Philippine Marine Fishery Resources

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

LIST OF APPENDIX FIGURE

A. INTRODUCTION

The Philippines consists of 7,100 islands and islets with a coastline of about 18,000 kilometers. Its territorial waters cover about 2.2 million square kilometers, twelve percent of which is coastal while eighty-eight percent is oceanic, including the Exclusive Economic Zone (EEZ). The Philippine coastal ecosystem is comprised of biologically productive habitats such as mangroves, seagrasses and coral reefs that support the country's marine fisheries. The country is also endowed with 569,600 hectares of freshwater ecosystem that includes lakes, major rivers, reservoirs, swamplands and fishponds. The diverse aquatic resources favor the development of the various interrelated but distinct components of the coastal zone.

During the past decade, the Philippine coastal zone has been under intense pressure from overfishing[1]. Fishing capacity for demersal and small pelagic fisheries exceeded the levels allowed to ensure maximum productivity of fish stocks. The nearshore fish stocks are believed to have been fished most heavily. Furthermore, due to the extent of overfishing in the country, small and juvenile fish are now being caught along with the bigger fish, further slowing down the natural recovery of the fish stocks. The country's increasing population further aggravates the situation as it causes a corresponding increase in the demand for fish.

Fishing is the major source of livelihood in coastal zones. In the absence of alternative sources of income in the area, however, an increasingly conflicting situation in the use of fishery resources results. Cases of illegal fishing among commercial and municipal fishermen have been plaguing the industry. Our laws prohibit commercial fishing vessels (vessels which exceed the three gross ton capacity limit) from fishing within 15 kilometers from the shore. Yet many commercial fishing vessels compete with municipal fishing vessels in nearshore fishing grounds. Owing to the fact that commercial fishing vessels have bigger storage space and nets with bigger fishing capacities than those of municipal fishing boats, the encroachment of commercial fishermen on municipal fishing grounds effectively crowds out the municipal fishermen in the area. This also leaves the municipal fishing grounds unproductive and less able to replenish the fish stocks.

Other environmental damages, which are mostly due to activities of man, also contributed to the degradation of coastal zone resources. Such activities include destructive fishing practices, which destroy the coral reefs; inland logging, which causes siltation; and industrialization, which causes pollution. Not to be discounted are the wastes produced by the consumption activities of the overgrowing population.

It is believed that fishing has not been maximized in the offshore and EEZ waters, which constitute 88 percent of the area of marine waters. Some foreign commercial fishing companies with modern technology and equipment have been illegally fishing in the EEZ waters of the country to maximize catch. Philippine commercial fishermen are deterred from venturing into these areas because of high fuel costs, inadequate information on availability of resources in offshore waters, lack of technical expertise on post-harvest handling and obsolete fishing fleet.[2]

The importance of fishery in the Philippine economy can not be understated. It is the country's second staple food next to rice. For the period 1988-1993 at constant 1985 prices, the contribution of the fishery sector to the country's gross domestic product

[1] Philippine Fisheries Sector Program, 1993
[2] Ibid.

(GDP) averaged 4.5 percent (NSCB, 1994). The fishing industry also provides employment to around 1.4 million Filipinos, equivalent to six percent of the country's total labor force (PFSP, 1993).

In 1990, the Philippines ranked eleventh in the world in terms of total fish production, yielding a total of 2.27 million metric tons. The country also ranked third in tuna production and was the top producer of cultivated seaweed (carageenan) in the world (Padilla, 1994).

Because of its importance, concern for the fishery sector has been incorporated in the government's development plans as early as the 1978 to 1982 Medium Term Development Plan (MTDP). It was during this time that the country's growing environmental problems began to be accorded a higher priority. Today, the current MTDP (1992-1998) gives emphasis on the following policies on fisheries and aquatic resource management:

1. Intensify the implementation of resource management and conservation programs by protecting and rehabilitating traditional fishing grounds, coral reefs, mangrove and other habitats of marine life, and designating coastal resources for the exclusive use of subsistence municipal fisherfolk in consultation with the local government units (LGUs);

2. Conduct an inventory of remaining mangrove areas and prohibit their conversion;

3. Formulate a framework for coastal research and provide means for its implementation;

4. Establish more marine nature reserves;

5. Conduct more baseline studies on the ecological characteristics and dynamics of corals and marine ecosystem diversity productivity; and

6. Expand deep-sea fishing to non-traditional fishing grounds in the Philippine EEZ.

However, information necessary for the formulation of policies and plans for the fishery sector in accordance with the concept of sustainable development is still wanting, as with other natural resources and the environment in general. Nevertheless, there are several macro-economic indicators relating to the performance of the fishery sector, as well as biological and environmental information on this resource and the related ecosystem. Attempts to develop a common framework that addresses consistently both economic and natural resource/environmental problems have been initiated, although they are mostly fragmented and are still in their initial stages. Hence, a working document towards this end is still lacking.

Natural resources have always been considered as free goods, such that the conventional national accounts do not value the use of these resources. Hence, the medium and long-term plans for the economy, which use these macroeconomic aggregates, do not link with the policies concerning natural resources.

This study demonstrates the accounting and valuation of the use of these natural resources, specifically fishery resource as input to fishing activity, and the monitoring of the corresponding stocks. This paper is organized as follows: 1) the conceptual framework; 2) operationalizing the framework which includes sources of data and

estimation methodology; 3) results and discussions; and 4) recommendations for the improvement of fishery resource accounting.

B. CONCEPTUAL FRAMEWORK

B.1. Scope and Coverage

Fishery resource accounts cover the cultivated fish stock and stock of other aquatic animals in fishponds and farms, as well as non-cultivated fish stocks and other aquatic animals in the ocean and in the inland and coastal waters. Specifically, cultivated fishery resources cover aquaculture and mariculture, while the non-cultivated fishery resources include marine and freshwater fisheries. Due to data limitations, this initial study is confined only to marine fisheries.

B.2. Framework for the Asset Account

Guided by the proposed consolidated SEEA framework for the Non-Financial Asset Account, the following framework for the Asset Account of the Fishery Resource was prepared:

OPENING STOCK

Changes due to economic activity
- Depletion
- Total catch
- Sustainable Yield

Other Accumulation
- +/- Conversion of fish stockx to economic control

Other Volume Changes due to natural or multiple causes
- \+ Natural Growth
- \- Natural mortality
- +/- Net migration
- \- Mortality due to natural disasters or due to the destruction of natural habitats

Changes in Stocks

Revaluation

CLOSING STOCK

* depletion is only true if total catch is greater than sustainable catch.

FIGURE 1. ASSET ACCOUNT FRAMEWORK FOR FISHERY RESOURCES

This asset account framework is followed for both the physical and the monetary asset accounts for fishery resources, with the exception of revaluation which is used only for monetary asset accounting.

For non-cultivated fishery, which constitutes marine and fresh water resources, changes in stocks are due to depletion, other accumulation and other volume changes. Depletion is accounted for when fish caught exceeds the sustainable yield, that is, when harvest exceeds natural growth. Since fish is a renewable resource, the stock of fish can be increased if allowed to regenerate. But fish can only regenerate to a level allowed by the carrying capacity of the ecosystem. Given the capacity of the fish to regenerate and its natural life span, the use of this resource when provided for by its natural growth is not considered depletion. Other accumulation is the conversion of non-cultivated fish stocks to economic control, considered as "economic appearance" in the 1993 SNA.

Natural growth, natural mortality, net migration and mortality due to natural disasters or due to the destruction of natural habitats make up other volume changes which affect the closing stock of non-cultivated fishery resources.

C. OPERATIONALIZING THE FRAMEWORK

The study recognizes the complexity of fishery resource accounting, taking into consideration the highly mobile nature of fishery resources. Fish stocks can only be measured indirectly, using biological modeling. Through the Fox model, a clear relationship between decreases in stock and increases in fishing effort, with all other factors remaining constant, may be established. However, available data on fishing effort is wanting. Data for fishing effort, defined in terms of resource inputs to fishing activity, which include the fishing boat, men and gear among others, were regularly collected by the Bureau of Fisheries and Aquatic Resource (BFAR) until 1980. Collection of this data set ended with the transfer of the Statistics Division of the BFAR to the Bureau of Agricultural Statistics (BAS). So for the purposes of this study, fishing effort had to be estimated indirectly using other available parameters and indicators. These will be discussed in further detail later in the estimation methodology.

As for fish stocks, the Resource Ecological Assessment Study conducted by the BFAR in 1993, which covered 12 major fishing grounds can provide estimates of biomass for areas covered and other parameters relevant to the compilation of the asset accounts. Level of fish stocks for the entire country, however, is required in this study and the limited data available cannot be statistically raised to arrive at an estimate for all fishing grounds.

Depletion, as earlier mentioned, is the extraction of fishery resource beyond the rate of natural growth, measured as a positive difference between catch and sustainable yield. Sustainable yield is likewise dependent on fishing effort data, the monitoring of which, as mentioned above, has been stopped since 1981. However, special studies and administrative-based data are available which could provide indicators to estimate this variable, but only at the national level and limited to marine fishery resource.

As an initial exercise in operationalizing the concepts of natural resource accounting for the fishery resource, depletion will be the only indicator included in the asset account framework to be computed. The estimates on depletion are measured at the national level for total marine fishery resources. Variables on fish catch and sustainable catch serve as critical input variables in the estimation of depletion.

C.1. Sources of Data

Data used for the fishery study were sourced from agricultural censuses, current surveys on fisheries, administrative reports and results of special studies of research institutions. Data on fish production and prices were provided by BAS from Surveys of Commercial and Municipal Fish Landing Centers. Prior to 1980, these data were generated by BFAR based on regional monitoring reports of licensed fishing vessels.

Cost of production data for commercial fishing were obtained from various sources such as the Annual Survey of Establishments (ASE) of the National Statistics Office (NSO), the Input-Output Tables of the National Statistical Coordination Board (NSCB) and results of special studies on cost of production conducted by research institutions like the International Center for Living Aquatic Resources Management (ICLARM) and the College of Fisheries, University of the Philippines, Visayas.

Results of fishery studies conducted by the Environment and Natural Resources Accounting Project (ENRAP) Phase II also provided the parameters for the estimation of fishing effort.

C.2. Estimation Methodology

The succeeding discussions include the methodologies for estimating depletion in physical and in monetary terms, and also include the estimation of the different input variables necessary, given the limited data available.

C.2.1. Fish Stock

Fishery stocks data are not available at present. However, indirect estimation of this variable can be done as soon as the complete results of the 1993 Resource Ecological Assessment Study (REA) of the BFAR, covering 12 major fishing grounds, become available. This study provides estimates of biomass for areas covered and tackles other parameters relevant in the construction of the asset account. Stock assessment can only be meaningful, however, if estimated by fishing ground. With an incomplete set of data, the study cannot arrive at an estimate for all fishing grounds.

C.2.2. Fish Catch

Fish catch is one of the variables used in estimating depletion and sustainable catch. Catch data were classified into commercial and municipal fish production. Municipal production data were further classified into marine and inland fish production. For this study however, total marine fish catch refers to commercial and municipal marine fishes.

To derive the variable on sustainable catch, a longer series on fish catch was needed. This was obtained by extrapolating the BAS data on fish catch using trends of the BFAR data from 1980 backwards. Fish catch data is likewise used to estimate fishing effort. To be consistent with the national accounts, a correction factor of 20.0 percent was applied to reported fish production to account for the under coverage (see Appendix

Table 1, page 118). This ratio was obtained as the percentage difference between the survey data and the estimated actual production using the commodity flow method.

C.2.3. Fishing Effort

Data on fishing effort is necessary in computing for sustainable catch. Current production surveys do not produce data on fishing effort[3]. However, special studies and administrative-based data are available which can provide indicators to estimate this variable, at the national level, and limited to marine fishery resources. As such, fishing effort was estimated indirectly by using available parameters on horsepower for commercial and municipal fishing vessels.

For commercial fishing effort, expressed in horsepower (hp), the horsepower equivalent was obtained based on the computed catch per unit effort (CPUE). The CPUE for each major fishing gear was computed based on the actual fish catch data divided by the estimated parameters on horsepower[4] (hp) (see Appendix Table 2, Page 119). CPUE was computed by major fishing gear: purse seine, bagnet, ringnet, trawl, muro-ami and beach seine. The computation assumes that fishing effort is understated by the same percentage as catch. Thus, total commercial fishing effort was derived by applying the computed CPUE to the corrected commercial fish catch in metric tons, by major fishing gear (see Appendix Table 3, page 120).

To standardize catching efficiency of the various fishing gears used over a certain period of time, each of the horsepower of other fishing gears was converted to purse seine equivalent (PS)[5] using the ratio of CPUE of each fishing gear to CPUE of purse seine (see Appendix Table 4, page 121).

For municipal fishing effort, the available benchmark estimates on horsepower of municipal fishing vessels and total municipal fishermen by type were obtained from the results of the 1980 Census of Fisheries. Both sets of data were extrapolated using ENRAP estimates[6] on horsepower of municipal fishing vessels and number of fishermen. To translate number of fishermen to fishing power (hp equivalent), the following conversion factors[7] were applied:

(a) hp of full-time fishermen = number of full-time fishermen x 0.18 Hp x 6/24 hours;
(b) hp of part-time fisherman = hp of full-time x 40%; and
(c) hp of occasional fishermen = hp of full-time x 11%.

[3] Fishing effort and fish catch were generated by BFAR prior to 1980. This was not however continued by the BAS, which took over data collection from BFAR.

[4] The relationship between horsepower and vessel tonnage by fishing gear was estimated by ENRAP based on data from BFAR.

[5] Purse seine equivalent is used to standardize fishing efficiency for the different gears because purse seine accounts for a large proportion of marine fish landed.

[6] ENRAP series on horsepower of municipal fishing vessels and number of fishermen were estimated using time series analysis.

[7] The constant factors used are based on available studies. The horsepower equivalent of a full-time fisher is placed at 0.18 hp per day (Southeast Asia average), based on a study by Karim (1985) on Energy Expenditure of a Group of Students. Six hours is assumed to be the number of hours worked by a fisher per day (full-time fishing). Forty percent is the mean percentage of days of actual part-time fishing with respect to full-time fishing and 11 percent is the mean percentage of actual occasional fishing with respect to full-time fishing.

The above constant factors were applied throughout the series. Total horsepower equivalent for municipal fishermen is equal to (a) + (b) + (c).

To arrive at total fishing effort in hp equivalent for municipal fishing, fishing effort for municipal fshing vessels was added to fishing effort of fishermen, afterwhich, a two-year average was computed to obtain a smoother set of time series data. This was then translated to PS equivalent following the same methodology used for commercial fishing effort in PS equivalent. Results of the above estimates are presented in appendix table 5 (page 122). Total fishing effort in PS equivalent for marine fishery is the sum of estimated commercial fishing effort and municipal fishing effort, both in PS equivalent (see Appendix Table 6, page 123).

C.2.4. Sustainable Yield (Catch)

The level of sustainable catch was estimated using the Fox Model[8]. This model shows that catch decreases as fishing effort increases, with all other factors remaining constant. The following equation was used:

$$Y = E^{\exp(a + b E)}$$

Where:	Y	=	catch or yield from the resource
	E	=	fishing effort per unit time
	a	=	constant
	b	=	regression coefficient

The regression coefficient was derived by establishing the relationship between the time series data on fish catch and fishing efforts estimated[9] earlier, with an R-square of 0.7960 (see Appendix Table 7, page 124). The sustainable catch level estimated using the above equation is shown in Appendix Table 8 while the sustainable yield curve is presented in Appendix Chart 1.

C.2.5. Depletion

Fish is a renewable biological resource that will eventually die if not harvested. When the harvest of fish exceeds natural growth, depletion occurs. Depletion was computed as follows:

Depletion = Actual Catch less Sustainable Catch

In monetary terms, the value of depletion, expressed as net rent was estimated using the Net Price Method, that is,

Net Rent = Net Price per Unit x Depletion

Appendix Table 8 and 9 (page 125&126) present the results of these formulas.

[8] 1989. FAO Fisheries Technical Paper #306/2. Introduction to Tropical Fish Assessment, Part 1&2.
[9] Time series of the fishing effort was smoothened using the two-year moving average.

The ASE of the NSO provided the basis for arriving at net rent. To arrive at net rent, costs of intermediate inputs (fuel, compensation of employees, indirect taxes, depreciation, and a 15.0 percent opportunity cost - based on experts' opinion - for holding fixed assets) were subtracted from the gross output valued at producer's price (gross revenue). Based on the above computations, the ratio of net rent to gross output was derived.

Net price at market prices was estimated from net price at producer's price. Since ASE data do not provide information on the corresponding catch, the net price at producer's price was obtained by applying the ratio of net rent to gross output, which is 12.2 percent, to the producer's price[10] of fish. The trend of producer's price was applied to derive estimates of net price.

C.2.6. Environmentally Adjusted Net Value Added (EVA)

The net value added (NVA) includes factor payments to production, namely, compensation, indirect taxes less subsidies, and net operating surplus (excludes the cost of depreciation of fixed assets). From the computed NVA, the resulting net rent was deducted to arrive at an estimate for environmentally adjusted NVA. However, only depletion of fish stocks, as a component of the asset account that effects the changes in the closing stock, was computed in this study. All other factors have yet to be included in the preliminary estimate of environmentally adjusted NVA.

Available data from the National Accounts cover estimates of gross value added (GVA) of the fishery sector by factor shares. The GVA estimates at current prices for fishery were derived using the formula:

$$GVAt = Qt \times (1+UNC) \times Pt \times GVAR$$

where :

Qt	=	quantity of production
UNC	=	undercoverage ratio
Pt	=	current producer's price
GVAR	=	gross value added ratio

Separate estimations were done for commercial and municipal marine fishing to generate total GVA for marine fishery. However, since the breakdown of GVA by factor share is not available separately for commercial and marine municipal fishing, the same structure as the total fishery sector was used. NVA was estimated by deducting the depreciation cost of fixed assets from the computed GVA.

D. ANALYSIS, RESULTS AND DISCUSSIONS

The importance of the fishery resources lies heavily on its ability to support the population's food requirements. Increasing population demands for increased fish production. Thus, from the period 1985 to 1993, total fish production continued to increase. Per capita fish consumption also showed an increasing trend from 32.5 kilograms in 1985 to 40.9 in 1991. In 1992, however, this declined to 40.2 kilograms,

[10] Producers Price for fish was generated from the BAS Survey of fish landing centers.

further decreasing to 40.1 kilograms in 1993. Table 1 presents the complete data and Figure 2 further illustrates the situation.

TABLE 1. PER CAPITA CONSUMPTION, FISH PRODUCTION, AND POPULATION IN THE PHILIPPINES, 1985-1993

YEAR	PER CAPITA CONSUMPTION (kg)	FISH PRODUCTION ('000 MT)	POPULATION ('000)
1985	32.5	2,052	54,668
1986	37.3	2,089	56,004
1987	38.9	2,213	56,764
1988	38.1	2,270	58,112
1989	39.6	2,356	59,470
1990	40.3	2,503	62,049
1991	40.8	2,597	63,692
1992	40.2	2,624	65,339
1993	40.1	2,648	65,982

Source: Food Balance Sheet, NSCB.

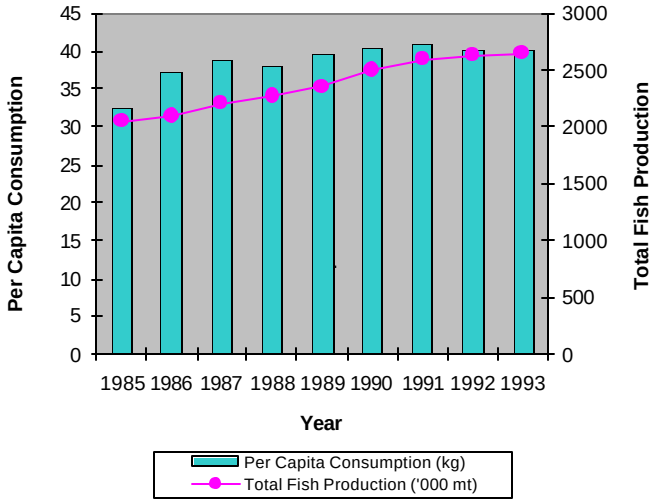


FIGURE 2. TOTAL PRODUCTION AND PER CAPITA CONSUMPTION OF FISH, 1985-1993

In 1985, GVA of total fishery at constant 1985 prices accounted for 19.0 percent of total GVA for agriculture, forestry and fishery. On the other hand, the aggregate GVA for fishery constituted 5.0 percent of the total domestic product (GDP). GVA of the fishery sector has steadily grown during the period 1985 to 1993 as shown in the following table and chart.

TABLE 2. CONTRIBUTION OF FISHERY GVA TO AFF GVA AND GDP, 1985-1993

YEAR	FISHERY GVA	% to AGRICULTURE, FISHERY and FORESTRY	% GDP
1985	27,058	19.25	4.73
1986	29,246	20.07	4.94
1987	30,920	20.56	5.01
1988	28,581	18.40	4.34
1989	29,628	18.52	4.24
1990	30,783	19.15	4.27
1991	32,001	18.89	4.47
1992	32,375	19.79	4.51
1993	32,820	19.65	4.47

Source: Economic and Social Statistics Office, NSCB.

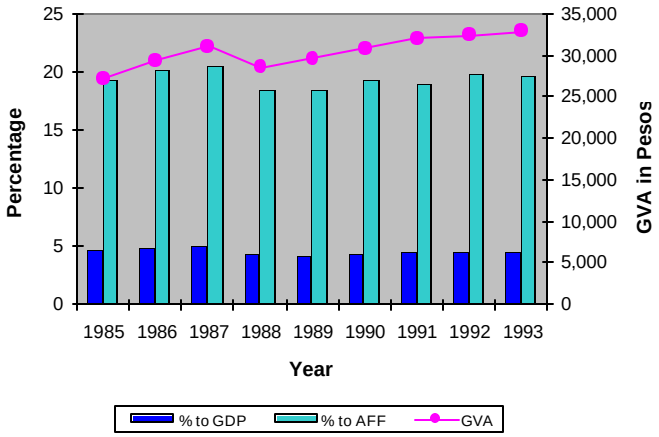


FIGURE 3. GVA OF TOTAL FISHERY AND PERCENTAGE TO AFF AND GDP

Important as it is to the economy, fishery resources must be managed properly to ensure its sustainability. An idea on the level of stocks available is essential in the management of this resource. However, given the nature of the resource and data limitations, computations for this indicator could not be covered by this study.

In spite of data constraints, the study was able to come up with a measure of sustainability of fish production. If depletion goes beyond sustainability, the cost of depletion or net rent is computed. A positive value for net rent indicates that we are overexploiting our fish stocks. If the fish resource is to be valued as nature's input, net rent should be netted out of the value added of the fishery industry to determine the true contribution of this activity to the economy.

From the resulting sustainable yield curve $Y = E \exp(2.138495808 - 1.88251E\text{-}06)$, the maximum sustainable yield (MSY) was estimated at an effort of 531,206 HP and a catch of 1,658,461 metric tons. By harvesting at MSY, the regenerative capacity is maximized. Although this point serves as the optimum physical point of resource use, it is

not the economically optimal management policy. The point where harvesting is rewarding is where marginal revenue (MR) is equal to marginal cost (MC).

TABLE 3. ESTIMATED VALUE OF MARINE FISHERY RESOURCE DEPLETION, 1985-1993

YEAR	FISHING EFFORT (Hp)	SUSTAINABLE CATCH (m.t.)	ACTUAL CATCH (m.t.)	DEPLETION 1/ (m.t.)	NET PRICE (P/m.t.)	NET RENT ('000 Pesos)
1985	649,477	1,622,976	1,556,542	0	0	0
1986	650,655	1,622,318	1,624,206	1,888	2,391	4,513
1987	653,145	1,620,911	1,688,926	68,015	2,159	146,845
1988	611,119	1,641,475	1,726,033	84,558	2,223	187,939
1989	561,349	1,655,890	1,823,409	167,518	2,183	365,741
1990	548,115	1,657,639	1,914,725	257,086	2,230	573,224
1991	455,734	1,640,049	2,008,007	367,957	2,543	935,700
1992	380,379	1,577,501	1,991,463	413,963	2,671	1,105,772
1993	405,231	1,603,754	1,978,350	374,596	2,866	1,073,460

1/ Actual Catch Less Sustainable Catch.

An examination of catch data from the table above reveals that the period 1986-1993 witnessed higher harvest rates than the natural growth rates. Catch was highest in 1991 where it peaked prior to tapering off in 1992-1993. The slowdown could be attributed in part to the decrease in fishing effort. It was during this time that the government started introducing interventions to curb overfishing. Realizing the adverse effects of overexploitation of the resource, the government formulated and implemented the Fisheries Sector Program which aims to address the problems besetting the fishery sector. The following figure further depicts the relationships among the variables.

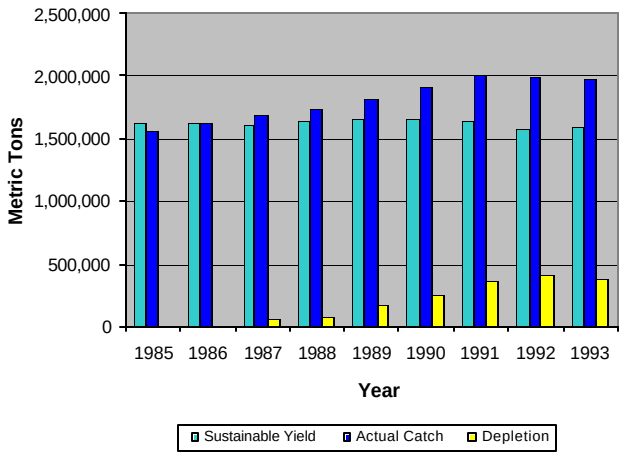


FIGURE 4. SUSTAINABLE YIELD, ACTUAL CATCH AND DEPLETION, 1988-1993

The use of the resource will only be valued at points where production activities put pressure on the environment, that is, when harvesting is greater than the volume of natural growth. For the country's fishery resources, depletion was recorded starting 1986 but was most evident when it grew by a hefty 98.1 percent, from 84,558 metric tons in 1988 to 167,518 in 1989. Up to this point, depletion was occurring but at a decelerating rate. From a high of ₱ 1.106 billion in 1992, the value of depletion started to decrease slightly to ₱ 1.073 billion the following year due to an appreciation in the net price of fish during the period. For the period 1986 to 1992, the estimated net rent continued to increase.

Measures have been initiated by government to curb overfishing activities. One measure that promotes the regeneration of fish stocks was the government's campaign to shift fishing activities into less exploited fishing grounds. Fishers were encouraged to tap fishery resources in the identified EEZ. This formed part of the government's strategy to reduce overfishing and depletion of fishery resources.

Another measure initiated by the government to reduce the rate of depletion during the period was to focus its efforts on addressing increasing trends in fishing through the regulation of traditional commercial fishers as well as new fishing vessels in both ocean and coastal waters. In 1990, a 5-year loan package program from the Asian Development Bank (ADB) was introduced in the Philippines to regulate fishing in 12 priority bays. Included in the program is the Coastal Resource Management (CRM) Component which aims to rehabilitate and regenerate damaged and depleted marine resources. The Credit Component aimed to assist municipal fishermen to engage in other non-fishing livelihood programs. With a continuing decrease in fishing effort from 1992-1993, it is expected that government intervention, by means of regulating the fishing industry, will lead to a decrease in the depletion of fishery resources. Finally, an effective fishery licensing system can be a means of controlling fishing effort to achieve the twin objectives of resource conservation and economic efficiency.

During the period 1985 to 1993, as GVA continued to increase, NVA which represents the GVA less the cost of depreciation of fixed asset, also increased. Deducting resource depletion from the NVA, the resulting environmentally adjusted net value added (EVA) showed a general increasing trend from 1985 to 1991, but at a slower rate compared to the conventional NVA. Growth in EVA picked-up thereafter growing at a rate that is faster than the NVA, reflecting a slowing down of the depletion rate. The computations for EVA of fishery resources, taking into consideration the depletion of marine fisheries from 1985 to 1993 in million pesos at current prices, are shown in the table below. The succeeding chart also illustrates the levels of both NVA and EVA of the fishery sector.

TABLE 4. ESTIMATED GVA, NVA, AND EVA FOR MARINE FISHERY, 1985-1993

YEAR	GROSS VALUE ADDED 1/ (in million P)	NET VALUE ADDED 2/ (in million P)	GROWTH RATE (%)	NET RENT (in million P)	EVA 3/ (in million P)	GROWTH RATE (%)
1985	15,297	15,177	-	0	15,177	-
1986	18,269	18,126	19.43	5	18,121	19.40
1987	17,492	17,399	(4.01)	147	17,252	(4.80)
1988	21,371	21,266	22.23	188	21,078	22.18
1989	26,214	23,111	8.68	366	22,745	7.91
1990	24,376	24,261	4.98	573	23,688	4.14
1991	27,057	29,927	10.99	936	28,991	9.72
1992	29,409	29,264	8.68	1,106	28,158	8.34
1993	30,645	30,382	3.82	1,073	29,309	4.09

1/ Gross Value Added = Compensation + Depreciation + (Indirect Taxes - Subsidies) + Net Operating Surplus.
2/ Net Value Added = Gross Value Added - Depreciation of Fixed Assets.
3/ EVA = Net Value Added - Resource Depletion.

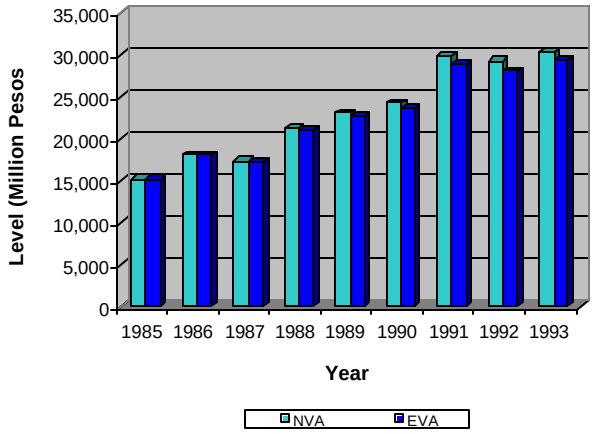


FIGURE 5. NET VALUE ADDED (NVA) AND ENVIRONMENTALLY ADJUSTED NET VALUE ADDED (EVA), 1988-1993

E. RECOMMENDATIONS

A lot has to be done to fully operationalize fishery resource accounting in the Philippines. The following recommendations were drawn on the basis of data problems encountered during the conduct of the study:

1. Data set on fishing effort is considered as one of the most critical variables in the study therefore, regular surveys on fisheries of the BAS should incorporate this data set. Other factors that affect fishing effort, like number of hauling, fishing days, number of crew, etc., likewise, should be included. The current available data on production is estimated with 20.0 percent under-coverage ratio thus, there is a need to improve this data to further refine the estimates on sustainable catch.

2. The available data from the 1991 Census of Fisheries failed to include relevant information on characteristics of fishing units, particularly on inventory of fishing boats and its corresponding tonnage and horsepower. These variables need to be looked into in succeeding censuses.

3. Data on cost of production for both commercial and municipal fishing are inadequate and limited only to results of special studies. A conduct of a nationwide survey for commercial and municipal fishing should be pursued separately.

4. The study also showed that although there are available data from BFAR studies on stock assessment, the coverage is limited only to selected fishing grounds. To be able to derive accurate estimates on the level of fish stock at the national level, an expansion of the coverage of these studies should include the remaining fishing grounds.

5. Finally, more venues for discussions and exchange of experiences in operationalizing the concepts in fishery resource accounting should be made available, given the complexity of the bioeconomics of the resource.

ACRONYMS

ASE	Annual Survey of Establishments
BAS	Bureau of Agricultural Statistics
BFAR	Bureau of Fisheries and Aquatic Resources
CPUE	Catch Per Unit Effort
EEZ	Exclusive Economic Zone
ENRA	Environmental and Natural Resource Accounting
ENRAP	Environmental and Natural Resource Accounting Project
EVA	Environmentally Adjusted Net Value Added
FAO	Food and Agriculture Organization
FSP	Fishery Sector Program
GDP	Gross Domestic Product
GVA	Gross Value Added
Hp	Horse Power
ICLARM	International Center for Living Aquatic Resources Management
IEMSD	Integrated Environmental Management for Sustainable Development
Kg	Kilogram
LGU	Local Government Unit
MC	Marginal Cost
MR	Marginal Revenue
MSY	Maximum Sustainable Yield
MT	Metric Ton
MTDP	Medium Term Development Plan
NEDA	National Economic and Development Authority
NPM	Net Price Method
NSCB	National Statistical Coordination Board
NSO	National Statistics Office
NVA	Net Value Added
PS	Purse Seine
PSNA	Philippine System of National Accounts
REA	Resource Ecological Assessment
REECS	Resources, Environment and Economics Center for Studies
SEEA	System of Integrated Economic and Environmental Accounting
TWG	Technical Working Group

DEFINITION OF TERMS

Aquaculture	-	aquatic products that are cultured such as fish, oysters, seaweed and other aquatic resources in seas, lakes and rivers.
Biomass	-	the total entities that include fishes and other aquatic products in the waters measured in number or in weight.
Closing Stock	-	fish inventory at the end of the accounting period.
Commercial Fishing	-	the catching of fish with the use of fishing boats with a capacity of more than three gross tons.
Depletion	-	refers to the decrease of the existing stock due to fishing activities of man. This occurs when total catch exceeds sustainable catch.
Fish	-	Includes all fishes and other aquatic animals such as crustaceans (crabs, prawns, shrimps, lobsters, etc.) and mollusks (clams, scallops, oysters, snails and other shellfish).
Fish Catch	-	volume of fish landed from commercial and municipal fishing.
Fish Stock	-	level of fish available in the country's waters at a certain period of time which can be measured in number or in weight.
Fishery	-	business of catching, taking, handling, marketing and preserving fish or other fishery/aquatic products and the right to fish or take such products.
Fishing	-	refers to the catching, gathering and culturing of fish, crustaceans, mollusks, and all other aquatic animals and plants in the sea or in inland waters. It includes the catching of fish and aquatic animals like turtles; the gathering of clams, snails, shells and seaweeds; and the culturing of fish and oysters. Sport fishing or small scale fishing pursued as a hobby is excluded.
Fishing Boat	-	a type of watercraft, such as banca, sailboat, motor boat, etc., either licensed or not, used for fishing purposes. Carrier boats used for the purpose of transporting fish in the course of fishing shall also be considered fishing boats.
Fishing Effort	-	a collective variable referring to manpower, machine power and technology employed in harvesting fishery resource.

Fishing Gear	-	apparatus, gadgets, implements and other paraphernalia used in catching and gathering fish with or without the use of boats.
Fishing Method	-	the procedure of catching fish; it is usually identified by the name of the fishing gear used.
Fishing Mortality	-	fish loss due to fish harvesting activity and/or other natural causes.
Fishing Unit	-	minimum unit necessary for operating a fishing method. It is usually composed of fishing boat, fishing gear and manpower. When a fishing boat is not necessary for the operation of fishing method, the fishing unit may be composed of the fishing gear and manpower. When a fishing boat and fishing gear are not necessary for the operation of fishing method, the fishing unit is composed of manpower only.
Growth	-	biological process specifying the rate at which the size of fish increases over time.
Marinewater Fish	-	fishes thriving on seawater outside of the coastal line.
Migration	-	inflow/outflow of fish in the country's waters.
Municipal Fishing	-	characterized by the use of simple gear and fishing boat some of which are non-motorized and with a capacity of less than three gross tons.
Natural Mortality	-	represents the loss from death of fish due to predation and from adverse ecological conditions.
Opening Stock	-	fish inventory at the beginning of the accounting period.
Overfishing	-	extraction of fishery resources beyond the rate of natural growth

APPENDICES

APPENDIX TABLE 1. TOTAL MARINE FISH CATCH[1/], 1976-1993
IN METRIC TONS

Year	Commercial	Municipal (marine)	Total Marine Fish Catch
1976	609,836	640,185	1,250,021
1977	621,798	736,727	1,358,525
1978	607,008	802,300	1,409,308
1979	600,896	762,652	1,363,548
1980	586,174	776,741	1,362,915
1981	593,722	851,987	1,445,709
1982	631,648	849,619	1,481,267
1983	623,179	925,186	1,548,365
1984	616,002	947,970	1,563,972
1985	614,384	942,158	1,556,542
1986	655,476	968,730	1,624,206
1987	709,430	979,496	1,688,926
1988	719,994	1,006,039	1,726,033
1989	764,566	1,058,843	1,823,409
1990	840,677	1,074,048	1,914,725
1991	911,778	1,096,229	2,008,007
1992	965,839	1,025,624	1,991,463
1993	1,014,517	963,833	1,978,350

Source : Bureau of Agricultural Statistics (BAS)

Note: 1/ Marine fish catch corrected with 20% undercoverage

APPENDIX TABLE 2. ACTUAL ESTIMATES: HORSEPOWER AND MARINE FISH CATCH AND THE COMPUTED CPUE OF COMMERCIAL FISHING VESSELS BY TYPE OF GEAR, 19

YEAR	PURSE SEINE			BAG NET			MURO-AMI			RING NET			TRAWL			BEACH SEINE		
	Hp	CATCH	CPUE	Hp	CATCH	CPUE	Hp	CATCH	CPUE	Hp	CATCH	CPUE	Hp	CATCH	CPUE	Hp	CATCH	CPUE
1976	50,253	211,417	4.21	133,366	42,012	0.32	7,976	13,800	1.73	7,151	22,647	3.17	189,690	206,205	1.09	189,690	727	0.00
1977	45,298	190,607	4.21	85,260	71,524	0.84	7,786	10,523	1.35	5,357	32,777	6.12	162,824	204,468	1.26	162,824	479	0.00
1978	62,754	186,073	2.97	96,920	69,823	0.72	974	10,273	10.55	12,855	31,997	2.49	156,035	199,605	1.28	156,035	468	0.00
1979	80,564	174,029	2.16	100,154	97,799	0.98	11,736	11,677	0.99	20,223	32,950	1.63	188,977	176,739	0.94	188,977	780	0.00
1980	35,844	163,153	4.55	62,179	106,254	1.71	636	11,553	18.17	16,810	33,913	2.02	150,633	164,287	1.09	150,633	664	0.00
1981	98,587	168,918	1.71	81,536	107,229	1.32	5,705	10,058	1.76	28,951	39,774	1.37	162,119	151,674	0.94	162,119	510	0.00
1982	105,602	198,178	1.88	84,469	114,624	1.36	11,437	10,367	0.91	28,729	40,862	1.42	174,682	151,837	0.87	174,682	801	0.00
1983	95,186	212,979	2.24	80,397	84,958	1.06	11,985	8,694	0.73	29,498	50,283	1.70	199,949	152,106	0.76	199,949	669	0.00
1984	81,530	193,054	2.37	90,186	93,990	1.04	8,732	9,748	1.12	45,857	58,360	1.27	159,854	151,053	0.94	159,854	486	0.00
1985	80,202	183,414	2.29	90,325	102,879	1.14	10,098	10,284	1.02	48,944	75,406	1.54	162,472	129,327	0.80	162,472	2,260	0.01
1986	91,677	224,730	2.45	87,438	91,053	1.04	12,648	10,002	0.79	47,924	72,958	1.52	171,906	136,604	0.79	171,906	3,657	0.02
1987	97,182	239,663	2.47	91,717	92,413	1.01	11,362	11,491	1.01	62,440	86,175	1.38	184,112	147,317	0.80	184,112	7,241	0.04
1988	87,826	263,439	3.00	89,958	95,474	1.06	11,362	11,646	1.02	37,047	87,965	2.37	179,035	117,932	0.66	179,035	9,940	0.06
1989	89,328	279,747	3.13	91,489	101,384	1.11	11,362	12,367	1.09	37,681	93,411	2.48	182,100	125,233	0.69	182,100	10,555	0.06
1990	87,954	307,596	3.50	90,090	111,477	1.24	11,362	13,598	1.20	37,101	102,709	2.77	179,298	137,699	0.77	179,298	11,606	0.06
1991	88,368	453,807	5.14	90,513	53,506	0.59	11,362	0	0.00	37,280	90,012	2.41	180,142	90,173	0.50	180,142	1,106	0.01
1992	91,196	467,438	5.13	91,484	53,396	0.58	11,362	7	0.00	33,691	109,418	3.25	193,731	90,547	0.47	193,731	2,087	0.01
1993	94,114	425,261	4.52	92,465	53,889	0.58	11,362	0	0.00	30,447	159,270	5.23	208,345	86,965	0.42	208,345	1,040	0.00

Notes:

1. Catch data refers to actual fish catch from BAS.
2. Hp data is based on parameters used by the ENRAP study.

APPENDIX TABLE 3. CORRECTED ESTIMATES: HORSEPOWER AND MARINE FISH CATCH OF COMMERCIAL FISHING VESSELS BY TYPE OF GEAR, 1976-1993

YEAR	GEAR TYPE												TOTAL	
	PURSE SEINE		BAG NET		RING NET		TRAWL		MURO-AMI		BEACH SEINE		UNADJUSTED	
	Hp	CATCH	Hp	CATCH	Hp	CATCH	Hp	CATCH	Hp	CATCH	Hp	CATCH	Hp	CATCH
1976	61,686	259,516	163,708	51,570	8,778	27,799	232,846	253,118	9,791	16,940	232,846	892	709,655	609,836
1977	55,187	232,218	103,873	87,138	6,526	39,933	198,370	249,105	9,486	12,820	198,370	584	571,812	621,798
1978	76,454	226,695	118,078	85,066	15,661	38,983	190,099	243,180	1,187	12,515	190,099	570	591,578	607,008
1979	98,002	211,698	121,833	118,968	24,600	40,082	229,882	214,995	14,276	14,205	229,882	949	718,475	600,896
1980	43,789	199,315	75,961	129,805	20,536	41,430	184,020	200,700	777	14,114	184,020	811	509,102	586,174
1981	122,413	209,741	101,241	133,143	35,948	49,386	201,299	188,329	7,084	12,489	201,299	633	669,283	593,722
1982	129,103	242,280	103,267	140,132	35,122	49,955	213,556	185,627	13,982	12,674	213,556	979	708,585	631,648
1983	116,381	260,402	98,299	103,875	36,066	61,479	244,471	185,975	14,654	10,630	244,471	818	754,340	623,179
1984	99,119	234,703	109,642	114,267	55,750	70,950	194,340	183,640	10,616	11,851	194,340	591	663,807	616,002
1985	97,851	223,775	110,202	125,518	59,714	92,000	198,225	157,786	12,320	12,547	198,225	2,757	676,537	614,384
1986	111,487	273,291	106,332	110,728	58,280	88,723	209,053	166,122	15,381	12,163	209,053	4,447	709,586	655,476
1987	117,994	290,988	111,359	112,204	75,812	104,630	223,540	178,865	13,795	13,952	223,540	8,792	766,040	709,430
1988	107,836	323,458	110,453	117,226	45,488	108,006	219,824	144,800	13,951	14,299	219,824	12,205	717,375	719,994
1989	109,680	343,482	112,333	124,483	46,265	114,692	223,588	153,764	13,951	15,185	223,588	12,960	729,405	764,566
1990	107,993	377,675	110,615	136,875	45,554	126,110	220,147	169,071	13,951	16,696	220,147	14,250	718,407	840,677
1991	117,008	600,884	119,847	70,847	49,363	119,185	238,525	119,398	0	0	238,525	1,464	763,268	911,778
1992	121,844	624,532	122,229	71,341	45,013	146,191	258,839	120,978	15,180	9	258,839	2,788	821,945	965,839
1993	131,438	593,915	129,136	75,261	42,521	222,435	290,972	121,454	0	0	290,972	1,452	885,040	1,014,517

Notes:

1. Corrected Hp = corrected marine fish catch x computed CPUE in Table 2
2. Corrected Catch = actual marine fish catch x 20% undercoverage

APPENDIX TABLE 4. COMMERCIAL AND MUNICIPAL HORSEPOWER ADJUSTED TO PURSE SEINE EQUIVALENT, 1976-1993

YEAR	COMMERCIAL FISHING VESSELS							TOTAL MUNICIPAL Hp ADJUSTED to PS EQUIV.	TOTAL MARINE FISHERY Hp ADJUSTED to PURSE SEINE EQUIVALENT
	PURSE SEINE	BAG NET	MURO-AMI	RING NET	TRAWL	BEACH SEINE	TOTAL COMM'L Hp ADJUSTED to PS EQUIV.		
1976	61,686	12,258	4,026	6,608	60,165	212	144,956	152,169	297,125
1977	55,187	20,709	3,047	9,490	59,200	139	147,771	185,223	332,994
1978	76,454	28,689	4,221	13,147	82,013	192	204,716	232,688	437,404
1979	98,002	55,074	6,576	18,555	99,528	439	278,175	334,742	612,918
1980	43,789	28,517	3,101	9,102	44,093	178	128,780	164,681	293,461
1981	122,413	77,708	7,289	28,824	109,916	370	346,519	463,338	809,857
1982	129,103	74,672	6,754	26,619	98,914	522	336,583	429,236	765,819
1983	116,381	46,425	4,751	27,477	83,117	366	278,515	392,028	670,543
1984	99,119	48,257	5,005	29,964	77,554	250	260,148	379,561	639,709
1985	97,851	54,886	5,486	40,229	68,996	1,206	268,654	390,592	659,246
1986	111,487	45,171	4,962	36,194	67,768	1,814	267,397	374,668	642,065
1987	117,994	45,498	5,657	42,427	72,529	3,565	287,670	376,554	664,224
1988	107,836	39,081	4,767	36,008	48,274	4,069	240,035	317,978	558,013
1989	109,680	39,750	4,849	36,623	49,100	4,138	244,139	320,545	564,684
1990	107,993	39,138	4,774	36,060	48,345	4,075	240,385	291,161	531,546
1991	117,008	13,796	0	23,208	23,250	285	177,547	202,374	379,921
1992	121,844	13,918	2	28,521	23,602	544	188,432	192,404	380,836
1993	131,438	16,656	0	49,227	26,879	321	224,521	205,105	429,626

APPENDIX TABEL 5. NUMBER OF FISHERS AND HORSEPOWER EQUIVALENT ADJUSTED TO PURSE SEINE EQUIVALENT, 1976-1993

YEAR	NUMBER OF FISHERS				FISHING EFFORT			2-YEAR AVERAGE of TOTAL Hp	ADJUSTMENT FACTOR to PS EQUIVALENT	ADJUSTED Hp to PS EQUIVALENT
	FULL TIME	PART TIME	Occasional	SUB-TOTAL	FISHER HP	MUNICIPAL VESSEL Hp	TOTAL HP			
1976	230,960	157,945	72,333	461,238	13,572	1,030,959	1,044,531	1,044,531	0.1457	152,169
1977	197,310	109,616	58,462	365,388	11,121	924,994	936,115	990,323	0.1870	185,223
1978	266,199	181,317	84,881	532,397	15,636	1,284,654	1,300,290	1,118,203	0.2081	232,688
1979	285,786	194,269	91,950	572,005	16,784	1,434,031	1,450,815	1,375,553	0.2434	334,742
1980	369,126	284,574	143,671	797,371	22,408	1,537,462	1,559,870	1,505,343	0.1094	164,681
1981	329,391	223,016	107,904	660,311	19,339	1,786,913	1,806,252	1,683,061	0.2753	463,338
1982	353,628	238,948	116,891	709,467	20,757	1,994,692	2,015,449	1,910,851	0.2246	429,236
1983	379,648	256,017	126,627	762,292	22,281	2,226,630	2,248,911	2,132,180	0.1839	392,028
1984	407,583	274,306	137,173	819,062	23,918	2,485,539	2,509,457	2,379,184	0.1595	379,561
1985	437,192	293,902	148,598	879,692	25,656	2,774,552	2,800,208	2,654,833	0.1471	390,592
1986	469,259	314,897	160,974	945,131	27,505	3,097,171	3,124,676	2,962,442	0.1265	374,668
1987	503,677	337,393	174,382	1,015,451	29,519	3,457,304	3,486,824	3,305,750	0.1139	376,554
1988	540,621	361,495	188,905	1,091,022	31,682	3,859,313	3,890,994	3,688,909	0.0862	317,978
1989	580,274	387,319	204,639	1,172,232	34,002	4,308,066	4,342,068	4,116,531	0.0779	320,545
1990	622,835	414,988	221,683	1,259,506	36,493	4,808,999	4,845,492	4,593,780	0.0634	291,161
1991	668,518	444,634	240,146	1,353,298	39,166	5,368,180	5,407,346	5,126,419	0.0395	202,374
1992	717,552	476,397	260,148	1,454,096	42,428	5,815,284	5,857,712	5,632,529	0.0342	192,404
1993	770,182	510,429	281,815	1,562,426	45,962	6,299,626	6,345,588	6,101,650	0.0336	205,105

APPENDIX TABLE 6. TOTAL FISHING EFFORT IN PURSE SEINE EQUIVALENT, 1976-1993

YEAR	MUNICIPAL HORSEPOWER	COMMERCIAL HORSEPOWER	TOTALHp (2-YEAR AVERAGE)
1976	152,169	144,956	297,125
1977	185,223	147,771	315,059
1978	232,688	204,716	385,199
1979	334,742	278,175	525,161
1980	164,681	128,780	453,190
1981	463,338	346,519	551,659
1982	429,236	336,583	787,838
1983	392,028	278,515	718,181
1984	379,561	260,148	655,126
1985	390,592	268,654	649,477
1986	374,668	267,397	650,655
1987	376,554	287,670	653,145
1988	317,978	240,035	611,119
1989	320,545	244,139	561,349
1990	291,161	240,385	548,115
1991	202,374	177,547	455,734
1992	192,404	188,432	380,379
1993	205,105	224,521	405,231

APPENDIX TABLE 7. SUMMARY OUTPUT OF REGRESSION

Regression Statistics	
Multiple R	0.892168288
R Square	0.795964254
Adjusted R Square	0.78321202
Standard Error	0.139034696
Observations	18

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.20657318	1.20657318	62.4176318	6.5208E-07
Residual	16	0.309290345	0.019330647		
Total	17	1.515863525			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.000%*	*Upper 95.000%*
Intercept	2.138495808	0.131286743	16.28874139	2.2064E-11	1.860180408	2.416811208	1.860180408	2.416811208
X Variable 1	-1.88251E-06	2.38278E-07	-7.900483009	6.5208E-07	-2.38764E-06	-1.37738E-06	-2.38764E-06	-1.37738E-06

APPENDIX TABLE 8. ESTIMATED MARINE FISHERY RESOURCE DEPLETION, 1976-1993

YEAR	EFFORT (Hp) (1)	ACTUAL CATCH (m.t.) (2)	SUSTAINABLE CATCH (m.t.) (3)	DEPLETION (m.t.) (4)
1976	297,125	1,250,021	1,441,311	0
1977	315,059	1,358,525	1,477,571	0
1978	385,199	1,409,308	1,583,061	0
1979	525,161	1,363,548	1,658,353	0
1980	453,190	1,362,915	1,638,723	0
1981	551,659	1,445,709	1,657,263	0
1982	787,838	1,481,267	1,517,283	0
1983	718,181	1,548,365	1,576,930	0
1984	655,126	1,563,972	1,619,775	0
1985	649,477	1,556,542	1,622,976	0
1986	650,655	1,624,206	1,622,318	1,888
1987	653,145	1,688,926	1,620,911	68,015
1988	611,119	1,726,033	1,641,475	84,558
1989	561,349	1,823,409	1,655,890	167,518
1990	548,115	1,914,725	1,657,639	257,086
1991	455,734	2,008,007	1,640,049	367,957
1992	380,379	1,991,463	1,577,501	413,963
1993	405,231	1,978,350	1,603,754	374,596

Note:

Estimated Maximum Sustainable Yield (MSY)	1,658,461	m.t.
Estimated Maximum Fishing Effort (EMSY)	531,206	Hp

APPENDIX TABLE 9. ESTIMATED NET RENT FOR PHILIPPINE MARINE FISHERY RESOURCES, 1985-1993

YEAR	DEPLETION (m.t.)	NET PRICE (P/m.t.)	NET RENT ('000 P)
1985	0	0	0
1986	1,888	2,391	4,513
1987	68,015	2,159	146,845
1988	84,558	2,223	187,939
1989	167,518	2,183	365,741
1990	257,086	2,230	573,224
1991	367,957	2,543	935,700
1992	413,963	2,671	1,105,772
1993	374,596	2,866	1,073,460

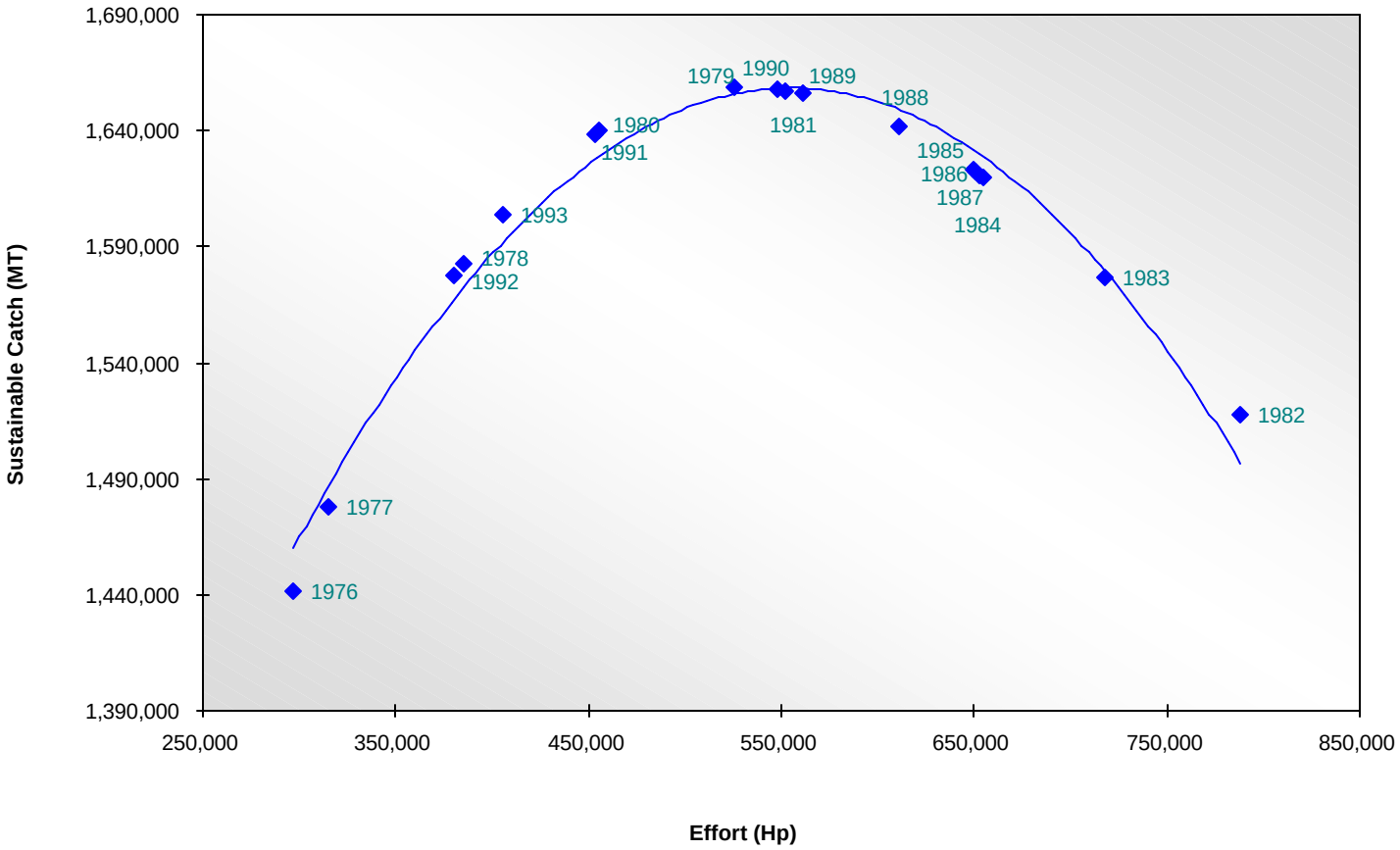
Notes:

(1) Net price was derived by using the 1989 ASE. Series was generated by applying the change in producers price to the derived Net Price of 1989.

(2) To translate the Net Price at purchaser's price, the trade and transport margin was added to NP at producer's price.

(3) Net rent is the value of resource depletion.

APPENDIX FIGURE 1. SUSTAINABLE YIELD-EFFORT CURVE FOR MARINE FISHERY RESOURCES



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