or Artisanal Fisheries:

In the Philippines, like in any other third world countries, limited statistical data are available on artisanal (or municipal) fisheries (especially on a national scale), primarily due to their dispersed nature and the problems in classification. Nevertheless, the survey conducted by Librero, et al. (1982) to study the relationship between fish capture technology and productivity, income, and employment in the Philippines may shed some insights into the matter. However, care must be taken when using their data since the sampling strategy that they followed were biased towards provinces where the government made extensive loans to fishermen for fishing boat improvement and mechanization (see Figure 27). The results of the their survey are summarized below:

- Almost all of the sample sites have a high degree of mechanization except for Ilocos and Southern Mindanao. Almost all of the fishing boats surveyed in the Central Luzon, Southern Tagalog, and Western Visayas regions are fully motorized and generally larger in size than the least mechanized regions (Table 8).

- Non-motorized vessels generally caught less than the motorized ones and production tends to increase with increasing engine horse power (Table 9). There is not much difference in the production level among the regions except for Ilocos which exhibits the lowest production level, even lower than the national average for non-motorized vessels.

- Gill net was the most popular fishing gear in all of the regions followed by long-line (Table 10). Baby trawl, a smaller version of mini-trawl adapted for use with motorized bancas, is popular among the fishermen of Western Visayas and Central Luzon while net and line, handline, and beach seines are the more popular fishing gears in Bicol and Mindanao. This maybe in response to the available fishery resources in their respective waters. Ilocos has the most number of lift nets, a traditional, passive fishing gear that is not used anymore in most other regions.

- The results of the financial analyses of gear performance are tabulated in Table 11. Although motorized gears realized larger revenues than non-motorized ones, the net economic profit (which determines the long term viability of the enterprise) achieved from their operation was generally less. Fishermen from Mindanao achieved the largest net positive economic profit from their operation while fishermen from the Visayas got the least. In general, the pure profits from the resource was negative for the whole Philippines, with the Visayan region exhibiting the most negative resource rent of all indicating that the equilibrium of this open- access fishery has already been reached or even surpassed.

DISCUSSION:

A. THE FRAMEWORK

Using Boserup's (1965, 1981) theory, the following evolutionary pattern of fishery development is predicted:

1st. In the presence of adequate resources and scattered settlements with low population density, subsistence fishing/farming (level I) prevails as surplus production is neither necessary nor needed since everyone can meet their daily food requirements with just a few hours of fishing or food gathering and trading/marketing system is non-existent or marginal (Boserup, 1981; Pingali, et al., 1985).

2nd. As the population increases, the needed supply of food is achieved through the expansion of areas devoted to fishing/farming (level II) and/or increasing the time spent in fishing/gathering. As tribes grow and the carrying capacity of the resource (given the present state of technology) is approached, tribes break up, with one group outmigrating to newer fishing grounds in order to relieve the pressure on the resource (Boserup, 1965, 1981; Smith, et al., 1987).

3rd. With continued population growth and decreasing area available to fishing/gathering, intensification of production (level III and higher) is undertaken to raise the present carrying capacity of the resource to meet population demands (Boserup, 1981). As market systems and distribution centers develop, urban/town settlements also start to evolve which then makes it economical and advantageous to achieve surpluses in food production. Fishing techniques gradually shift from passive to active gears, and from small-scale to more organized and capital-intensive commercial fishing operations (Spoehr, 1984). Demersal fishing activities generally move and extend from the shallow, coastal fishing grounds to deeper, less favored, offshore fishing grounds. Fishfarming, on the other hand, increases total production through the use of extensive methods, shifting more gradually to semi-intensive and later to more intensive methods as the areas available for fish pond development decrease (Smith, 1981; PCARRD, 1983a). Specialization of roles develop as the fishery moves from a lower level to a higher level of operation (Spoehr, 1984).

This framework not only allows a clear view of the development of Philippine fisheries starting from the pre-colonial era to the present but, since it also defines an evolutionary pattern, permit the extension of the analysis into the future.

B. POPULATION, RESOURCES, AND THE ENVIRONMENT

Considering the situation in the Philippines during the pre-colonial era when natural resources were in abundance and the small native population widely dispersed, the selection of permanent sites for settlements may have been influenced more by environmental conditions, i.e., weather and climate, and accessibility than anything else. The location of old settlements attest to this, i.e., traditional coastal trading centers like Manila, Zamboanga, and Cebu are all located along the western part of the archipelago where they are adequately protected from the devastating typhoons and the strong waves/currents brought about by the northeast monsoon winds. When the Spaniards came, they forcibly established settlements and cities all over the country (mostly along the coasts although some were also established in the hinterlands) which served as the foundation for the present day urban and rural settlement patterns (Constantino, 1975; Agoncillo & Guerrero, 1986).

However, neither the abundance of resources nor the presence of optimal environmental conditions alone can adequately explain the spatial and historical patterns of fishery development that emerged in the country today. The existence of large, widely dispersed pockets of highly advanced fishing communities like the ones in Manila, Iloilo, and Zamboanga, set over a background of largely subsistence fishing villages in resource rich and environmentally favorable areas like Palawan, Southern Mindanao, and the Ilocos region points to the complexity of this problem. In this regard, the influence of population density, a factor that is almost always disregarded in most fishery analysis, needs to be introduced to give a fuller understanding of the situation.

It should be noted that the Philippine population during the pre- and early colonial era had been small and grew at a very slowly pace until the end of the Spanish period despite high fertility rates (Cheetam & Hawkins, 1976; Pernia, 1977). From then on, as epidemic diseases were put into control and mortality rate significantly checked, the population started to increase logarithmically up to the present. While additional cities emerged and developed late in the 18th century, the primacy of Manila remains uncontested even to date. Whereas trade was generally limited to domestic, inter-regional exchange and to some extent, highly regulated international trade with Mexico and Spain during the Spanish colonial period, the 1900's opened up and enmeshed the Philippine economy to the international market and economic system (Agoncillo & Guerrero, 1986). Hence, the period up to 1900 can be considered as a period of slow economic, political, and social growth while the years following that can be considered as a rapidly changing and dynamic era in Philippine history. Looking back at the aquaculture and fishing sectors, a distinct connection to these historical events and pattern of development can be made that will help clarify this seeming fisheries paradox.

C. THE AQUACULTURE SECTOR

Although milkfish pond culture originated some 500 years ago in Indonesia, its adoption in the Philippines took place only in the late 1800's (Smith, 1981). This late development of fishfarming relative to capture fisheries may be due to the higher capital requirements needed by this enterprise. Despite the close geographical and cultural proximity of the southern Philippine provinces with Indonesia, milkfish culture started and flourished in Manila and adjoining provinces and not in Mindanao. From then on, the technique was developed further by Manila-based fishfarmers/entrepreneurs but did not spread to other regions of the country despite unhindered opportunites for technology exchange. It was only in the late 1960's that the fishfarming industry developed rapidly, primarily at first through the spread of extensive methods to other areas of the country and later on through the intensification of aquaculture in existing farms (PCARRD, 1983 a & b).

It is interesting to note, however, that despite the numerous places in the country that is well-suited for fishfarming, it was only in a few areas (near population and central distribution centers) where the industry really spread out to develop, e.g.: the provinces around Manila Bay, Western Visayas, and Pangasinan. Later on, when further expansion of fishpond areas were not feasible in these provinces, the fishfarmers started shifting towards more intensive methods of production, i.e., from level II to level III and IV, while the rest of the fishfarms in the country continue to expand and operate at a lower level (Smith, 1981; PCARRD, 1983 a & b; Apud, et al., 1986). In fact, some areas in Ilocos, Cagayan, Palawan, and Mindanao still remain at level I up to the present.

In the case of mussels and oysters, level I fisheries persisted until about the early 1900's. It was only in the 1930's when some Manila Bay oyster farmers started to shift to level II technology in response to the growing demand for oysters by the Manila market (PCARRD, 1983b). Today, oyster and mussel farming are spreading rapidly to other areas of the country but it is only in Manila Bay that farmers are using more advanced farming technologies. The growth pattern of the newly emerging prawn/shrimp farming industry also seems to follow those of the oyster, mussel, and milkfish industry, except that in this case, the market demand comes from outside the country (Samson, 1985).

D. THE MARINE FISHERIES SECTOR

Although archaeological data are limited, early accounts of Spanish chroniclers indicate that most coastal dwellers in the Philippines probably spent some time fishing and collecting aquatic products using a wide range of small-scale techniques in response to the great diversity of demersal and pelagic fish, crustacean, and molluscan species (Constantino, 1975; Spoehr, 1984). The subsequent growth of Manila and of provincial towns provided the economic milieu for small fishing communities to take form, and by the end of the 18th century a variety of fish-catching techniques (mostly level II) and markets (organized on the basis of monetized exchange) emerged (Spoehr, 1984). By the 1700, Chinese immigrants who were attracted by the fast rising city of Manila, introduced lever nets, called "*salambaw,*" and also gill nets and casting nets (Rasalan, 1952). These two gears were capable of producing the large catches needed to satisfy the growing urban demand for fishery products which cannot be met using traditional Filipino fishing techniques alone (Blair & Robertson, 1903-1909). However, from the technological point of view, the general development of fisheries during the Spanish period was a relatively static one.

Shortly before 1900, the "*sapyaw*" or round-haul seine, and somewhat later, the deep-water fish corral (apparently both Tagalog innovations) initiated a line of development of individual techniques which spread to other parts of the archipelago (Szanton, 1971; Umali, 1950). Thereafter, in the pelagic fishery, a number of innovations and developments in fishing gear and techniques made their appearances and then rapidly adopted and improved, again in response to urban demand (Spoehr, 1984), such as: *kubkuban*, using a form of purse seine; *lawagan*, an improved version of the *sapyaw*; the *largarete*, using a gill net; and the *basnigan*, using a lift net (Umali, 1950; Rasalan, 1952; Szanton, 1971). For demersal fisheries, Japanese fishermen in the early 1900's introduced a new technique in Manila Bay - beam trawls with sailing sampans and the *muro ami*, a large drive-in net (Manacop, 1950; Manacop & Laron, 1956). In the 1920's and 1930's, the Japanese motorized their trawlers and expanded their operations into other parts of the Philippines (Montalban & Martin, 1930).

After World War II the pace of change in all aspects of Philippine life was highly accelerated. Technological transfers from abroad were combined with local innovations through the initiative of Filipino fishermen and entrepreneurs to bring about technological change that has been greater that any other period in the Philippine historic records (Spoehr, 1984). Among the new developments of that time were: the rapid and extensive motorization of fishing crafts of all types and the corresponding changes in boat sizes, the adoption of synthetic fibers to replace abaca and cotton for nets and lines, the use of generators and incandescent lights for night fishing, and the development of large-scale fishing based primarily (although not exclusively) on the adoption of the stern-set otter trawl and modern one-boat purse seining (Szanton, 1971; Spoehr, 1980, 1984; Pauly, 1982a).

For the capture fisheries as a whole, the innovations shifted the over-all technological patterns from broad-spectrum, small-scale adaptation to one where more capital-intensive, highly specialized fish-catching methods assumed a prominent role in response to urban demand which stimulated the exploitation not only of the coastal but also of the little-used or unused marine resources offshore (Spoehr, 1984).It should also be noted that private initiative has been the dominant force in the generation of all of these innovations. Numerous attempts by the government to accelerate these processes in areas where adequate population base, market structure, transportation system, etc. were lacking almost always ended in failure.

E. THE CO-EXISTENCE OF SUSTENANCE AND COMMERCIAL FISHERIES

How can a wide range of fishery conditions co-exist in a given fishing ground when the evolutionary pattern of fishing development indicates that a gradual shift from a lower to a higher fishery level should be expected in response to the current population growth and market access? The answer can be found by looking into the historical development of the Philippine socio-economic and political structure.

During the pre-colonial period, social stratification was already in its infancy, with the *datu* or chief serving as the moral leader of the local *baranggay* or village. Although he does not have political ascendancy over the others, special privileges were provided to him and his family in gratitude to his leadership role, e.g., territorial use rights for *baklad* or fish corral (Constantino, 1975). The coming of the Spaniards reinforced this leadership role by providing not only traditional roles but also political and economic privileges as well to the *datu* which gave him and his family a secure economic edge over the others (Agoncillo & Guerrero, 1986). Since small-scale fisheries was the only fisheries existing during that time, social and economic stratification had only minimal effects to the fishing communities. However, as Manila grew to prominence in the 1700's, Chinese traders dominated the marketing and distribution of fishery products and later on, even engaged in fishing themselves using more advanced technologies (Spoehr, 1984). Exclusive fishing enclaves and guilds were established which started the widening disparity between the commercial and small-scale sustenance fishermen.

As fishing activity moved from individual to group operations, the catch sharing system developed which greatly favored the fishing boat/gear owner-operator, especially in the middle-scale fishery sector. During the present century, beginning with middle-scale and culminating in large-scale fishing, the increased capital investment costs associated with technological development gave rise to the non-fishing owners-operators' class - entrepreneurs and managers who in turn are linked to the prevailing national social and economic stratification, interclass and intraclass patterns of behavior, and to both continuities and change in Philippine social structure (Spoehr, 1984). Owners of middle-scale gear may or may not live in fishing communities while owners of trawlers and purse-seiners, if not residing in towns and cities, nevertheless tend to be urban-oriented (Szanton, 1971; Spoehr, 1984).

In remote fishing villages, small-scale fishing operations suitable to existing local population demand and market condition is usually undertaken. However, if these villages are near major towns, it will also be common to see middle-scale fishing operations financed by local businessmen and economic elite working alongside small-scale fishermen. Often, as the competition for resources in fishing grounds near large urban settlements becomes economically unbearable, commercial fishing operators, (with their large boats and gears capable of continous and extended operations), expand their area of operation by exploiting far-off, sparsely populated fishing grounds in the other regions of the country. These accounts for the observed apparent co-existence of a wide range of fishing activities in a given fishing ground.

CONCLUSIONS AND POLICY IMPLICATIONS

The primary finding of this study is that the solutions formulated by Filipino fishermen/fishfarmers generally follows Boserup's evolutionary thesis which is similar to the solutions found historically in other parts of the developed or developing world. Fishfarmers have responded to increasing population density or increased demand for aquacultural output with an expansion of the area devoted to aquaculture, larger investments in land, and later on, intensification of aquacultural systems. Fishermen, on the other hand, responded by expanding their area of operation and fishing time, larger investments in fishing vessel and gear, and innovations in mechanical technology and modern commercial fishing techniques.

Population growth and access to markets are the main determinants of fisheries intensification, which is defined here as the movement from a lower to a higher fishery level. The existence of a positive relation between population density and agricultural intensification has been described by Boserup and seems to be true to fisheries as well. Better access to markets also leads to intensification for two reasons: a) higher prices and elastic demand for tradeable goods mean greater marginal rewards for effort, so fishermen/fishfarmers will begin to fish/farm larger areas, and b) higher rewards to labor encourage immigration into the area from neighboring regions where transport costs are higher (Pingali, et al., 1987).

High output prices accelerate the pace of intensification and mechanization, provided they are transmitted to the farmers/fishermen. Price incentives motivate fishery intensification and associated investments, (e.g., investments in mechanical equipment), but they are not sufficient encouragement for technical change. Among the other requirements are the existence of adequate market infrastructure, (e.g., interregional roads and farm-to-market roads), which will enable the high border prices of fishery products to be transmitted to the fishermen's/ fishfarmer's villages. However, since the per capita cost of infrastructural development is high in regions where population density is low, adequate feasibility studies should precede any policy moves along this line.

Intensification leads to an increase in yields per hectare of fishfarms and yields per vessel of fishing enterprises. The higher yields are obtained because fishfarmers respond to decreasing availability of aquaculture land by increasing the input to labor to improve pond preparation, crop husbandry, and fertilization. Fishermen obtain higher yields by adopting more efficient and powerful fishing methods designed to catch large schools or to operate in deeper fishing grounds.

Private initiative has been the dominant force in the generation of mechanical innovation and development of aquacultural/fishing techniques. Mechanical technology and aquacultural/fishing techniques are sensitive not only to climatic and oceanographic factors, (e.g., tidal characteristics, rainfall and wind regimes, behavior of target species, etc.) but also to economic factors as well, (e.g., availability of capital and raw materials, wage rates , farm/vessel size, etc.). Any incongruencies in either environmental or economic conditions will limit the opportunities for the direct transfer of mechanical technology. However, where factor endowments warrant and where the benefits from innovation can be realized, a great deal of inventiveness or adoptation of mechanical technology to meet local conditions can be seen.

Transition from a lower fishery level to a higher one, where it is appropriate, occurs rapidly and does not depend on government intervention. Where transition to intensive prawn culture or motorized fishing operations is profitable, rapid adoption of prawn culture techniques and motorization often takes place with minimal government involvement. Supply-side constraints do not constitute a significant bottleneck in their adoption, repair and service facilities follow demand, and privately operated farms and machineries historically exhibity long lives and high rates of utilization. The poor performance of various government sponsored fishery development projects provides a good point in contrast.

The planning of project interventions to promote any form of mechanization or fishing/fishfarming technique is best done at the regional or subregional level rather than at the national level. The appropriateness of a fishing/fishfarming technique varies with a lot of factors as elucidated earlier. Due to the heterogeneity of conditions existing in the different regions of the country, the profitability of adopting a particular system will vary widely among different locales. Therefore, the selection of an appropriate location is the single most important determinant for the eventual success of a project. Decentralized planning is therefore essential.

Identifying and alleviating short-run constraints in the transition from one fishery level to another is the most appropriate goal of government intervention. The profitability of using any fisheries innovation is dependent upon the existing farming/fishing system, soil/substratum type, and climatic/oceanographic conditions. Mechanization policy and interventions can, at best, affect these factors only marginally, however, at appropriate locations, they can be used to alleviate some of the short-run transitional constraints that may be encountered through such strategies as:

* Credit availability - Sustenance fishermen find it hard (if not impossible) to secure credit for the modernization of his techniques compared to the local moneyed elite. Therefore, to minimize the growing economic disparity, a government program needs to be initiated.

* Training programs for fishermen and fishfarmers - During the early stages in the use of an advanced technique or machinery, government-sponsored training programs can help by reducing the learning cost substantially. To be effective, these training programs are best organized in small

regional training centers under conditions similar to those existing or encountered locally.

*Artisan training - The widespread use of modern equipment and machineries will create a demand for spare-parts and maintenance services. The establishment of regional or central workshops for repairs or procurement of spare parts is usually insufficient and often too bothersome for the farmers/fishermen. However, local artisans prove to be more effective in this respect. Therefore, the training and retraining of these artisans could be a useful component of government fishery intervention and should be seriously considered.

REFERENCES

Agoncillo, T. & M. Guerrero. 1986. History of the Filipino People (7th ed.). R.P. Garcia Publishing Co., Quezon City, Philippines. 648 p.

Apud, F., J. Primavera, & P. Torres, Jr. 1985. Farming of Prawns and Shrimps (3rd ed.). Aquaculture Extension Manual No. 5. SEAFDEC Aquacultural Department, Tigbauan, Iloilo, Philippines. 67 p.

Bardach, J., J. Ryther, & W. Mc Larney. 1972. Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, Inc., New York. 868 p.

Barnett, H. 1979. Scarcity and growth revisited. p. 163-217. In: Smith, K. (ed.) Scarcity and Growth Reconsidered. John Hopkins Press for Resources for the Future. Baltimore, Maryland.

Barnett, H. & C. Morse. 1963. Scarcity and Growth: The Economics of Natural Resource Availability. The John Hopkins Univ. Press for Resources for the Future, Inc. Baltimore, Maryland.

Baum, G. & J. Maynard. 1976a. Philippines: Panigayan, Lampinigan, Baluk-baluk, Manangal, a socio-economic study on four fishermen's communities affiliated to the Basilan Fishing Association (BFA), Isabela City, in connection with the Municipal Fisheries Pilot Programme. SCS/76/WP/23. 22 p., + 45 p. of annexes.

_________. 1976b. Bayawan municipality: a socio-economic study and development proposal. SCS/76/WP/42. South China Sea Development and Coordinating Programme. Manila, 41 p., + 28 p. of appendices.

_________. 1976c. Philippines: Coron/Tagumpay, Busuanga Island/ Calamianes Group, Palawan Province, a socio-economic study on two rural fishing populations in Northern Palawan in connection with the Municipal Fisheries Pilot Programme. SCS/76/WP/33. 45 p., + 61 p. of appendices.

_________. 1976d. Philippines: Salay Municipality, Misamis Oriental Province, Mindanao, a socio-economic study on the fishing population of the seven coastal barrios of Salay Municipality in connection with the Municipal Fisheries Pilot Programme. SCS/76/WP/29. 47 p.

BFAR. 1979. Fisheries Statistics of the Philippines. Bureau of Fisheries and Aquatic Resources. Manila, Philippines. 115 p.

Blair, E. & J. Robertson. 1903-1909. The Philippine Islands. 55 vols. Arthur H. Clark. Cleveland, Ohio.

Boserup, E. 1965. The Conditions of Agricultural Growth: the Economics of Agrarian Change Under Population Pressure. George Allen & Unwin, Ltd. London, 124 p.

________. 1981. Population and Technological Change: a Study of Long-term Trends. The Univ. of Chicago Press. Chicago, 255 p.

Cheetam, R. & E. Hawkins. 1976. The Philippines: Priorities and Prospects for Development:

Report of a Mission Sent to the Philippines by the World Bank. The International Bank for Reconstruction and Development/The World Bank. Washington, D.C. 573 p.

Chullasorn, S. & P. Martosubroto. 1986. Distribution and Important Biological Features of Coastal Fish Resources in Southeast Asia. FAO Fish. Tech. Paper, (278): 84 p.

Constantino, R. 1975. The Philippines: A Past Revisited vol. I. Manila, Philippines. 463 p.

DAP. 1977. Population, Resources, Environment, and the Philippine Future (PREPF) vol. II-3B. p. 1138-1387. Development Academy of the Philippines. Manila, Philippines.

Dickerson, R. 1928. Distribution of Life in the Philippines. Bur. Sci. Monogr. (Philippines) no. 21. 222 p. + plates.

Emmerson, D. 1975. Orders of meaning: understanding political changes in a fishing community in Indonesia. (Delivered to the annual meeting of the American Political Association, 2-5 Sept.). A preliminary analysis of the rejection of modern fishing technology by fishermen in Muncar, East Java.

_________. 1980. Rethinking Artisanal Fisheries Development: Western Concepts, Asian Experiences. Staff Working Paper No. 423. The World Bank. Washington, D.C., 97 p.

FIDC. 1980. State-of-the-art Report on Marine Fisheries Statistics, Economics, and Marketing. Fishery Industry Development Council. Manila, Philippines.

Gulland, J. 1982. The management of tropical multi-species fisheries. p. 287-298. In: Pauly, D. & G. Murphy (eds.) Theory and Management of Tropical Fisheries. ICLARM Conference Proceedings 9. International Center for Living Aquatic Resources Management, Manila, Philippines and Division of Fisheries Research, Commonwealth Scientific and Industrial Research Organization, Cronulla, Australia. 360 p.

Herre, A. & J. Mendoza. 1929. Bangos culture in the Philippine Islands. Philipp. J. Sci. 38: 451-509.

Kuhn, T. 1962. The Structure of Scientific Revolutions (2nd ed.) vol. II, no. 2. The University of Chicago Press, Chicago. 210 p.

Larkin, P. 1982. Directions for future research in tropical multi-species fisheries. p. 309-328. In: Pauly, D. & G. Murphy (eds.) Theory and Management of Tropical Fisheries. ICLARM Conference Proceedings 9. International Center for Living Aquatic Resources Management, Manila, Philippines and Division of Fisheries Research, Commonwealth Scientific and Industrial Research Organization, Cronulla, Australia. 360 p.

Librero, A. 1985. Marketing systems for fish in the Philippines. p. 197-204. In: Panayotou, T. (ed.) Small-scale Fisheries in Asia: Socio-economic Analysis and Policy. International Development Research Center, Ottawa, Canada. 283 p.

Librero, A., D. Ramos, & L. Lapie. 1982. Fish capture technology: its relationship to productivity, income, and employment in the Philippines. Fish. Res. J. 7(2): 1-20.

Losch, A. 1954. The Economics of Location (translation). Yale Univ. Press, New Haven, Connecticut.

Marr, J. 1982. The realities of fishery management in southeast Asian region. p. 299-307. In:

PCARRD. 1983a. The Philippines Recommends for Bangus. Philippine Council for Agriculture and Resources Research and Development Tech. Bull. No. 26-A, Los Baños, Laguna, Philippines. 77 p.

______. 1983b. The Philippines Recommends for Mussels & Oysters. Philippine Council for Agriculture and Resources Research and Development Tech. Bull. No. 26-A, Los Baños, Laguna, Philippines. 46 p.

Pelayo, R. 1983. The Philippine Fisheries System: A Management Planning Perspective. M.S. Thesis, Oregon State Univ., Corvallis, Oregon. 155 p

Pernia, E. 1977. Urbanization, Population Growth, and Economic Development in the Philippines. Studies in Population and Urban Demography No. 3. International Population and Urban Research, Univ. of California, Berkely. Greenwood Press. Westport, Connecticut, 213 p.

Pingali, P., Y. Bigot, & H. Binswanger. 1987. Agricultural Mechanization and the Evolution of Farming Systems in Sub-Saharan Africa. The John Hopkins Univ. Press. Baltimore, Maryland. 216 p.

Rasalan, S. 1952. Fishing gear commonly used in Philippine fishing p. 53-69. In: Villadolid, D. (ed.) Philippine Fisheries Handbook. Bureau of Printing, Manila, Philippines.

Reed, R. 1967. Hispanic Urbanism in the Philippines: A Study of the Impact of Church and State. Univ. of the Philippines, Manila and Quezon City. 29 p.

Ronquillo, I. 1978. The allocation of tuna fisheries. p. 10-30. In: Christy, F. (ed.) Law of the Sea: Problems of Conflict and Management of Fishes in Southeast Asia. Proceedings of the ICLARM/ISEAS Workshop on the Law of the Sea. ICLARM Conference Proceedings no. 2. The International Center for Living Aquatic Resources Management, Manila, Philippines, and the Institute of Southeast Asian Studies, Singapore. 68 p.

Samson, E. 1985. Fisheries. p. 101-154. In: Kent, G. & M. Valencia (eds.) Marine Policy in Southeast Asia. Univ. of California Press, Berkely and Los Angeles, California. 425 p.

SCSP. 1976. Report on the BFAR/SCSP workshop on the fishery resources of the Visayan and Sibuyan Sea areas, 18-22 October 1976, Iloilo, Philippines. SCS/GEN/76/7. 26 p.

____. 1977. Report on the BFAR/SCSP workshop on the fishery resources of the Sulu Sea, Bohol Sea, and Moro Gulf areas, 25-29 April 1977. Cagayan de Oro, Philippines. SCS/GEN/77/11. 125 p.

____. 1978. Report on the BFAR/SCSP workshop on the fishery resources of the Pacific coast of the Philippines, 18-22 September 1978, Naga City, Philippines. SCS/GEN/78/19. 48 p.

____. 1979. Report of a BFAR/SCSP workshop on the fishery resources of the north and western coast of Luzon. Manila, Philippines. SCS/GEN/79/22.

Simon, J. 1981. The Ultimate Resource. Princeton Univ. Press, Princeton, New Jersey.

Smith, C., L. Olufson, J. Stander, A. Tyler, and J. Young. 1987. The Nogero. Dept. of Anthropology, Oregon State University, Corvallis, Oregon. 21 p.

Smith, I. 1981. The Economics of Milkfish Fry and Fingerling Industry of the Philippines. ICLARM Tech. Reps. 1. International Center for Living Aquatic Resource Management, Manila and Aquaculture Department, Southeast Asian Fisheries Development Center, Iloilo, Philippines. 146 p.

Smith, I. & A. Mines. 1982. Implications for equity and management. p. 130-143. In: Smith, I. & A. Mines (eds.) Small-scale Fisheries of San Miguel Bay, Philippines: Economics of Production and Marketing. ICLARM Tech. Rep. No. 8. International Center for Living Aquatic Resources Management, Manila, Philippines; College of Fisheries, Univ. of the Philippines in the Visayas, Quezon City, Philippines; and the United Nations Univ., Tokyo, Japan. 143 p.

Smith, I., M. Puzon, & C. Vidal-Libunao. 1980. Philippine Municipal Fisheries: a Review of Resources, Technology, and Socio-economics. ICLARM Studies and Review No. 4. International Center for Living Aquatic Resources Management and Fishery Industry Development Council. Manila, Philippines. 87 p.

Spoehr, A. 1980. Protein from the Sea: Technological Change in Philippine Capture Fisheries. Ethnology Monograph No. 3. Department of Anthropology, Univ. of Pittsburgh. Pittsburgh, Pennsylvania.

Spoehr, A. 1984. Change in Philippine capture fisheries: an historical overview. Philipp. Quart. Cult. & Soc. 12: 25-56.

Standing, G. & R. Szal. 1979. Poverty and Basic Needs: Evidence from Guyana and the Philippines. International Labour Organization. Geneva, Switzerland, 154 p.

Szanton, D. 1971. Estancia in Transition: Economic Growth in a Rural Philippine Community. Ateneo de Manila Univ., Institute of Philippine Culture Papers No. 9. Ateneo de Manila Press. Quezon City, Philippines.

Szanton, M. 1972. A Right to Survive: Subsistence Marketing in a Lowland Philippine Town. Pennsylvania State Univ. Press. University Park, Pennsylvania.

Tietenberg, T. 1988. Environmental and Natural Resource Economics (2nd ed.) Scott, Foresman, and Co., Glenview, Illinois. 559 p.

Umali, A. 1950. Guide to the Classification of Fishing Gears in the Philippines. U.S. Department of the Interior, Fish and Wildlife Service, Research Report No. 17. Washington: Government Printing Office.

Umali, R. 1980. Coastal Resources Development and Management: Philippine Experience. Natural Resource Management Center, Quezon City, Philippines.

Valencia, M. 1985. National marine interests in southeast Asia. p.33-57. In: Kent, G. & M. Valencia (eds.) Marine Policy in Southeast Asia. Univ. of California Press, Berkely and Los Angeles, California. 425 p.

Warfel, H. and P. Manacop. 1950. Otter trawl explorations in Philippine waters. Research Report 25, Fish and Wildlife Service, U.S. Dept. of the Interior, Washington, D.C. 56 p.

Wyrtki, K. 1961. Physical Oceanography of Southeast Asian Waters. NAGA Report, vol. 2. Scripps Institution of Oceanography, La Jolla, California.

Table 1. Species typically comprising the commercial groups of otter trawl catches in the Philippines (from Warfel & Manacop, 1950).

Commercial groups	English name	Tagalog name	Scientific name
Shrimp (hipon)	Grooved shrimp	Hipon suage	*Penaeus canaliculatus.*
Do	do	Quakit	*Penaeus affinis.*
Do	do	Hipon suage	*Penaeus incisipes.*
Do	White shrimp	Hipon puti	*Penaeus indicus.*
Do	Tiger shrimp	Sugpo	*Penaeus monodon.*
Cephalopods (pusit and panos).	Cuttlefish	Panos	*Sepia* sp.
Do	Octopus	Pugita	*Octopus* sp.
Do	Squid	Pusit	*Loligo* sp.
Large-sized fishes (joya).	Barracuda	Babayo	*Sphyraena forsteri.*
Do	Banded barracuda	Asogon	*Sphyraena jello.*
Do	do	Torcillo	*Sphyraena obtusata.*
Do	Cavalla	Talakitok	*Caranx melampygus.*
Do	do	do	*Caranx sexfasciatus.*
Do	do	Dulusan	*Caranx kalla.*
Do	do	Babadlong	*Caranx crumenopthalmus.*
Do	do	do	*Caranx armatus.*
Do	do	do	*Caranx malabaricus.*
Do	Even-bellied crevalle	Salay-salay lalake	*Caranx djedaba.*
Do	Threadfish	Damis lawin	*Alectis indica.*
Do	Toothless cavalla	Banlog	*Caranx speciosus.*
Do	Yellow-striped crevalle	Salay-salay batang	*Caranx leptolepis.*
Do	Plain croaker	Alakaak	*Johnius aneus.*
Do	Smooth-scaled croaker	Kabang	*Sciaena dussumieri.*
Do	Honeycombed grouper	Lapu-lapung ligiig	*Epinephelus merra.*
Do	Marbled grouper	Garupa	*Epinephelus fuscoguttatus.*
Do	Lactarid	Pellan	*Lactarius lactarius.*
Do	Short-bodied mackerel	Hasa-hasa	*Rastrelliger brachysoma.*
Do	Spanish mackerel	Tanguingue	*Scomberomorus commerson.*
Do	Striped mackerel	Alumahan	*Rastrelliger chrysozonus.*
Do	Pomfret	Duhay	*Stromateus niger.*
Do	Banded pomadasid	Sekoy	*Pomadasys maculatus.*
Do	Spotted pomadasid	Agoot	*Pomadasys hasta.*
Do	Round scad	Galonggong	*Decapterus* sp.
Do	Big-eyed scad	Matang baka	*Selar crumenopthalmus.*
Do	Hump-backed red snapper	Maya-maya	*Lutjanus gibbus.*
Do	Red snapper	do	*Lutjanus malabaricus.*
Do	Spade fish	Kitang	*Scatophagus argus.*
Do	Turbots	Kalankao	*Psettodes erumei.*
Do	Four-rayed threadfin	Mamali	*Eleutheronema tetradactylum.*
Do	Small-mouthed threadfin	Mamalang bato	*Polynemus microstoma.*
Medium-sized fishes (halo).	Goatfish	Saramullete	*Upeneus sundaicus.*
Do	do	do	*Upeneus moluccensis.*
Do	Yellow-striped goatfish	do	*Upeneus sulphureus.*
Do	Grunt	Dukusan	*Therapon puta.*
Do	do	do	*Therapon theraps.*
Do	Convex-lined theraponid	Bagasang	*Therapon jarbua.*
Do	Four-lined theraponid	Babansi	*Pelates quadrilineatus.*
Do	Mojarras	Huhad	*Pentaprion longimanus.*
Do	Spotted mojarras	Malakapas	*Gerres filamentosus.*
Do	Nemipterid	Bisugong buntalan	*Nemipterus japonicus.*
Do	do	Bisugo	*Nemipterus taeniopterus.*
Do	Small-scaled pomadasid	Bangok-ngok	*Pomadasys argyreus.*
Do	Gizzard shad	Kabasi	*Anodontostoma chacunda.*
Do	Ribbon-finned scalopsid	Tagisang lawin	*Scolopsis taeniopterus.*
Do	Banded whiting	Asohos	*Sillago maculata.*
Do	Common whiting	do	*Sillago sihama.*
Do	Smooth-scaled brill	Dapang bilog	*Pseudorhombus arsius.*
Do	Smooth-scaled seacatfish	Kanduli	*Arius leiotetocephalus.*
Do	Manila seacatfish	do	*Arius thalassinus.*
Miscellany (samot)	Lizard fish	Kalaso	*Saurida tumbil.*
Do	do	Batang kalaso	*Synodus variegatus.*
Do	Eagle ray	Paol	*Aetobatus narinari.*
Do	Marbled sting ray	Paging	*Dasyatis uarnak.*
Do	Sting ray	do	*Dasyatis bleekeri.*
Do	Ovate soles	Tambike	*Solea humilis.*
Do	Black-finned shark	Pating	*Carcharias menisorrah.*
Do	Gray shark	do	*Scoliodon walbehmii.*
Do	Hammerhead shark	Binkingan	*Sphyrna zygaena.*
Do	Spotted guitar-fish	Pating sodsod	*Rhynchobatus djeddensis.*
Small fishes (sapsap)	Slipmouths	Sapsap	*Leiognathus daura.*
Do	do	do	*Leiognathus fasciatus.*
Do	do	do	*Leiognathus stercorarius.*
Do	do	do	*Leiognathus ruconius.*
Do	do	do	*Leiognathus splendens.*
Do	do	do	*Leiognathus equulus.*
Do	do	do	*Leiognathus blochii.*
Do	do	Dalupane	*Leiognathus insidiator.*
Do	do	do	*Gazza minuta.*
Do	do	Miralya	*Gazza leuciscus.*
Trash fish (jaco)	Small and immature fishes and shrimps and other nonmarketable aquatic forms.		

Table 2. Philippine regional road densities, 1973 (from Standing & Szal, 1979).

Region	Road kilometrage			% roadway paved	Motor vehicles per 1,000 population
	km/1,000 population	km/1,000 hectares	motor vehicle/km		
I	3.6	5.4	3	19.9	11
II	3.88	2.0	2	12.2	6
III	1.5	3.5	14	29.6	21
IV	1.35	2.69	25	33.3	33
V	2.34	4.15	2	24.7	4
VI	2.23	4.19	5	17.7	12
VII	2.55	5.52	5	13.2	11
VIII	2.09	2.39	2	12.1	4
IX	2.07	2.28	2	11.4	5
X	3.39	2.83	2	15.6	8
XI	2.71	2.19	4	7.8	11
TOTAL	2.3	3.09	7	18.8	16

Source: Department of Public Works, Transportation and Communication, National Transportation System, 1975.

Table 3. Philippine fishpond production by region, 1981.

Region	Area (ha)	Production MT	Average Yield (kg/ha/yr)
I. Ilocos	13,409.00	15,679	1169.2
II. Cagayan Valley	819.03	532	649.5
III. Central Luzon	42,992.88	51,267	1192.4
National Capital	752.00	677	900.2
IV. Southern Tagalog	29,982.79	18,553	618.7
V. Bicol	12,090.52	5,130	424.2
VI. Western Visayas	44,500.70	51,123	1148.8
VII. Central Visayas	6,783.71	4,126	608.2
VIII. Eastern Visayas	9,658.39	3,857	399.3
IX. Western Mindanao	18,650.06	8,435	452.2
X. Northern Mindanao	5,487.29	2,407	438.6
XI. Southern Mindanao	5,442.79	4,305	790.9
XII. Central Mindanao	5,262.73	4,340	824.6
TOTAL	195,831.89	170,431	870.2

SOURCE: BFAR Statistics, 1981

Table 4. Estimated areas presently used in oyster farming, Philippines.

Province	No. of Farms	Area Used (ha)
Aklan	9	8.3
Bulacan	145	18.0
Cagayan	32	9.5
Camarines Sur	1	0.1
Capiz	160	50.0
Catanduanes	2	0.1
Cavite	300	300.0
Ilocos Norte	19	0.7
Ilocos Sur	11	1.3
Iloilo	14	3.3
La Union	39	3.7
Negros Occidental	48	7.8
Pangasinan	386	16.8
Romblon	1	2.0
Samar	1	0.3
Surigao del Sur	2	0.5
	1202	429.00

[a]South China Sea Fisheries Development and Coordinating Programme, 1982.

Table 5. Estimated potential areas for oyster farming, Philippines.

Province	Area (ha)
Aklan	100
Antique	5
Bataan	10
Batangas	100
Bohol	100
Bulacan	20
Cagayan	30
Capiz	500
Cebu	100
Ilocos Norte	20
Ilocos Sur	100
Iloilo	15
La Union	200
Leyte	2,000
Marinduque	5
Mindoro	10
Negros Occidental	100
Palawan	20
Pangasinan	4,000
Quezon	200
Region 10	50
Samar	500
Sorsogon	530
Surigao del Sur	400
Tawi-tawi	10
Zambales	20
Total	9,145

[a]South China Sea Fisheries Development and Coordinating Programme, 1982.

Table 6. Estimated potential areas for mussel farming, Philippines.

Province	Area (ha)
Aklan	100
Antique	5
Bataan	10
Bohol	50
Bulacan	10
Capiz	200
Cebu	50
Iloilo	10
Leyte	100
Marinduque	5
Oriental Mindoro	10
Negros Occidental	100
Palawan	25
Quezon	200
Region 5	20
Romblon	5
Samar	4,000
Zambales	25
Total	4,925

[a]South China Sea Fisheries Development and Coordinating Programme, 1982.

Table 7. Philippine regional distribution of commercial fishing vessels, 1979.

	Region	Total No. of Units	Trawl	Purse Seine	Bag Net	Other Gears
I.	Ilocos	28	26	-	-	2
II.	Cagayan Valley	68	3	-	-	65
III.	Central Luzon	107	57	-	15	35
IV.	National Capital	839	452	137	33	217
IV-A.	Southern Tagalog	352	42	40	245	25
V.	Bicol	152	58	12	57	25
VI.	Western Visayas	283	191	54	34	4
VII.	Central Visayas	133	19	71	21	22
VIII.	Eastern Visayas	82	22	6	21	33
IX.	Western Mindanao	228	2	38	168	20
X.	Northern Mindanao	41	2	17	8	14
XI.	Eastern Mindanao	136	3	30	34	69
XII.	Southern Mindanao	15	-	3	5	7
	Total	2,464	877	408	641	538

Source: Fisheries Statistics of the Philippines
BFAR (1979)

Table 8. Frequency distribution of fishing boats by tonnage and horsepower, Philippines, 1978-1979 (from Librero, et al., 1982).

(In Percent)

Region	Sample	Motorized	Non-Motorized	Tonnage[a]			
				0.50	0.50-0.75	0.76-1.00	1.01-3.00
Luzon	*255*	*72*	*28*	*27*	*26*	*23*	*24*
Ilocos	64	27	73	55	20	18	7
Central Luzon	64	97	3	2	19	27	52
Southern Tagalog	64	92	8	30	42	20	8
Bicol	63	75	25	30	22	24	24
Visayas	*128*	*88*	*12*	*14*	*35*	*37*	*14*
Western Visayas	64	94	6	6	29	49	16
Central Visayas	64	83	17	12	41	24	13
Mindanao	*123*	*70*	*30*	*30*	*24*	*30*	*16*
Northern Mindanao	61	82	18	17	38	35	10
Southern Mindanao	62	58	42	43	11	25	21
Philippines	506	76	24	24	28	26	19

[a] Based on a somewhat smaller total sample of 475 fishing units.

Table 9. Annual production per vessel classified by horsepower of motor used and by region, Philippines, 1978-1979 (from Librero, et al., 1982).

(In Kilograms)

Region	MOTORIZED				NON-MOTORIZED	TOTAL
	3-8 HP	9-14 HP	Over 14 HP	Total		
Luzon	*2,068*	*2,375*	*3,546*	*3,181*	*1,378*	*2,686*
Ilocos	—	1,055	842	955	785	830
Central Luzon	1,153	3,195	4,380	4,128	440	4,013
Southern Tagalog	1,655	1,820	2,363	2,275	1,445	2,210
Bicol	2,959	2,890	5,718	3,875	3,216	3,708
Visayas	*930*	*2,058*	*2,415*	*2,039*	*588*	*1,868*
Western Visayas	260	2,417	3,410	2,770	239	2,620
Central Visayas	982	1,359	1,164	1,186	714	1,103
Mindanao	*1,505*	*1,937*	*4,458*	*1,893*	*823*	*1,569*
Northern Mindanao	1,269	1,200	5,244	1,495	705	1,352
Southern Mindanao	2,039	2,575	3,869	2,462	873	1,785
Philippines	1,472	2,144	3,288	5,560	1,118	2,213

Table 10. Types of fishing gear by region, Philippines, 1978-1979 (from Librero, et al., 1982).

In percent

	Sam-ple	Long-line	Gill-net	Baby trawl	Net & lines	Hand-line	Lift net	Beach seine	Other[a]
Luzon									
Ilocos	64	27	28	6	—	—	39	—	—
Central Luzon	63	—	41	49	—	—	2	—	—
Southern Tagalog	64	44	41	—	5	9	—	—	2
Bicol	63	17	21	—	13	11	—	—	37
Visayas									
Western Visayas	64	—	70	18	—	—	—	—	2
Central Visayas	64	17	56	8	3	3	—	—	13
Mindanao									
Northern Mindanao	61	3	16	3	18	11	—	38	10
Southern Mindanao	62	6	23	—	26	11	—	36	31
Philippines	505	14	38	12	8	6	5	5	12

[a] Includes combined handlines and longlines, liftnets and other types of nets, hand instruments, and barriers and traps.

Table 11. Gross revenues, income, and profit per fishing unit by gear type and location, Philippines, 1978-1979 (from Librero, et al., 1982).

(In pesos)

Region	Sample	Gross revenues	Gross family income	Net family income	Gross econ. Profit	Net econ. Profit	Opport. costs of mgt.	Pure profit or resource rents	Ret. to Capital (P)	Return to Management (P)	Return to Labor (P)
Luzon											
1. Gillnet											
—motorized	52	14,536	4652	3514	4405	2792	5400	(—2608)	(—76)	9	6
—non-motorized	15	6,987	4689	4406	4741	4335	3228	1107	129	26	10
2. Baby trawl (M)	19	14,896	4665	3934	4530	3438	4456	(—1018)	(—27)	15	10
3. Other nets											
—motorized	12	15,390	5319	3921	4794	2789	4512	(—1723)	(—24)	11	3
—non-motorized	21	6,698	4770	4682	3977	3799	4510	(—711)	(—211)	17	15
4. Handline											
—motorized	8	10,314	2219	1259	2455	1041	6626	(—5585)	(—174)	3	5
—non-motorized	3	5,138	4443	4396	4443	4384	3590	794	504	24	—
5. Longline											
—motorized	36	9,086	3302	2558	3279	2148	3192	(—1044)	(—27)	12	13
—non-motorized	18	6,150	4341	4285	4198	4050	2754	1296	742	29	—
6. Nets & Lines (M)	10	12,893	4339	3182	4048	2174	6118	(—3944)	(—84)	6	6
Total[a]											
—motorized	144	12,789	4169	3202	4009	2562	5092	(—2530)	(—64)	9	5
—non-motorized	59	6,364	4496	4371	4183	3966	2782	1184	309	28	13
Visayas											
1. Gillnet											
—motorized	57	5,980	1397	581	771	(—438)	4618	(—4180)	(—139)	1	2
—non-motorized	4	1,820	1437	1350	788	(—884)	2450	(—1566)	(—129)	7	2
2. Baby trawl (M)	19	5,394	941	194	718	(—467)	4504	(—4037)	(—144)	1	2
3. Longline											
—motorized	2	2,690	3618	282	1508	(—2633)	2802	(—173)	2	17	12
—non-motorized	7	4,137	3056	3008	2608	2548	6354	(—3806)	(—237)	8	—

Table 11. Gross Revenues, Income and Profit...... (continued)

Region	Sample	Gross revenues	Gross family Income	Net family Income	Gross econ. Profit	Net econ. Profit	Opport. costs of mgt.	Pure profit or resource rents	Ret. to Capital (₱)	Return to management (₱)	Return to Labor (₱)
4. Nets & Lines	2	8,750	1582	1039	1856	903	7168	(—6265)	(—323)	2	3
Total[b]											
—motorized	84	5,749	1254	476	741	(—429)	4696	(—4267)	(—150)	1	2
—non-motorized	13	3,350	2641	2582	1715	1641	4868	(—3227)	(—1606)	6	2
Mindanao											
1. Gillnet											
—motorized	11	6,759	3654	2916	3804	2732	3238	(—506)	(— 7)	16	6
—non-motorized	7	3,901	3471	3139	3633	3056	2660	396	58	22	5
2. Other nets (M)	15	5,530	2420	1468	2712	1230	1912	(—672)	(— 5)	10	5
3. Handlines											
—motorized	8	10,286	6590	5958	6740	5801	5330	471	37	21	9
—non-motorized	2	2,616	2316	2185	2316	2152	4390	(—2238)	(—501)	10	—
4. Hand & Longlines											
—motorized	6	11,423	4234	3631	4438	3480	5262	(—1782)	(— 71)	13	8
—non-motorized	5	6,051	4758	4540	4884	4485	3840	645	113	23	—
5. Nets & Lines											
—motorized	19	11,040	2231	1309	2481	1005	6190	(—5185)	44	22	9
—non-motorized	3	4,435	4231	4009	4334	3954	4096	(— 141)	(—142)	14	—
Total[c]											
—motorized	67	10,390	5141	4334	5376	4111	4616	(— 505)	(— 2)	11	7
—non-motorized	25	4,314	3477	3237	3597	3177	3364	(— 187)	(— 1)	19	4
Philippines											
—motorized	295	10,240	3559	2682	3388	2061	4870	(—2809)	(— 81)	8	5
—non-motorized	97	5,432	3986	3840	3703	3453	3212	241	72	21	10

[a] Includes also 8 miscellaneous gear types.

[b] Includes also 6 miscellaneous gear types.

[c] Includes also 5 miscellaneous gear types.

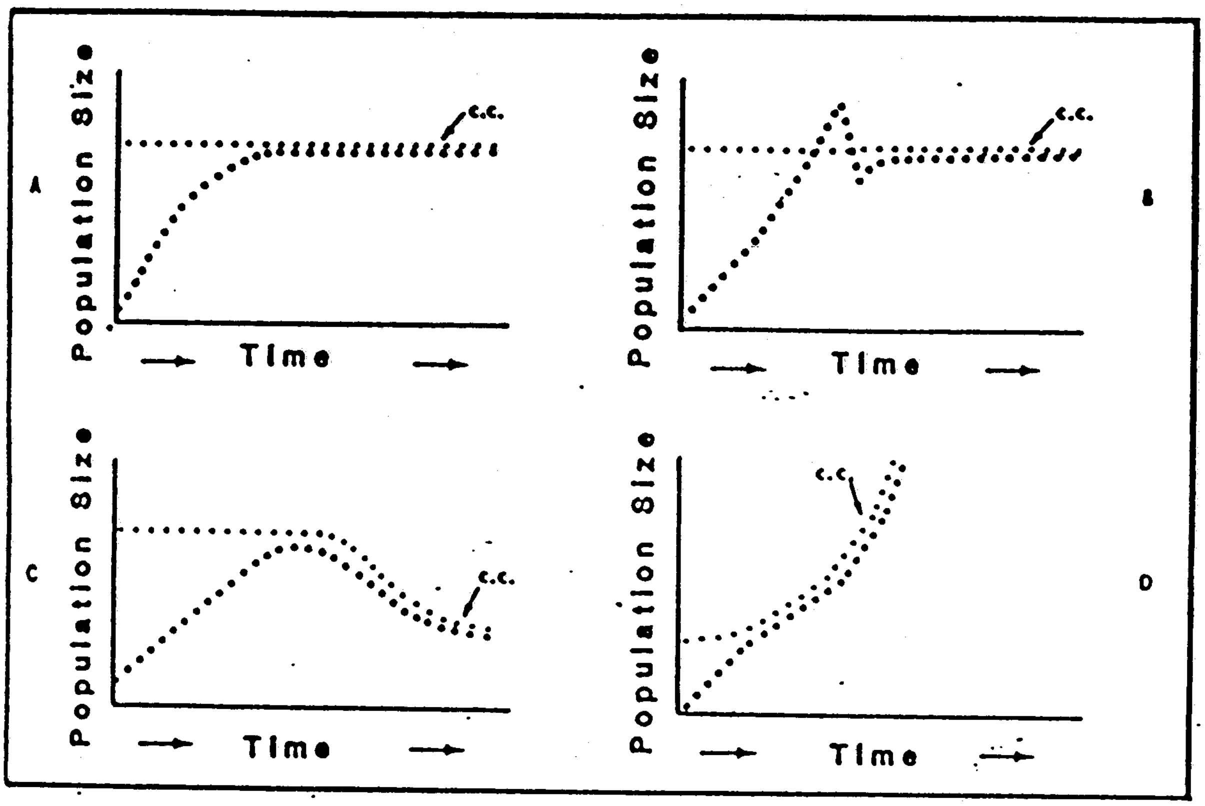


Figure 1. Alternative carrying capacity consequences. Carrying capacity ideas show considerable variation. Several common perspectives are shown above. (A) Carrying capacity as the upper limit for population growth. (B) Population adjustments resulting from exceeding the carrying capacity. (C) Downward adjustments of both population and carrying capacity as a result of excessive population. (D) Population growth which provides the stimulus for the redefinition of the resource base may increase the carrying capacity. (From Newman & Matzke, 1984).

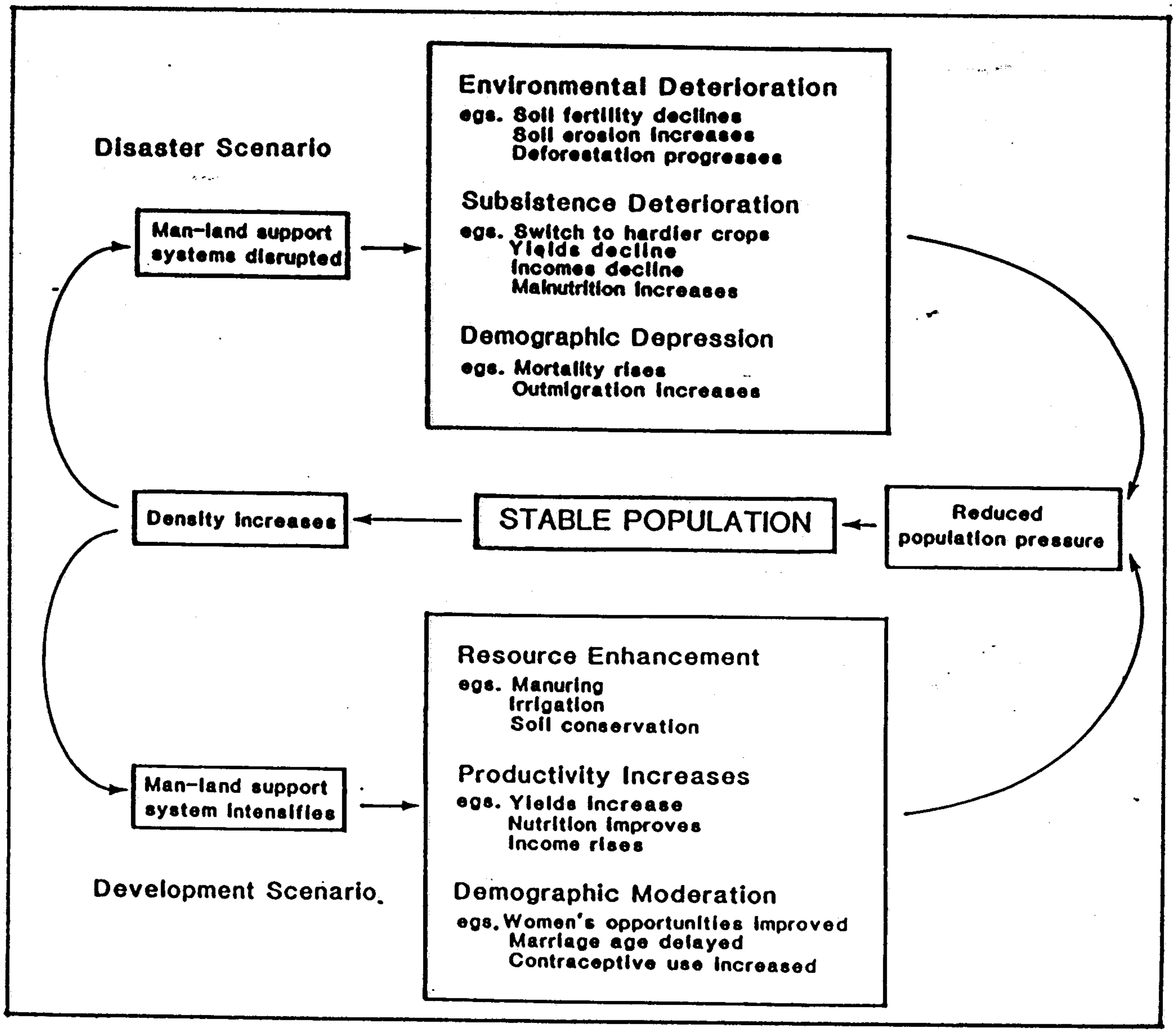


Figure 2. The disaster and development scenarios as responses to population growth. There is no assured outcome, in terms of resource deterioration, which results from population growth. The alternatives can lead to good or bad outcomes. In the disaster scenario, resource deterioration leads to demographic depression. In the development scenario, population increases stimulate adjustments which enhance the supportive capacity of the resource base. An improvement in living standards leads to demographic depression through smaller family norms. (From Newman & Matzke, 1984).

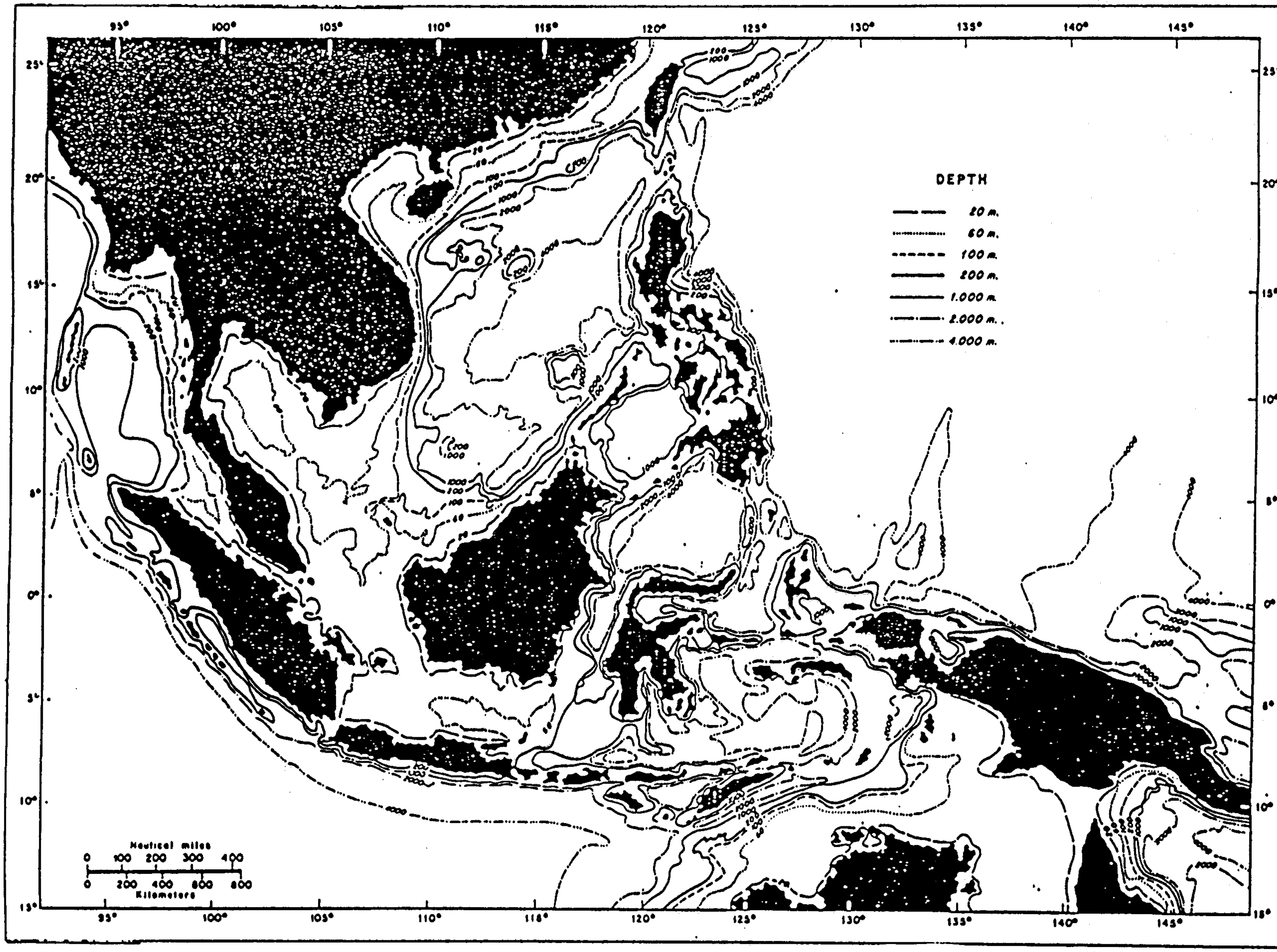
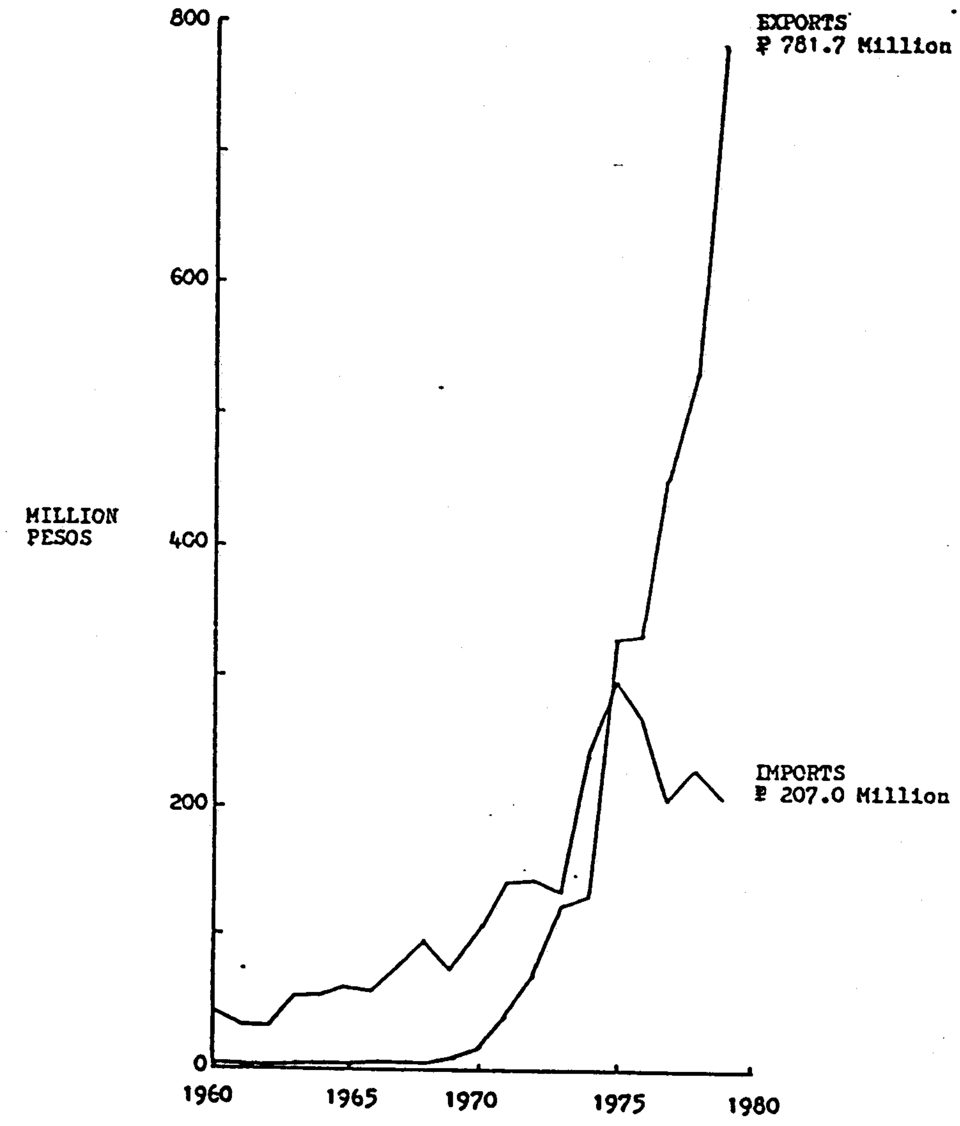


Figure 3. Bathymetry of Southeast Asian region (from Chullasorn & Martosubroto, 1986).

Figure 4. Foreign trade of fishery products, 1960-1979.



Source: Fisheries Statistics of the Philippines
BFAR (1979)

Figure 5. Natural hazards in Southeast Asian region (from Kent & Valencia, 1985).

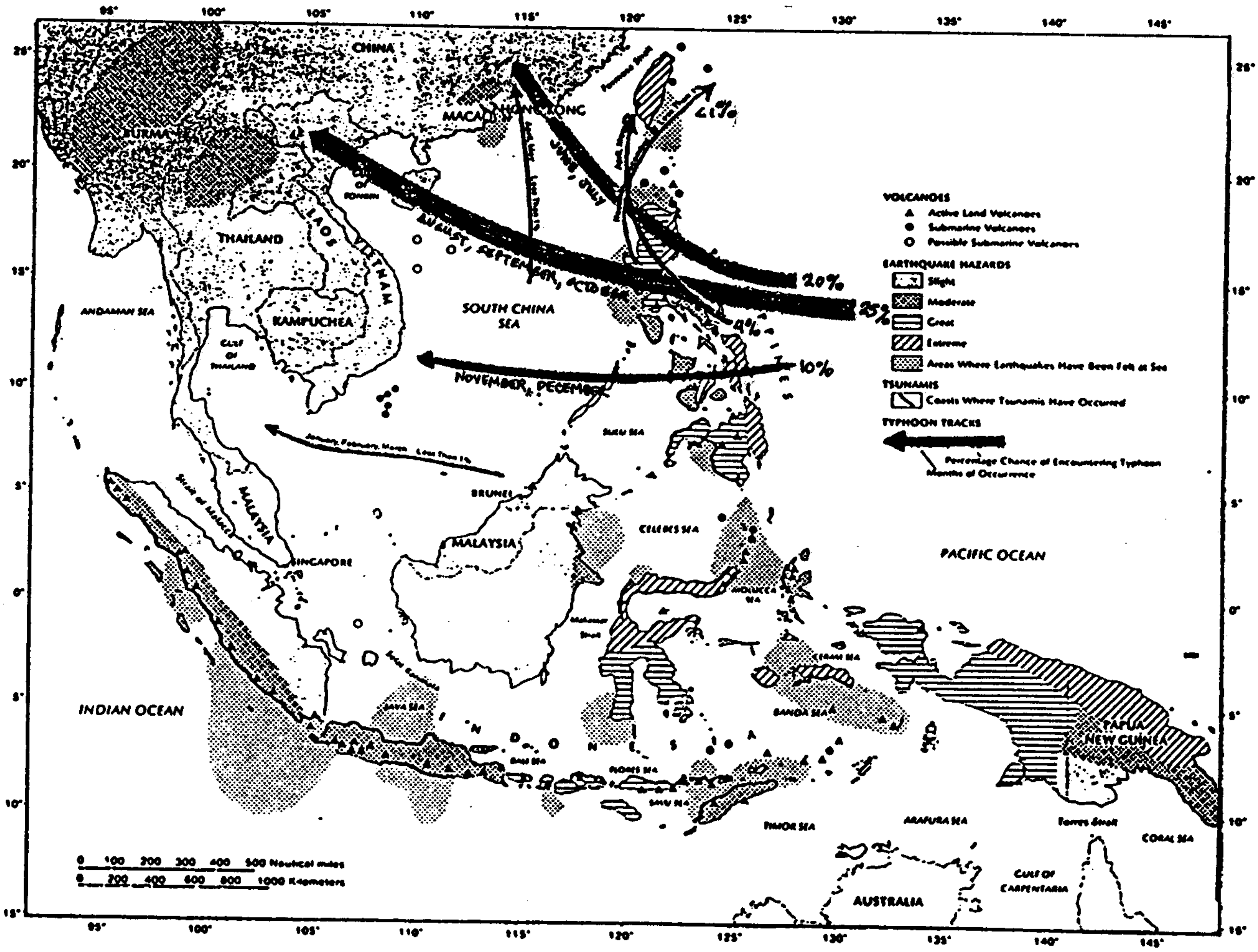


Figure 6. Climatic types of the Philippines (from PCARRD, 1983a).

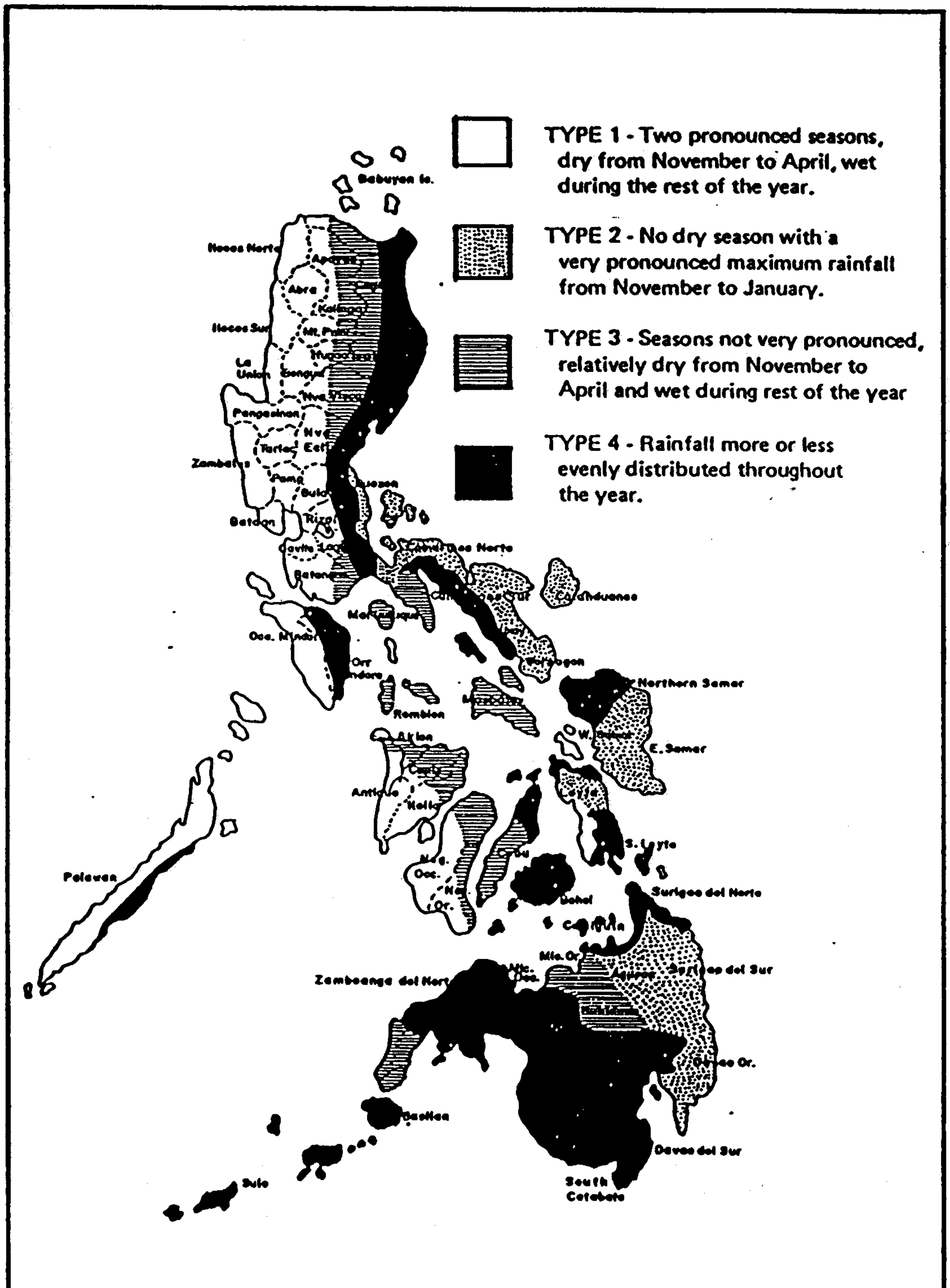
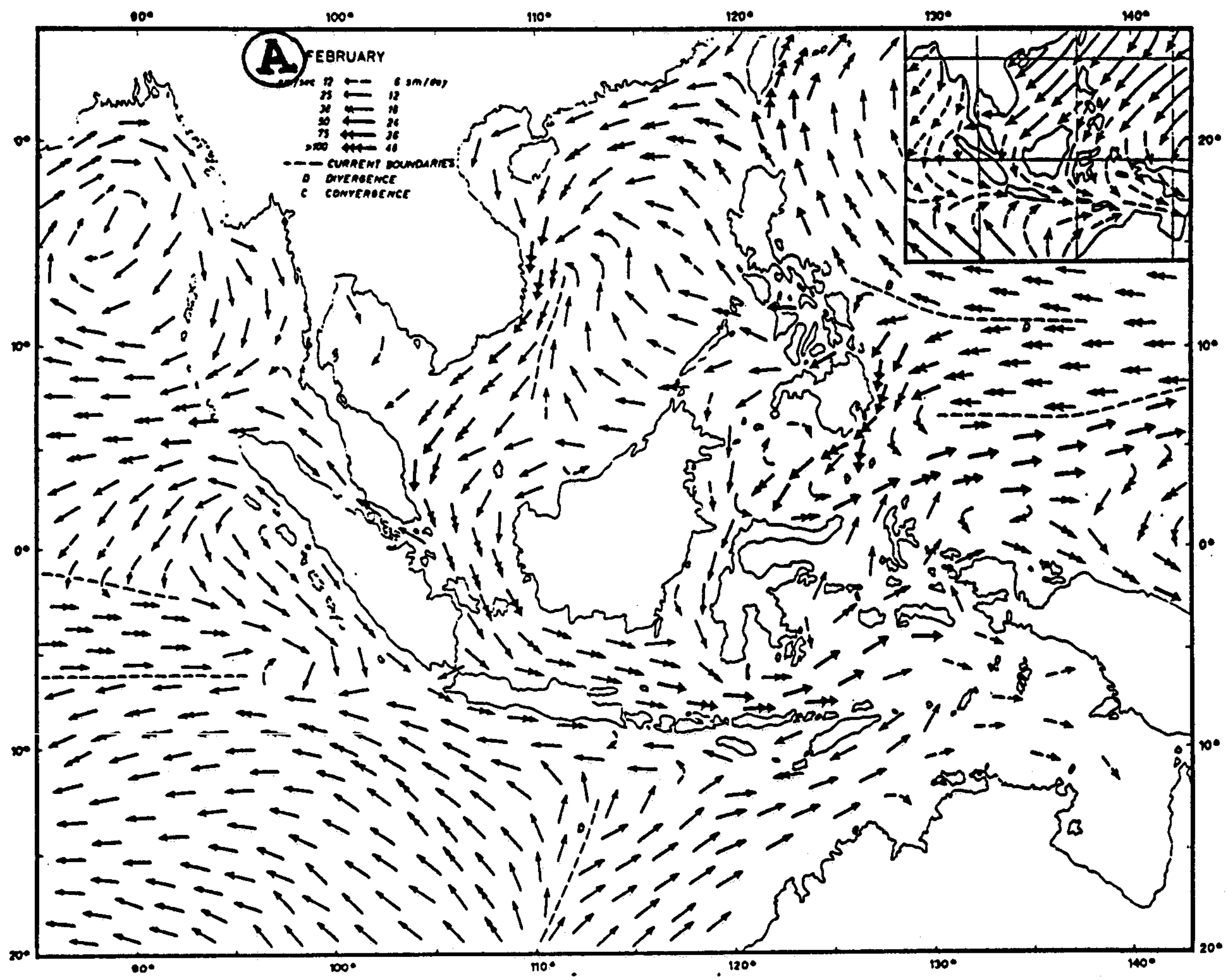


Figure 7. Surface currents: (a) February, (b) August in Southeast Asian region (from Wyrtki, 1961).



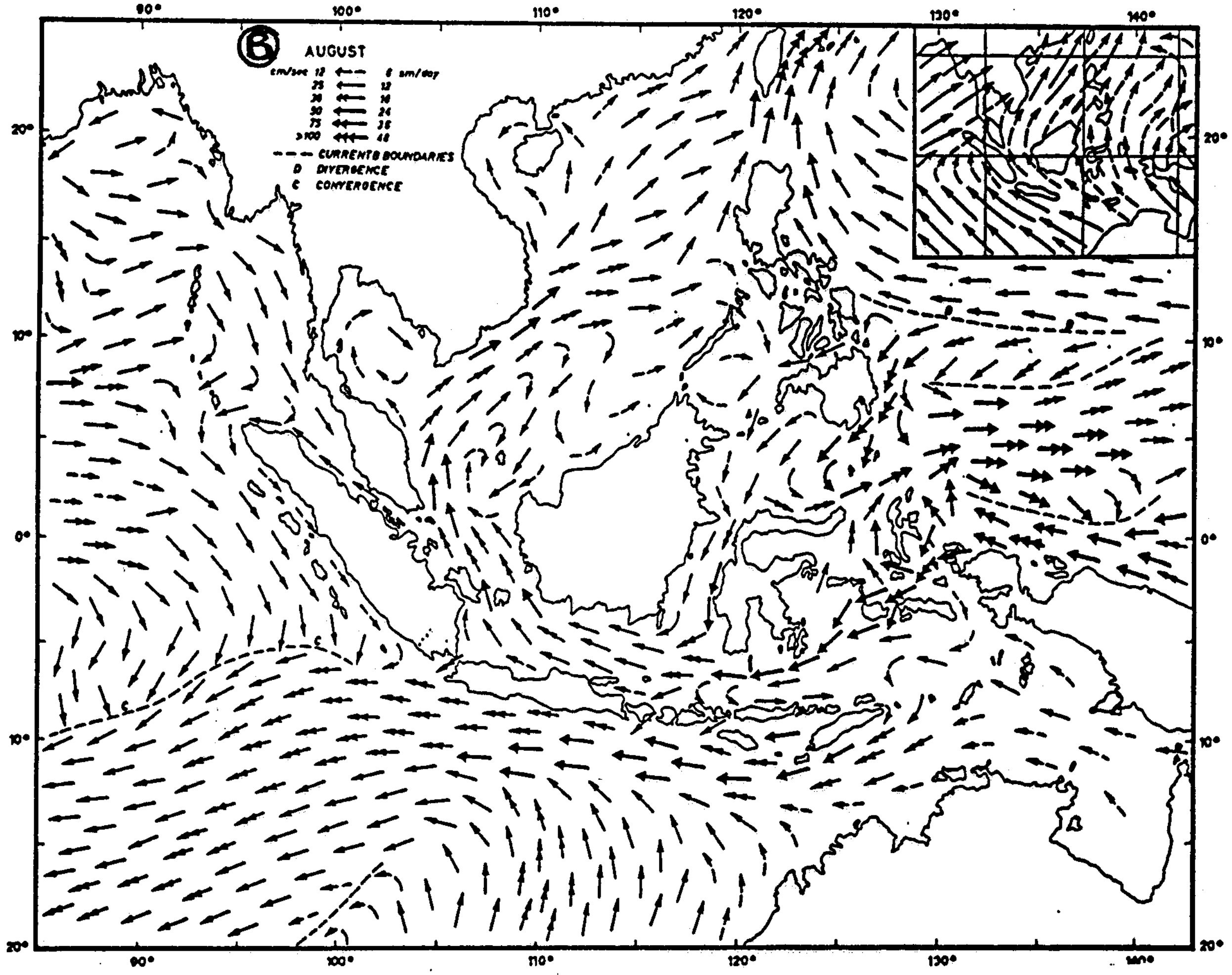

B
AUGUST
cm/sec 12 6 nm/day
25 12
50 24
75 36
>100 48
CURRENTS BOUNDARIES
D DIVERGENCE
C CONVERGENCE
90°
100°
110°
120°
130°
140°
20°
10°
0°
10°
20°

Figure 8. Regional boundaries of the Philippines (from Standing & Szal, 1979).

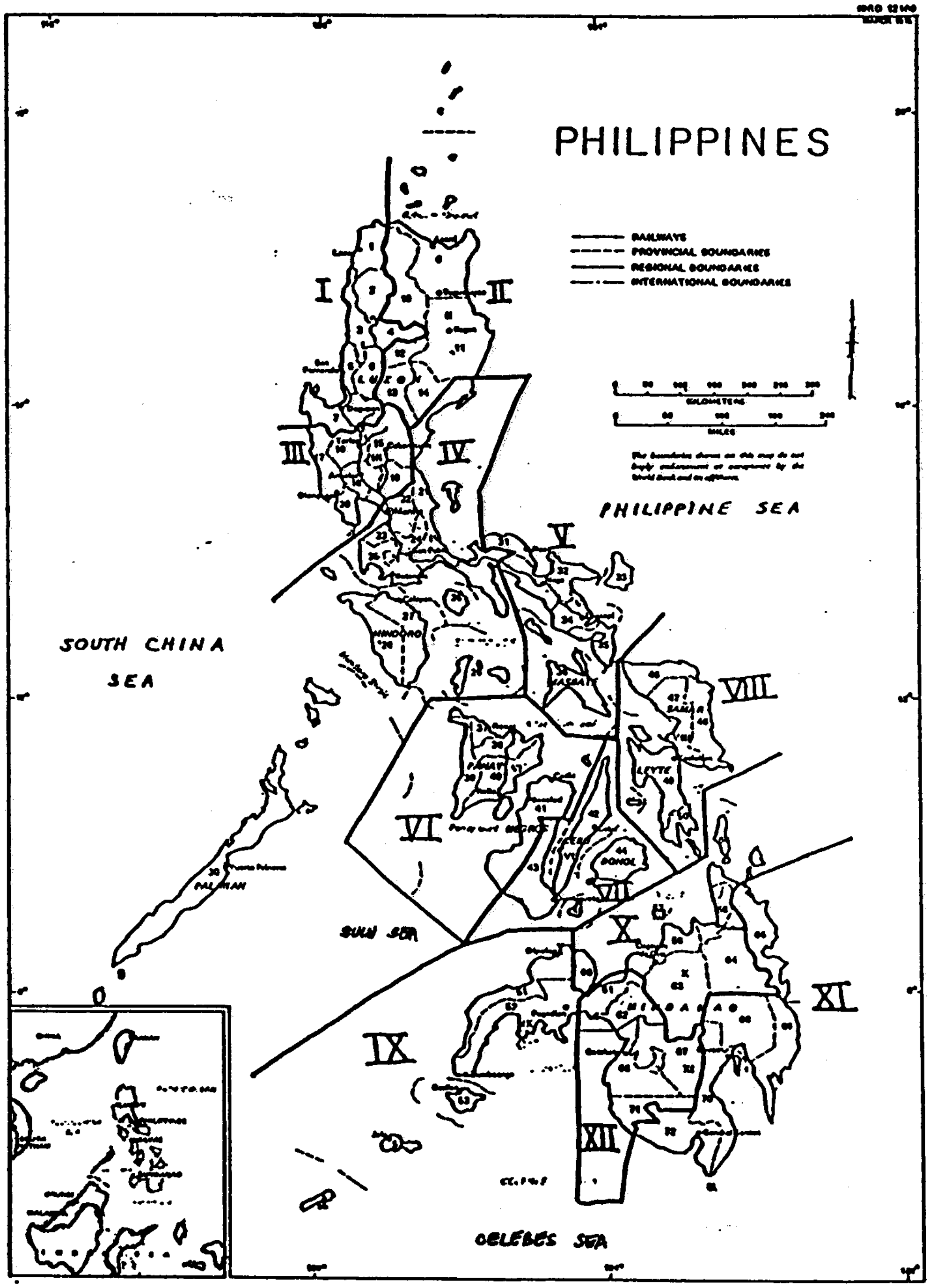


Figure 9. Philippine population growth from pre-colonial period up to the present (from various sources).

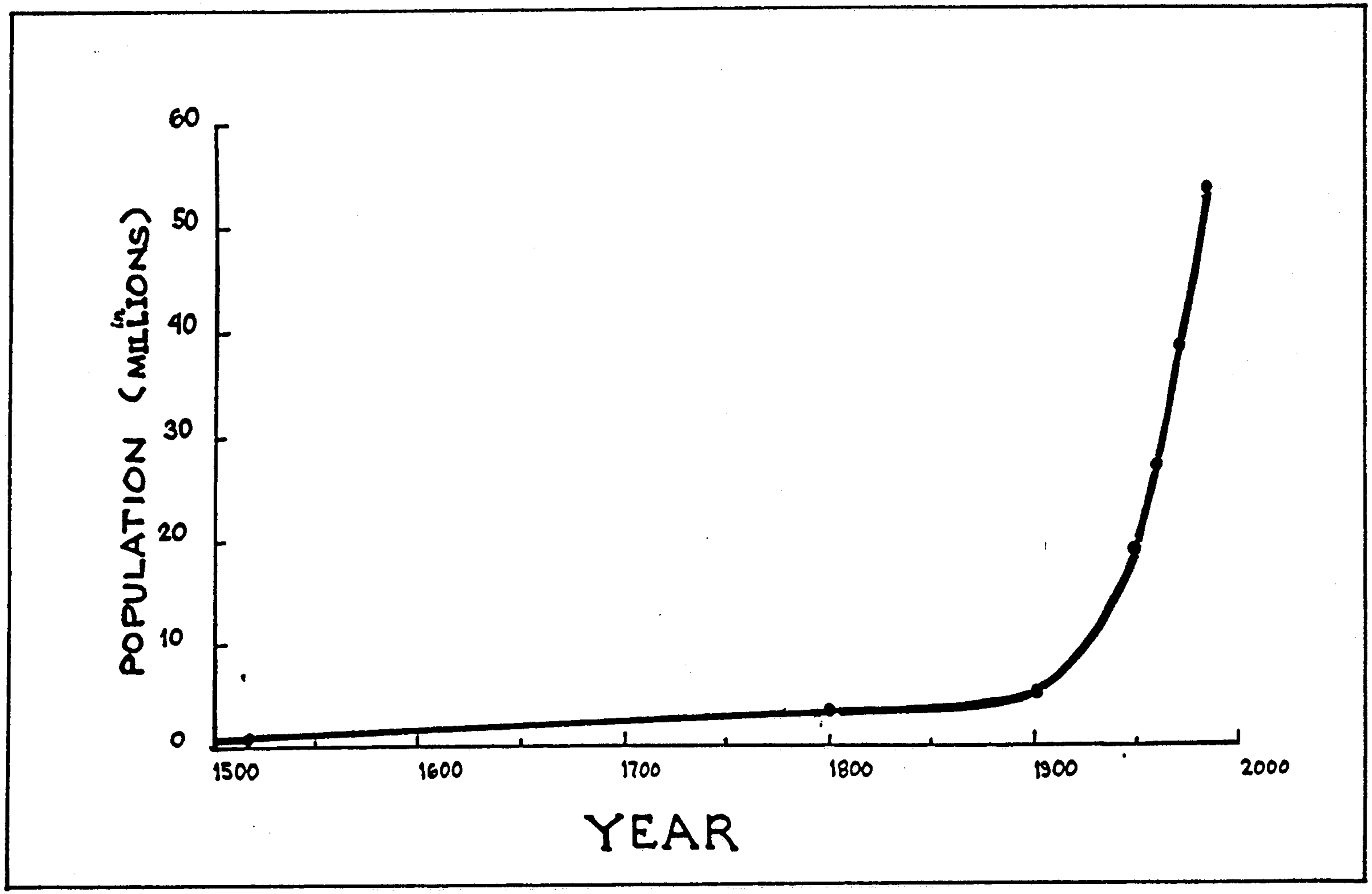


Figure 10. Population sizes of the major urban areas of the Philippines (from Cheetam & Hawkins, 1976).

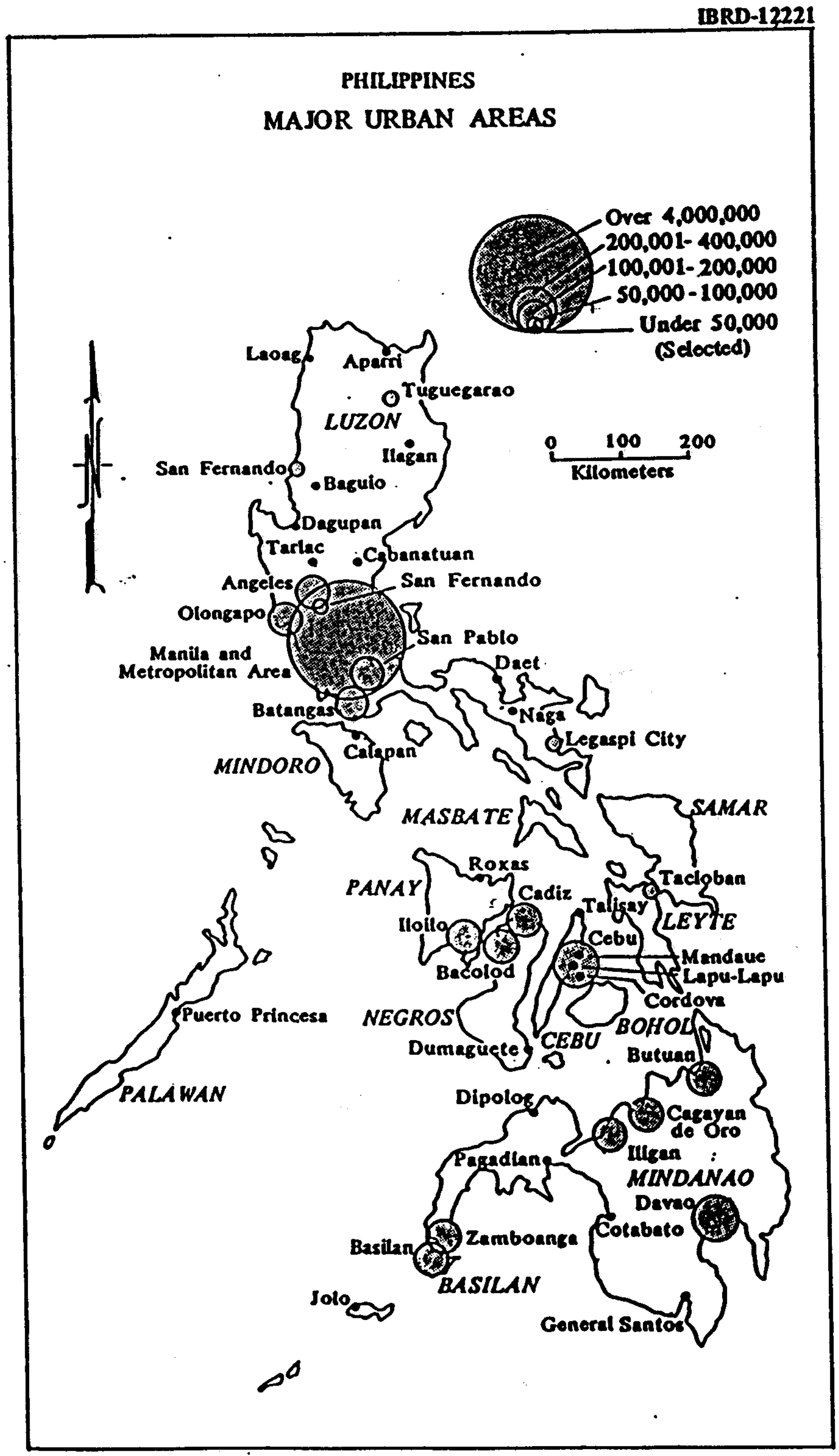
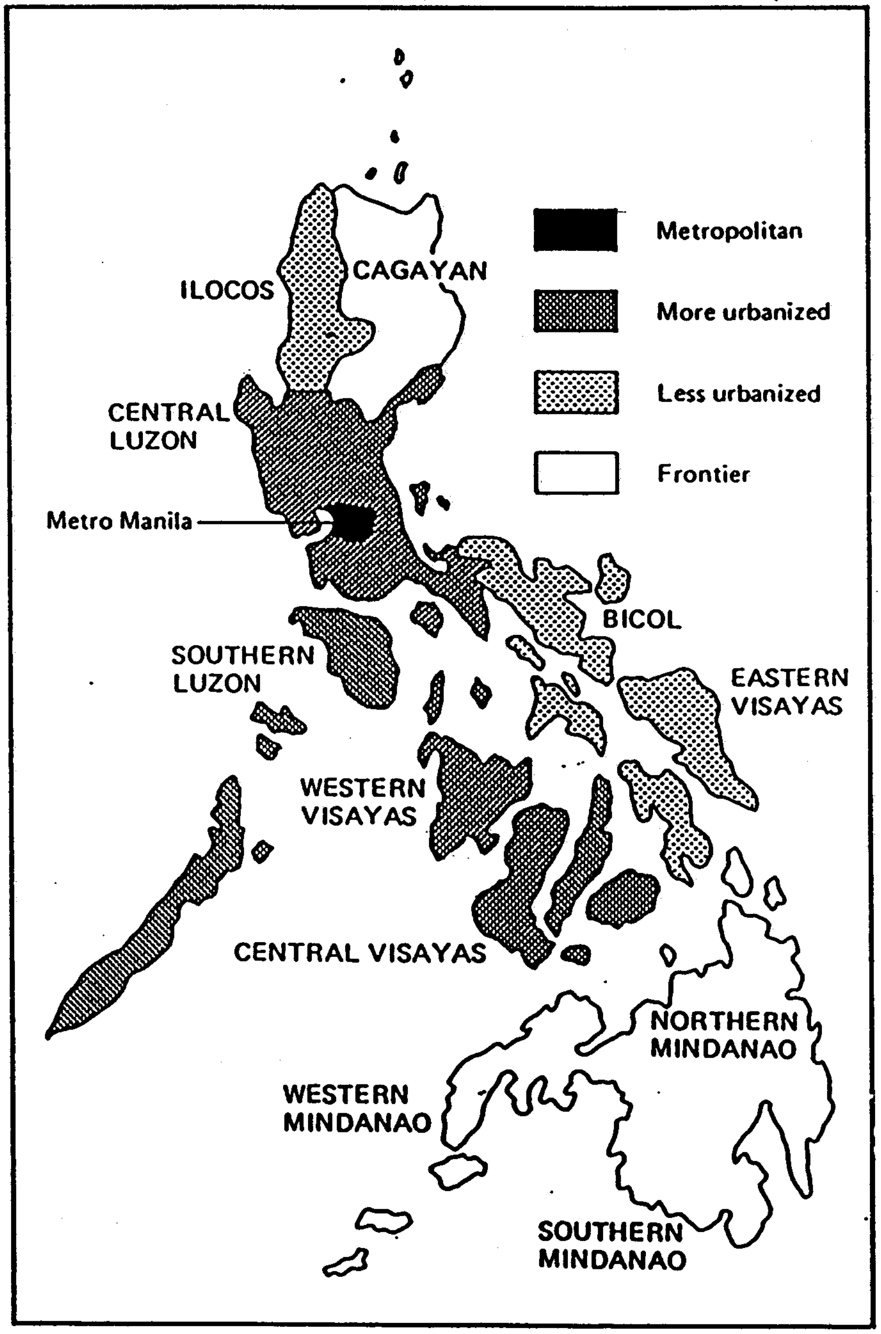


Figure 11. Philippines regions classified as metropolitan, more urbanized, less urbanized, and frontier regions, 1939, 1960, and 1970 (from Pernia, 1977).



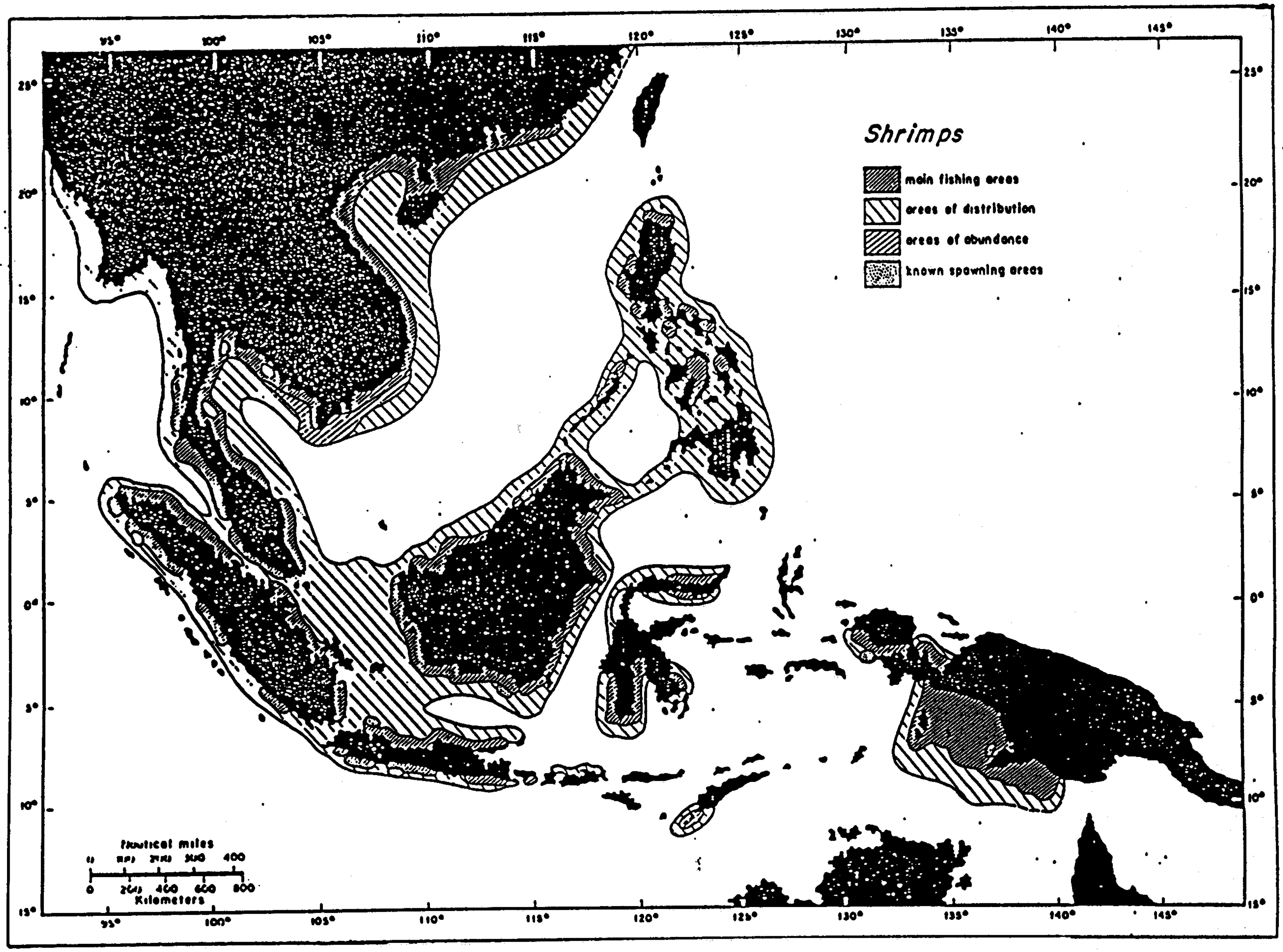


Figure 12. Geographical distribution of shrimps in Southeast Asian region (from Chullasorn & Martosubroto, 1986).

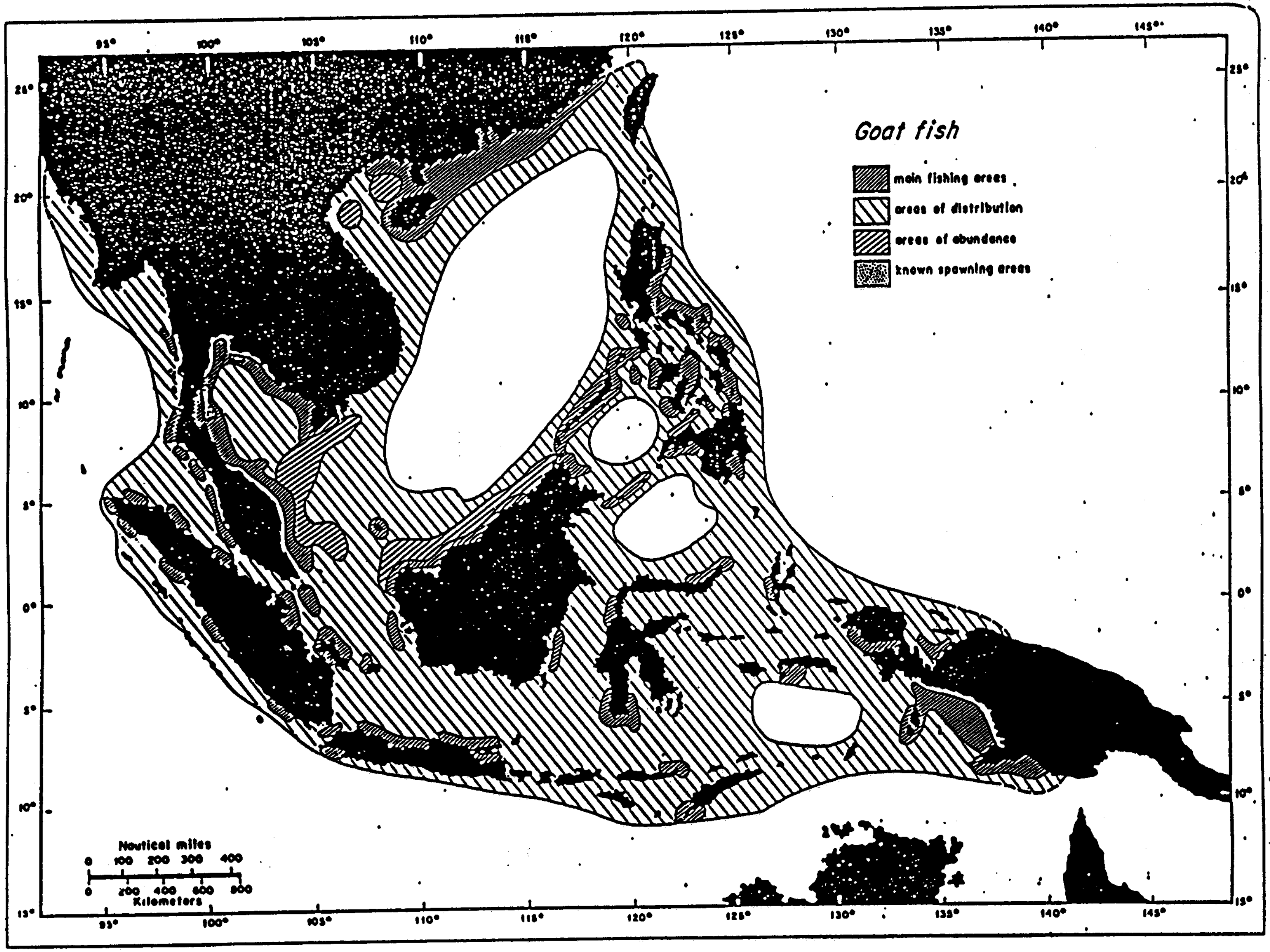


Figure 13. Geographical distribution of goatfishes in Southeast Asian region (from Chullasorn & Martosubroto, 1986).

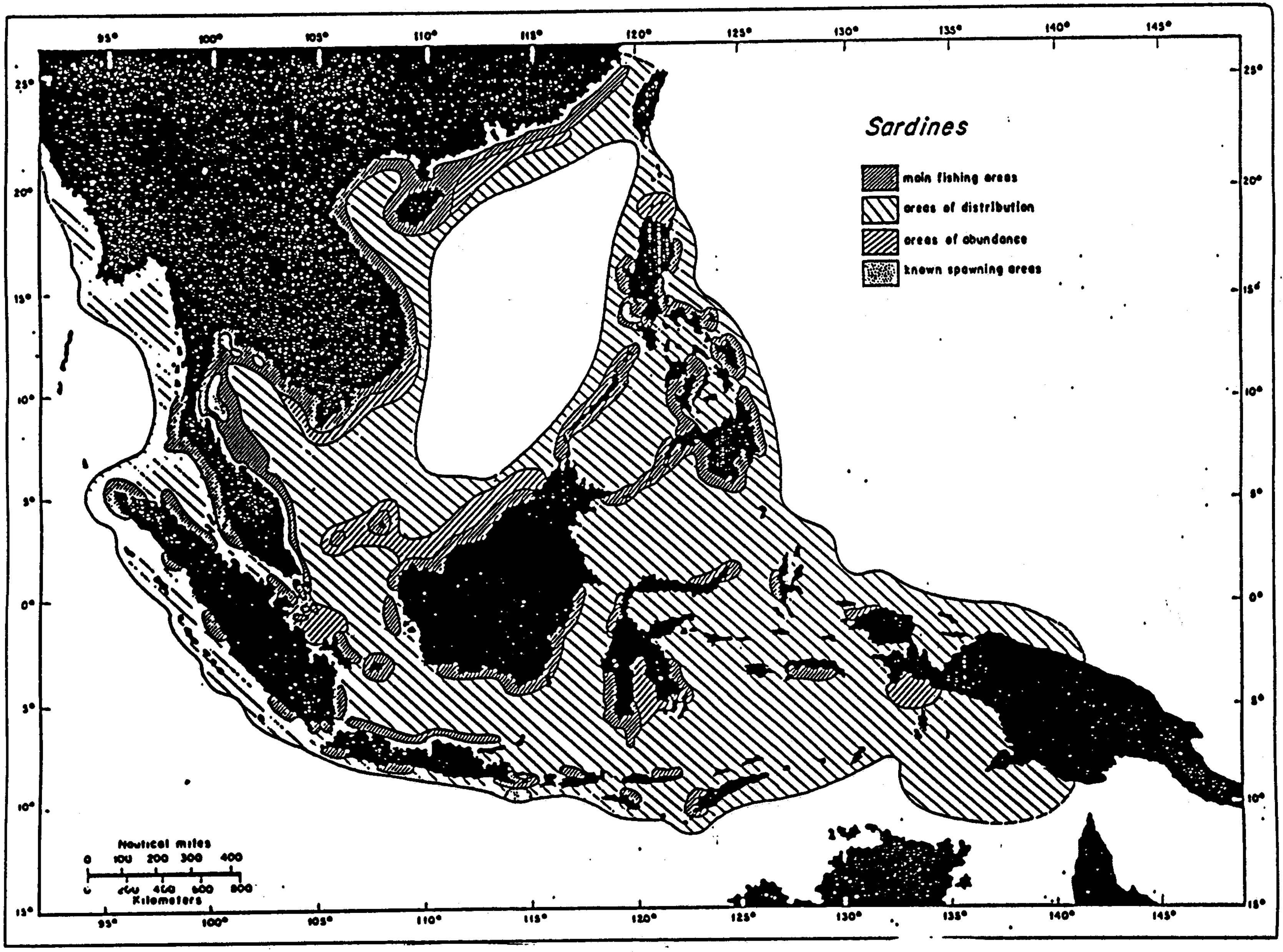


Figure 14. Geographic distribution of sardines in Southeast Asian region (from Chullasorn & Martosubroto, 1986).

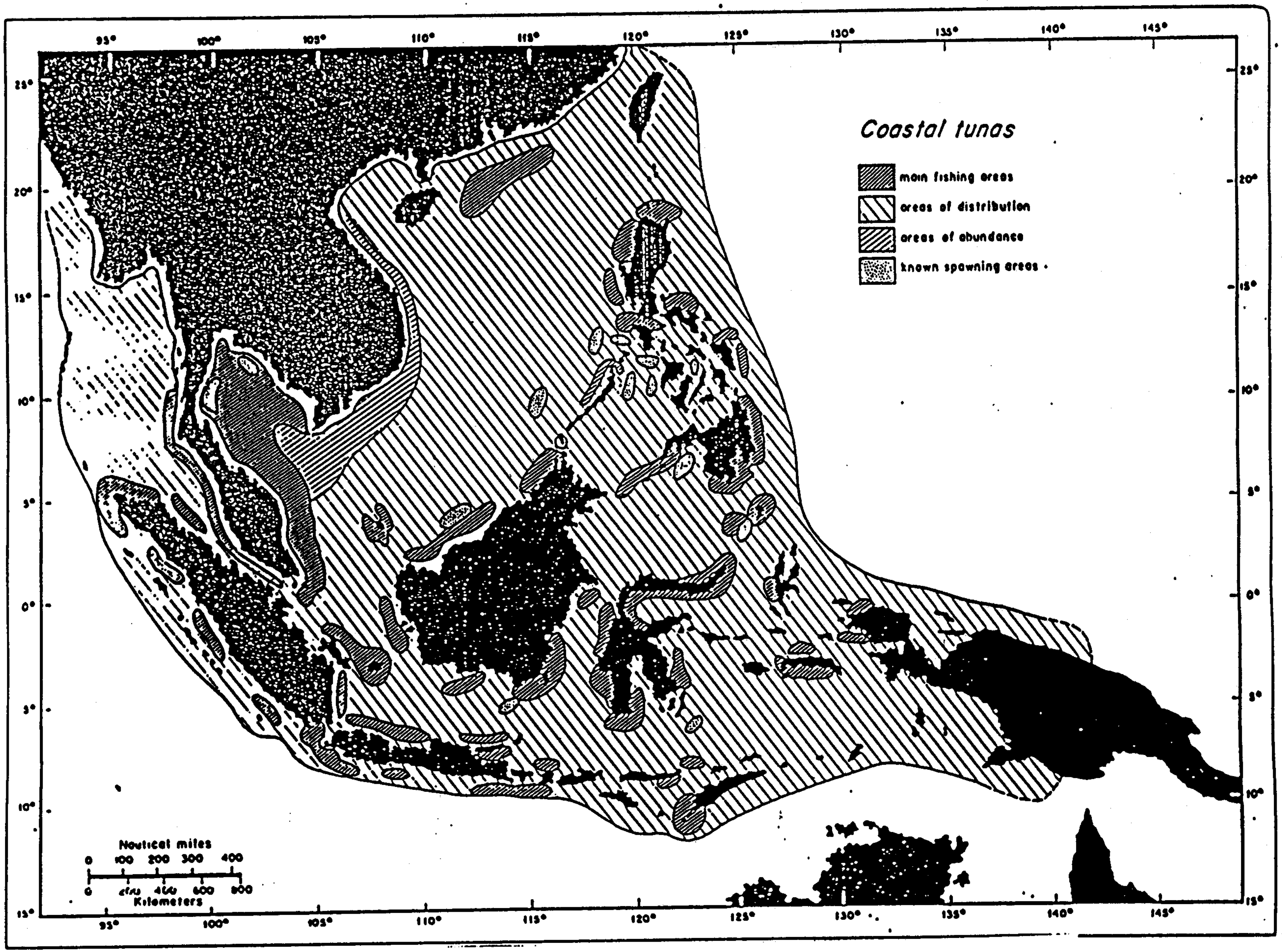


Figure 15. Geographical distribution of coastal tunas in Southeast Asian region (from Chullasorn & Martosubroto, 1986).

Figure 16. Status of fishing grounds in the Philippines (from Smith, et al., 1980).

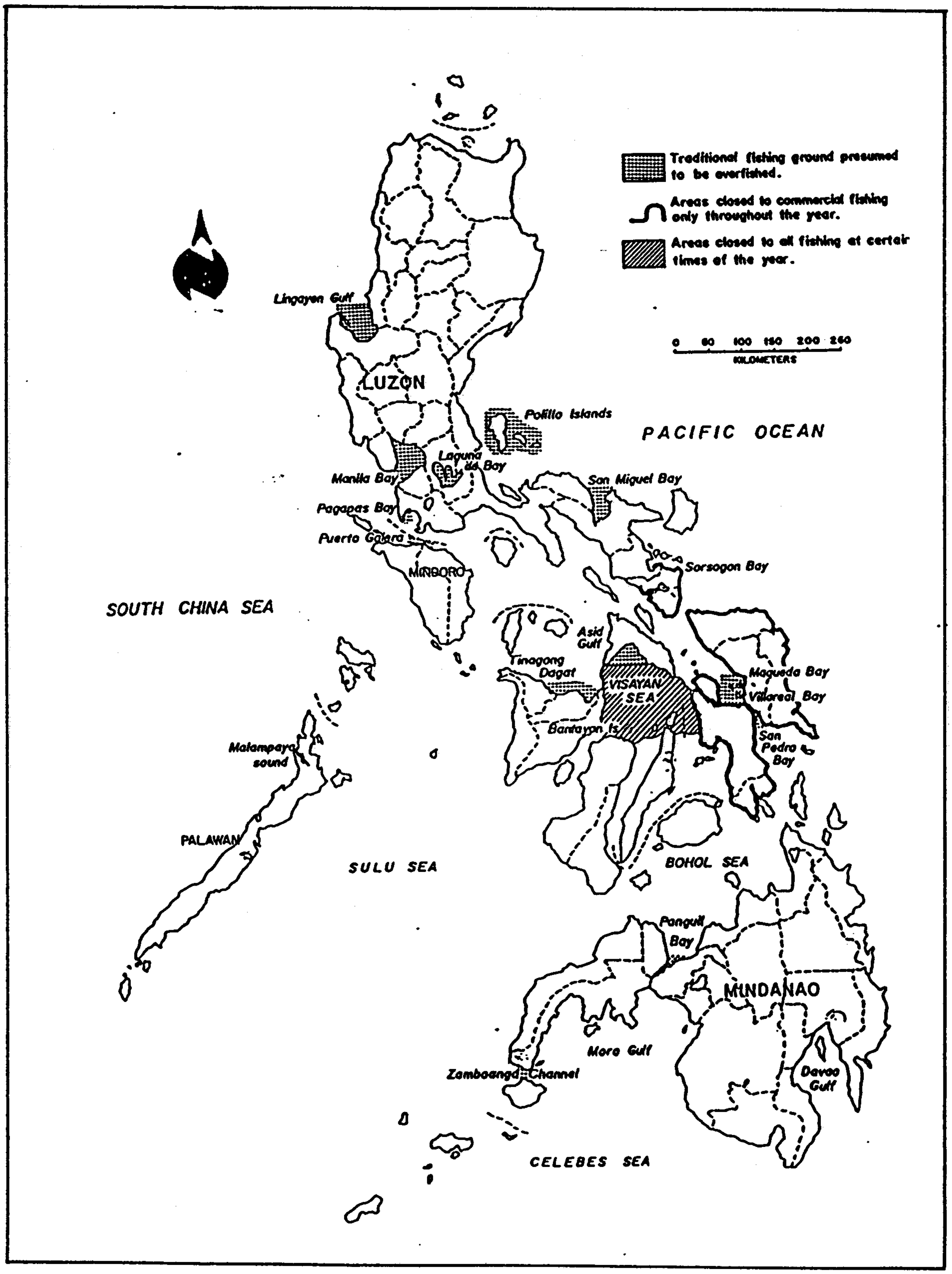


Figure 17. Map of Visayan and Sibuyan Seas (from SCSP, 1976).

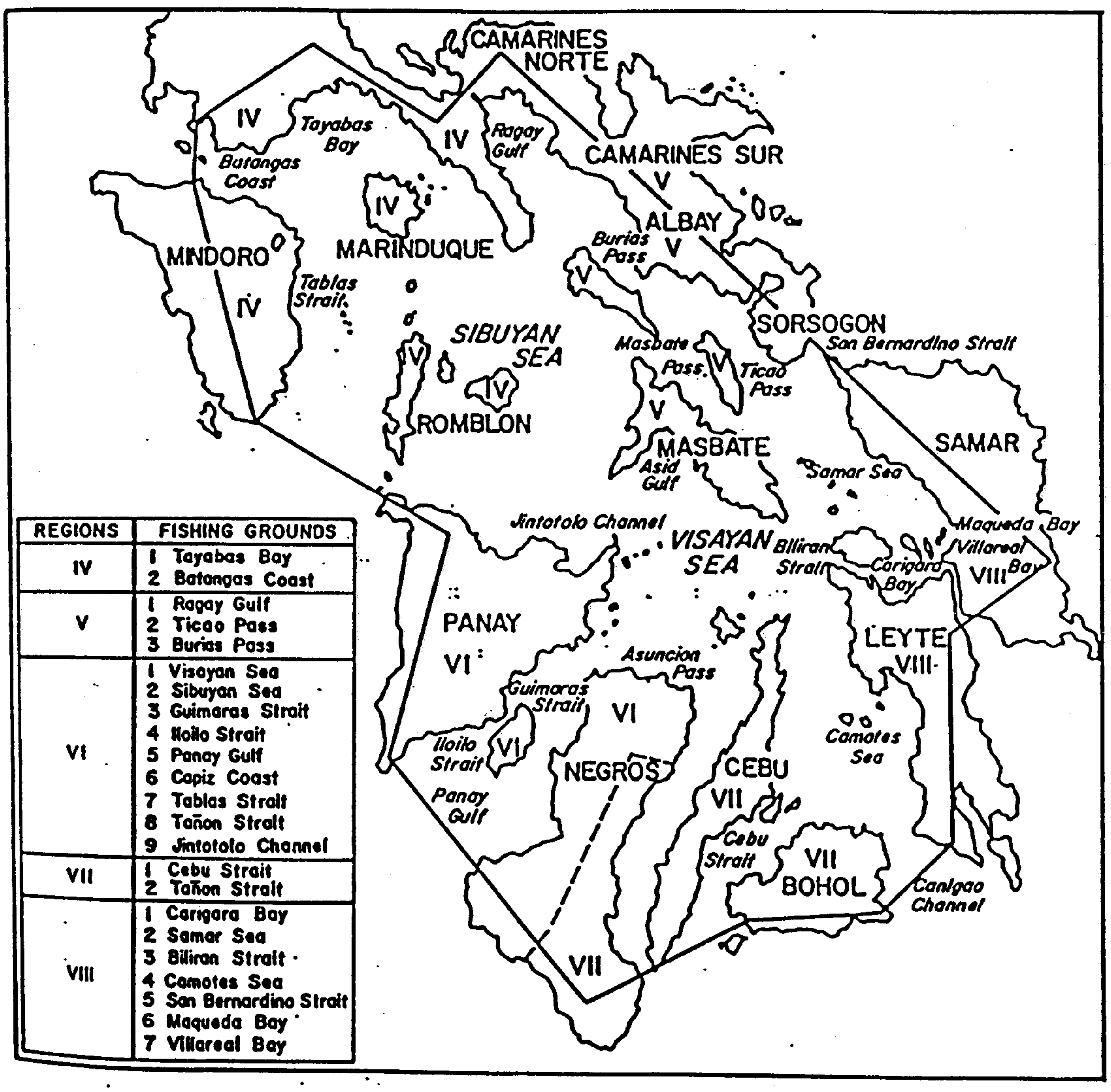


Figure 18. Map of Sulu Sea, Bohol Sea, and Moro Gulf (from SCSP, 1977).

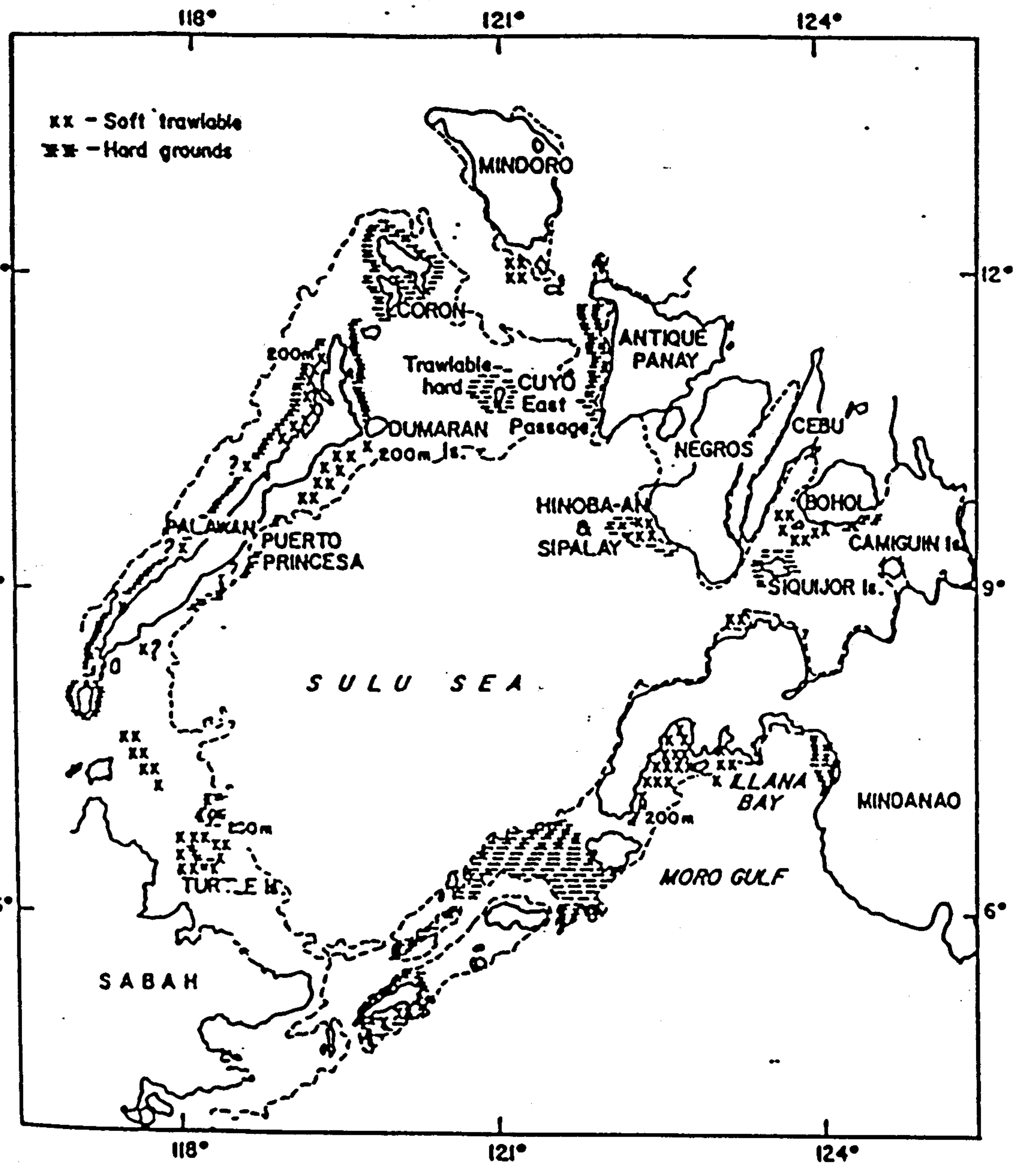


Figure 19. Fishery map of eastern Philippines (from Smith, et al., 1980).

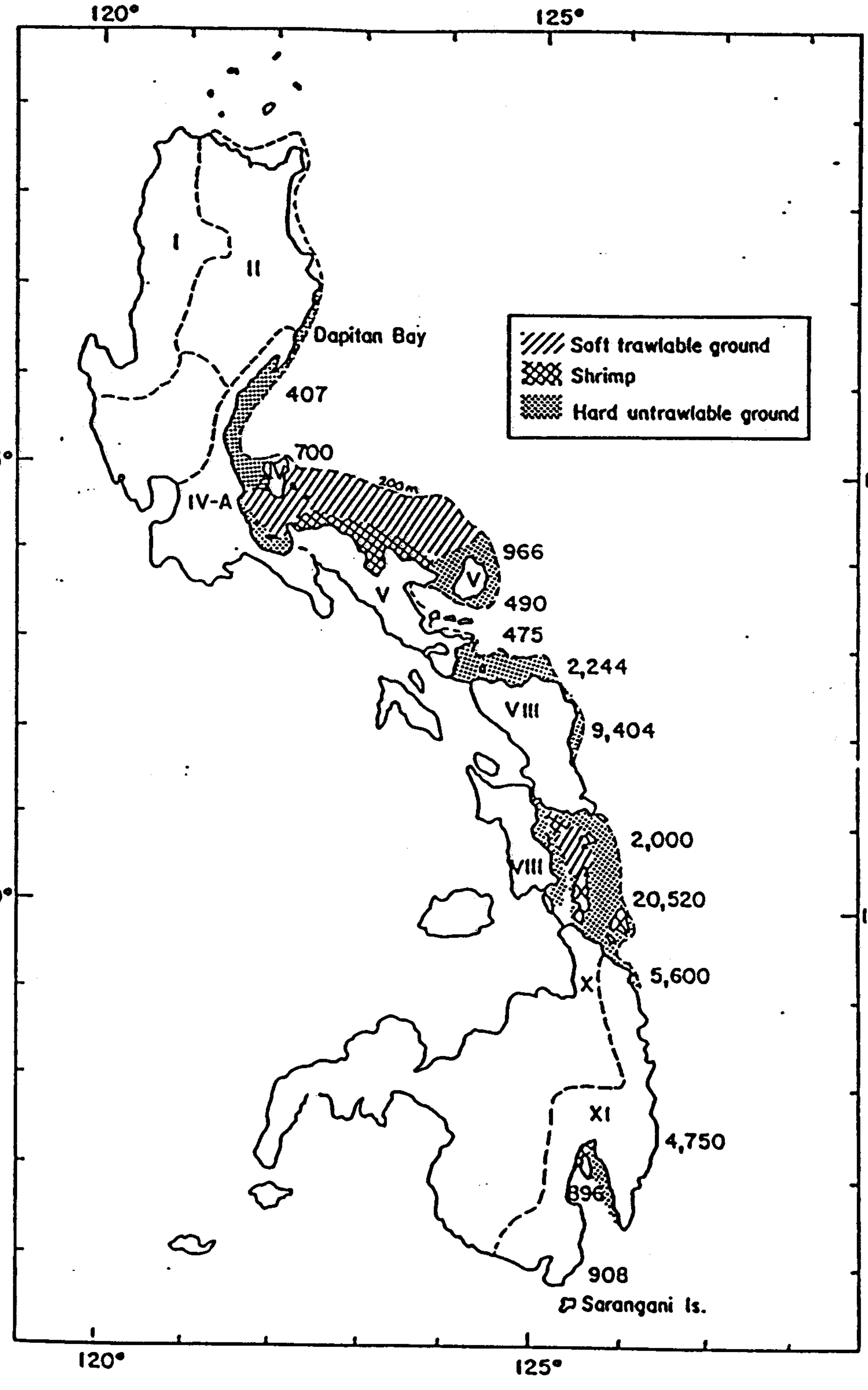


Figure 20. Western Visayas fry distribution pattern (from Smith, 1981).

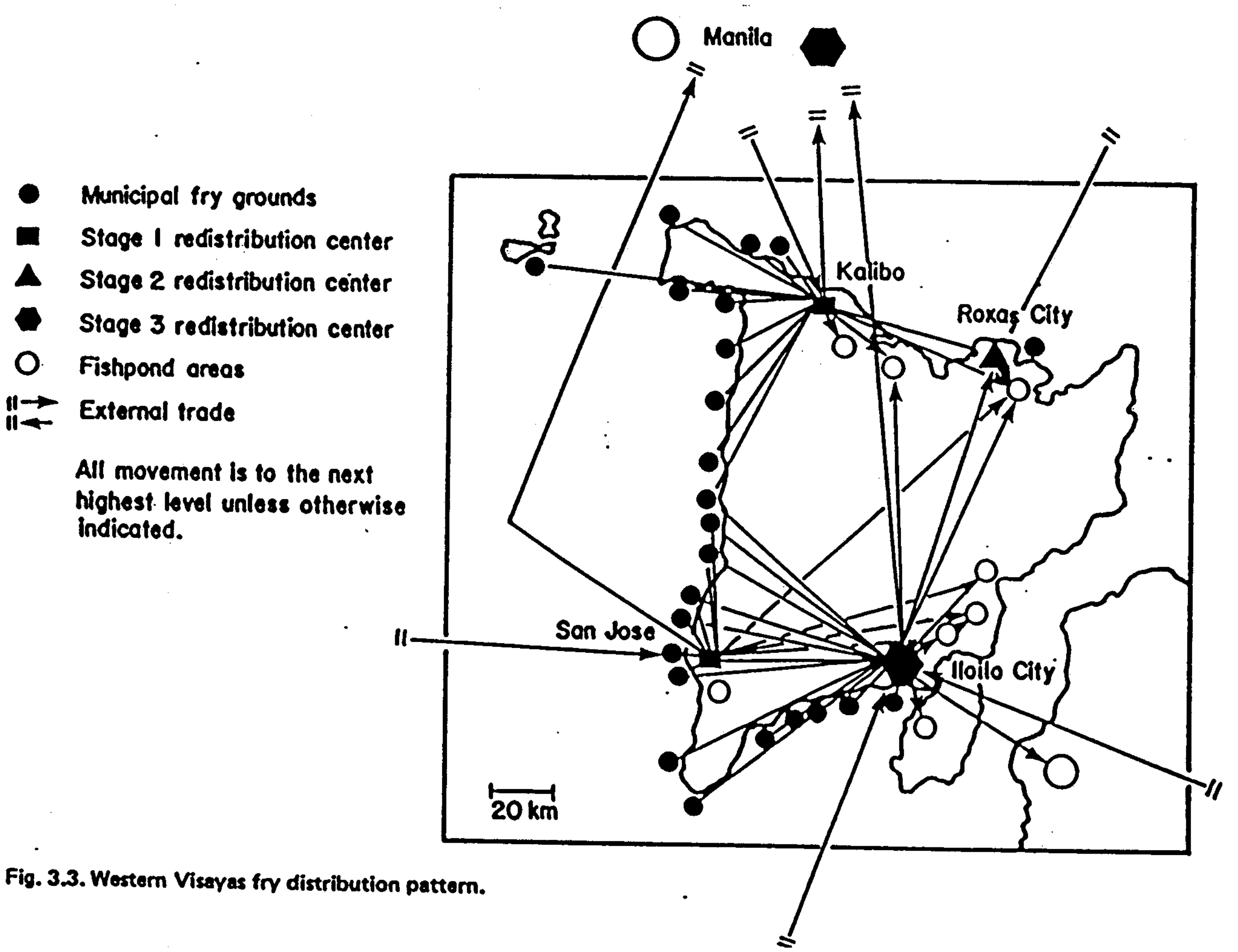


Fig. 3.3. Western Visayas fry distribution pattern.

Figure 21. The ten major Philippine fish marketing centers.

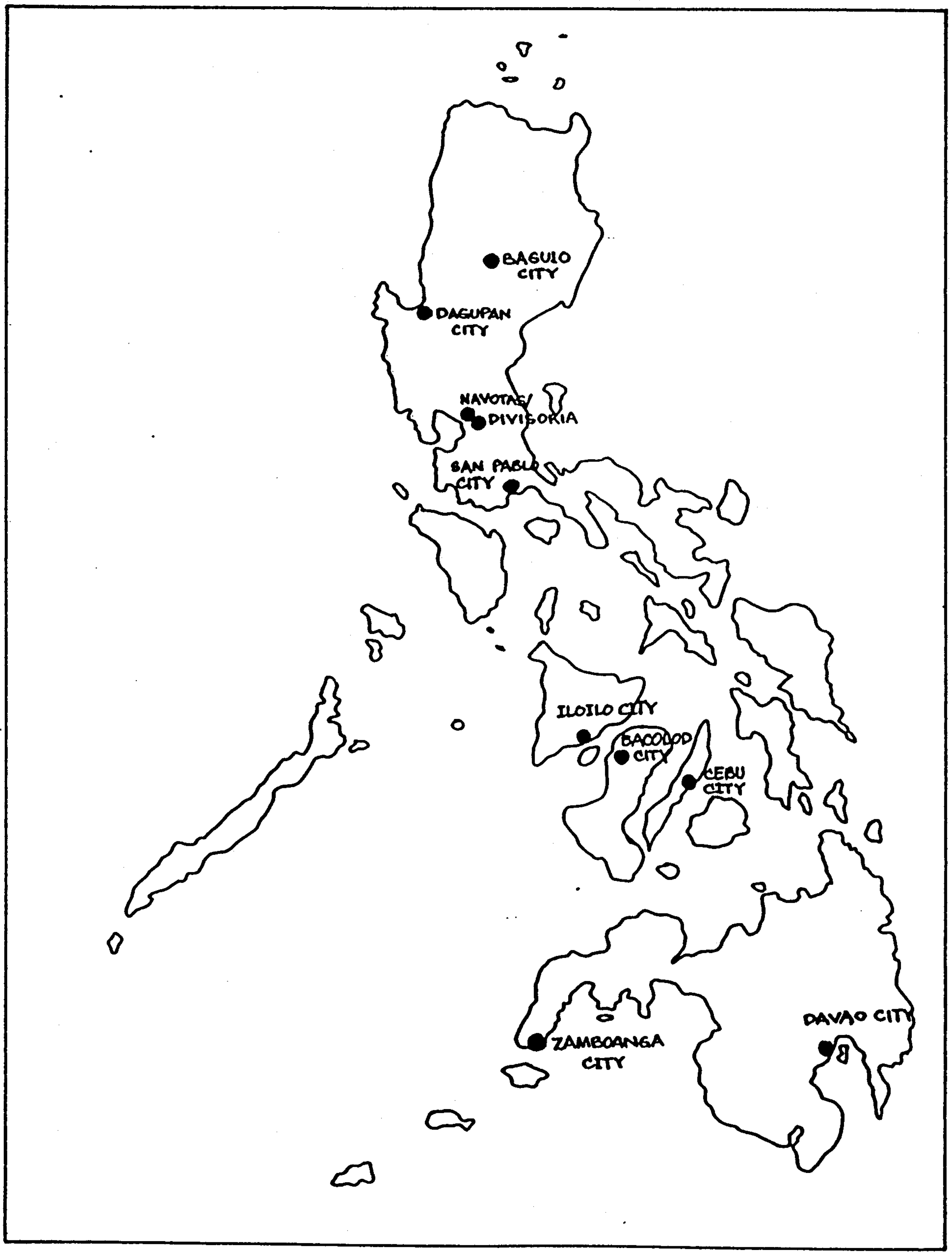


Figure 22. Interregional trade in milkfish fry, July-September, 1976 (from Smith, 1981).

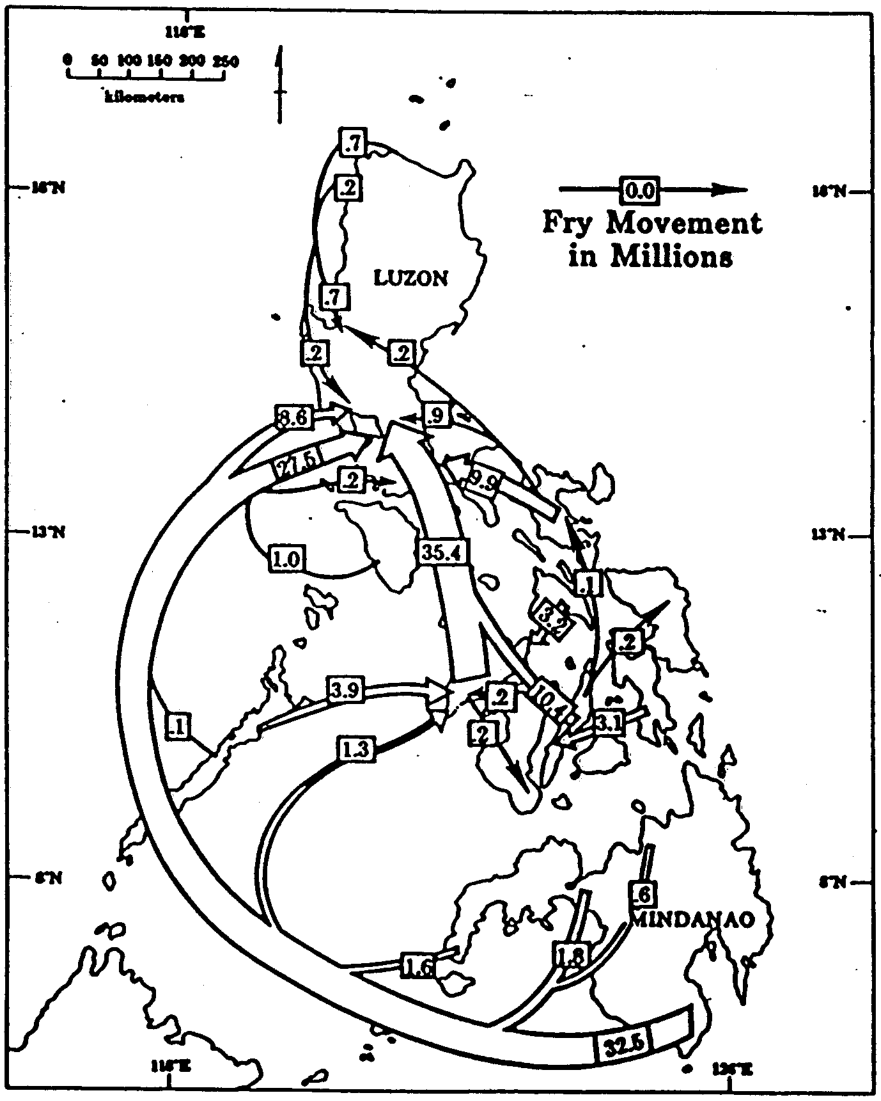


Figure 23. The major land, air, and sea transportation linkages in the Philippines (from various sources).

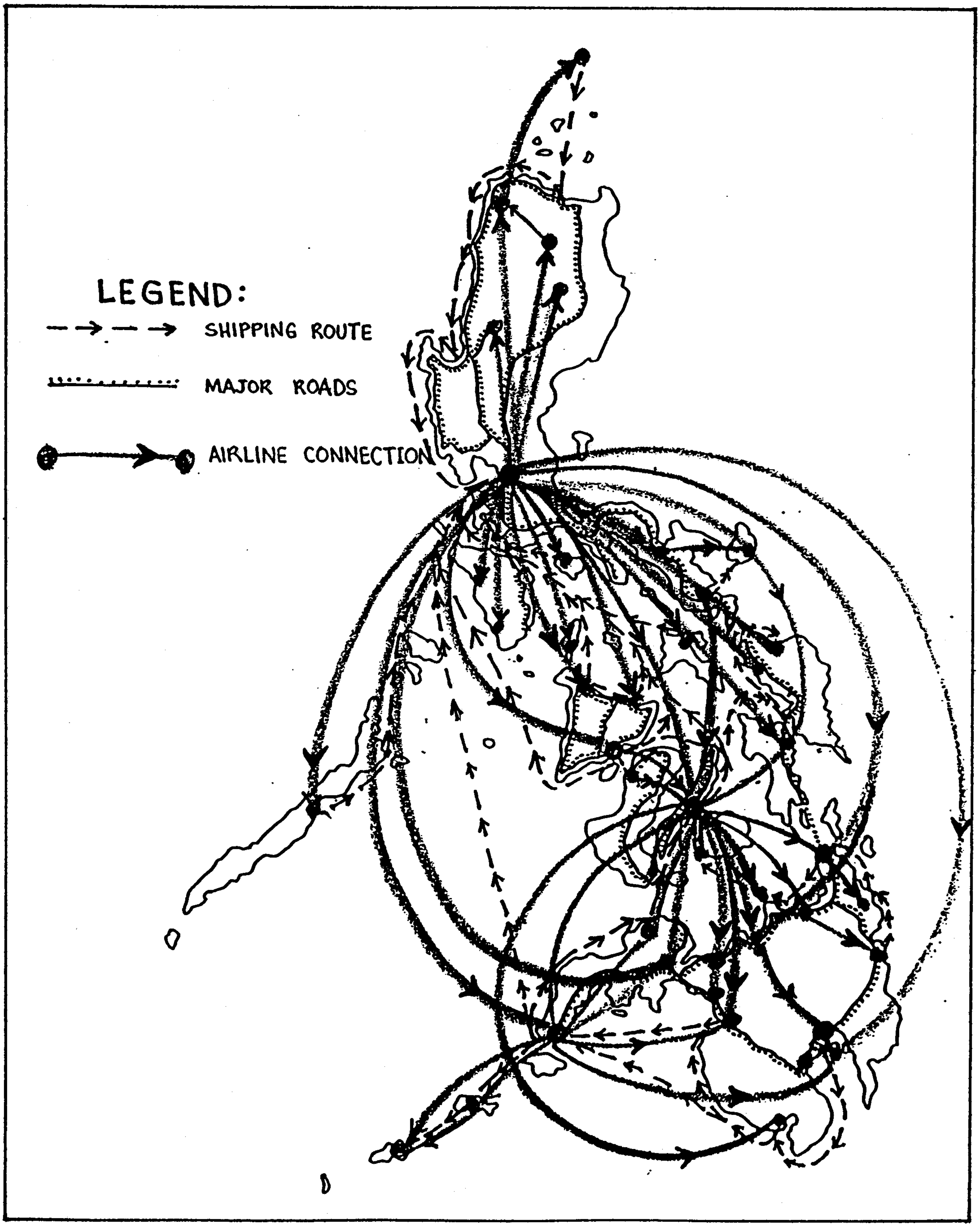


Figure 24. Distribution of fishponds in the Philippines (from Smith, 1981).

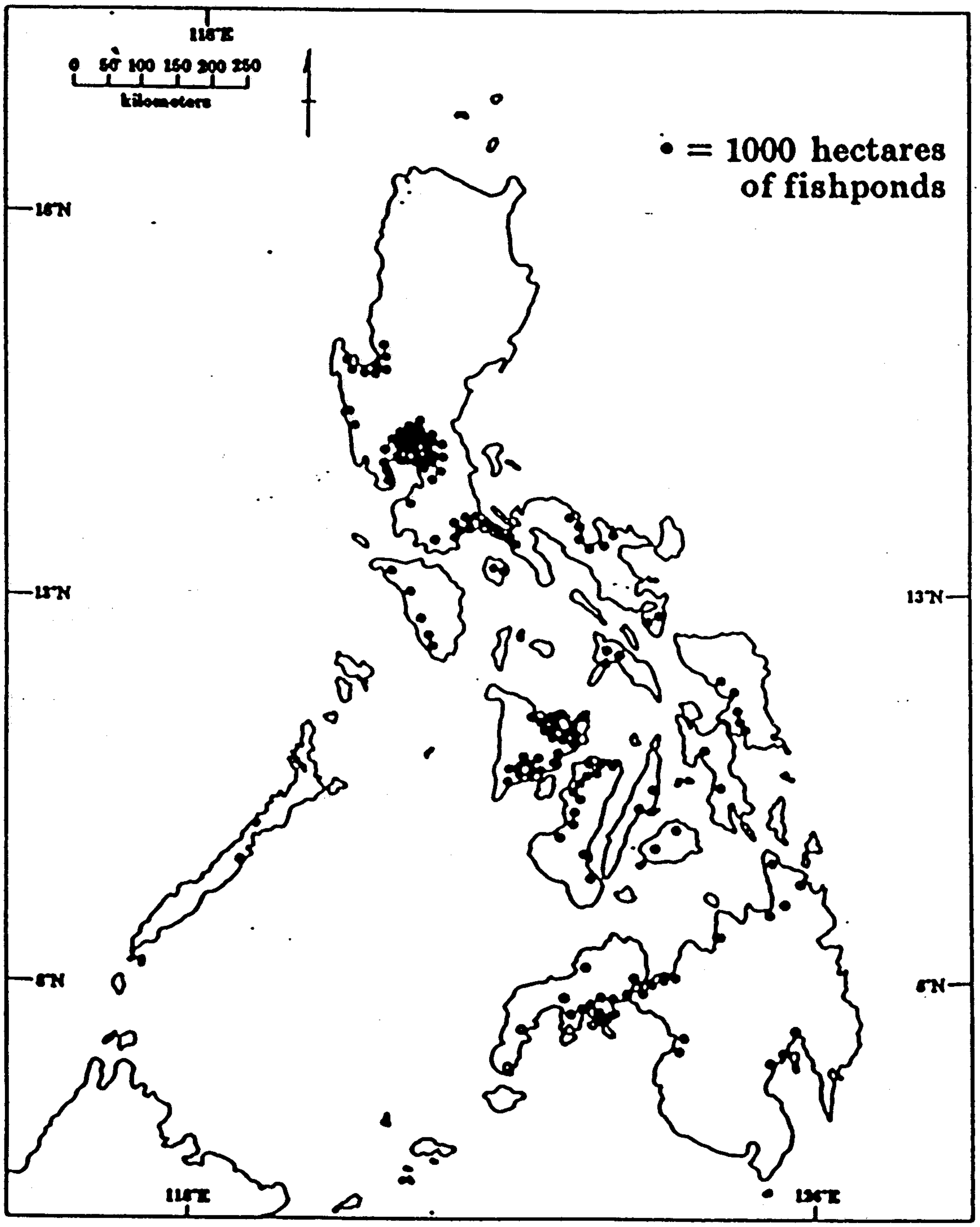


Figure 25. Annual productivities of Philippine fishponds (from Smith, 1981).

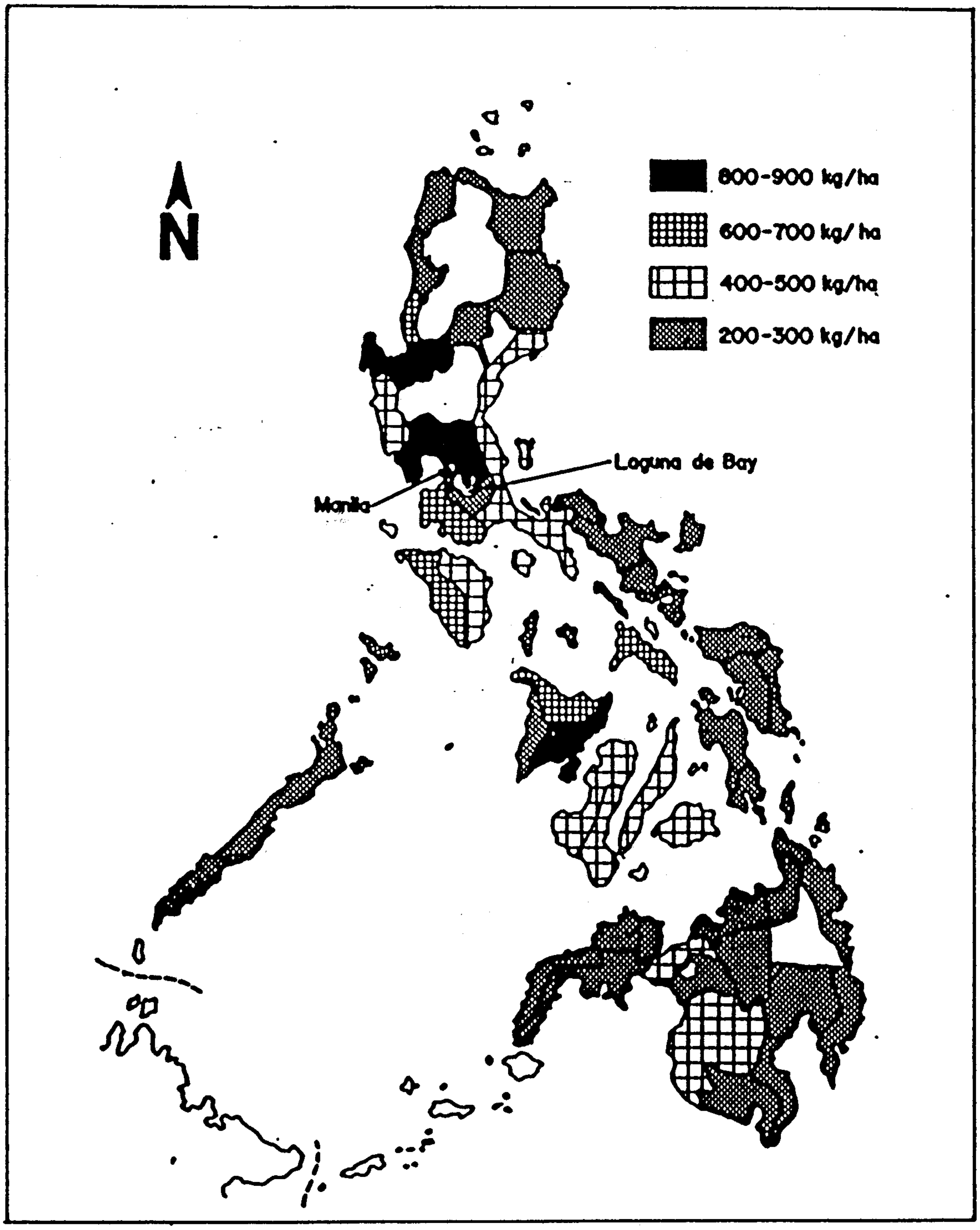


Figure 26. Fish pen belt and fish sanctuary in Laguna de Bay lake (from Smith, et al., 1980).

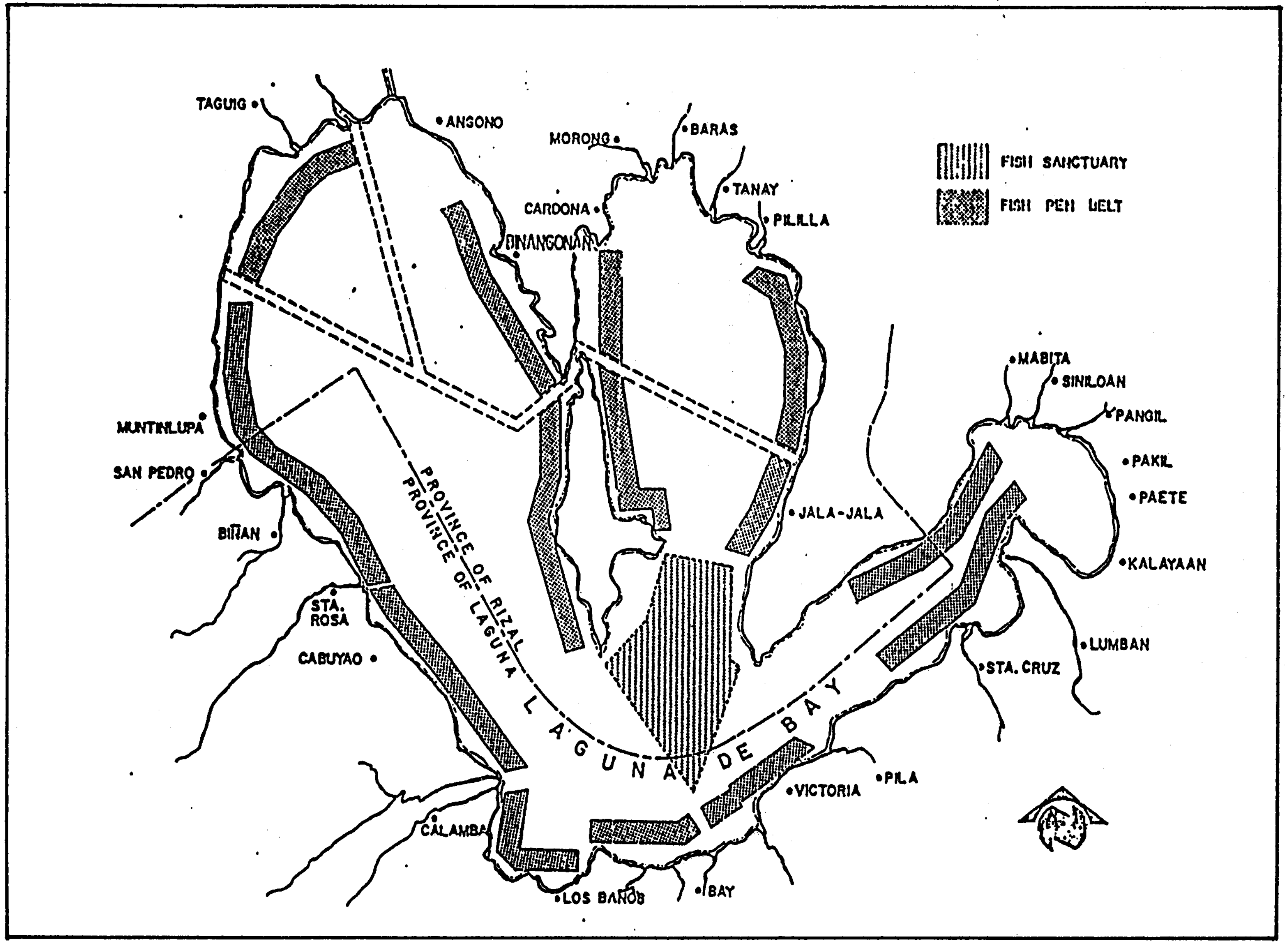


Figure 27. Areas sampled by Librero, et al., 1982.