

Israel, Danilo C.; Banzon, Cesar P.

**Working Paper**

## Overfishing in the Philippine Commercial Marine Fisheries Sector

PIDS Discussion Paper Series, No. 1997-01

**Provided in Cooperation with:**

Philippine Institute for Development Studies (PIDS), Philippines

*Suggested Citation:* Israel, Danilo C.; Banzon, Cesar P. (1997) : Overfishing in the Philippine Commercial Marine Fisheries Sector, PIDS Discussion Paper Series, No. 1997-01, Philippine Institute for Development Studies (PIDS), Makati City

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Philippine Institute for Development Studies

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*Danilo C. Israel and Cesar P. Banzon*

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January 1997

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**The Research Information Staff**, Philippine Institute for Development Studies  
3rd Floor, NEDA sa Makati Building, 106 Amorsolo Street, Legaspi Village, Makati City, Philippines  
Tel Nos: 8924059 and 8935705; Fax No: 8939589; E-mail: [publications@pidsnet.pids.gov.ph](mailto:publications@pidsnet.pids.gov.ph)  
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# OVERFISHING IN THE PHILIPPINE COMMERCIAL MARINE FISHERIES SECTOR

by

*Danilo C. Israel and Cesar P. Banzon<sup>1</sup>*

## 1. Introduction

Since the country is archipelagic, the fisheries sector of the Philippines is traditionally a significant contributor to its economy. The total output of the sector approximately comprises five percent of the Gross National Product. Furthermore, fisheries production meets more than two-thirds of national animal protein consumption (Guerrero 1989; BAR 1991).

While the fisheries sector is economically significant, it is currently facing a serious problem that threatens its viability as economic base. Specifically, empirical studies indicate that marine fishery stocks are already overfished (e.g. Silvestre and Pauly 1987; Dalzell et al. 1987; Trinidad et al. 1993; Padilla and De Guzman 1994). It has been argued that if the current rate of overfishing continues unabated, the marine fisheries may collapse as important edible fish species are driven to virtual extinction.

A survey of the available literature, however, shows that there are some gaps in the research on marine overfishing which need to be addressed. Among others, an important limitation of past studies is that analyses were mainly based on groupings of species, i.e. small pelagic and demersal marine fisheries. This approach may render findings inadequate for actual fisheries management and policy-making which may be sector-based. Secondly, the studies have generally disregarded the unemployment implications that proposed reductions in overfishing may cause. Needless to say, these should be major concerns in a developing country that emphasizes on social equity as a development goal.

The objective of this paper is to address the abovementioned gaps in research by looking into the commercial marine fisheries. The sector was chosen as subject of analysis because, in contrast to the municipal fisheries which is now generally accepted as overfished, there appears to be no consensus as to whether or not the same holds true for the commercial fisheries. It is the aim of the paper to help shed light on issues and contribute information useful for the management of the commercial fisheries.

The rest of the paper is organized as follows. A review of the performance of the fisheries industry in general and the commercial fisheries sector in particular is presented in

<sup>1</sup>Research fellow and former research associate, respectively, of the Philippine Institute for Development Studies, NEDA sa Makati Bldg., 106 Amorsolo St., Legaspi Village, Makati 1200, Metro Manila, Philippines.

section 2. Then, Section 3 summarizes the overfishing problem in the marine fisheries using species-based data obtained from past studies. The basic theory and models of overfishing are discussed in Section 4 while Section 5 explains the data used in the study. Finally Section 6 present the results while Section 7 provides the conclusions, recommendations and areas for future research.

## **2. Performance of the Fisheries Industry**

In terms of output, the Philippine fisheries industry has been steadily growing in recent years (Table 1). From 1981 to 1994, the sector posted an average annual growth rate of 3.30 percent, in terms of quantity, and 15.84 percent, in terms of value of production. Among the four fisheries sectors, aquaculture and commercial fisheries grew the fastest, in quantity terms, while municipal marine fisheries and inland fisheries increased the slowest.

The commercial fisheries, in particular, rose at an average annual rate of 4.62 percent, in quantity, and 13.76 percent, in value of production over the 1981-94 period. In 1994, the sector produced about 5 thousand metric tons of fish valued at approximately 14 billion pesos.

The fisheries industry employs about a million fishermen and fishfarmers, highlighting its importance as a generator of mainly rural jobs (BFAR 1991). Of these, 36 percent were in municipal marine fisheries, 29 percent were in commercial fisheries, 27 percent were in aquaculture and 8 percent were in inland fisheries (Figure 1). Hence, the commercial fisheries sector is a major employment base, second only to the municipal marine fisheries.

In addition, when all backward and forward linkages are considered, about 12 percent of the general population were in one way or another dependent on fisheries related activities for their livelihood (e.g. Trinidad et al. 1993). This again highlights the importance of fisheries as a source of employment to the national economy. It is not known, however, how much of this can be attributable to the commercial fisheries.

Lastly, the fisheries industry has been a steady dollar earner. In recent years, in particular, fishery exports have been growing at very high rates annually, especially in value terms (Table 2). While this was the case, however, imports have increased as well, at even greater rates than do exports. Because of this, the industry has been recording negative net exports over time, in quantity terms, although in value terms, it has been posting positive net exports.

## **3. Overfishing in the Marine Fisheries**

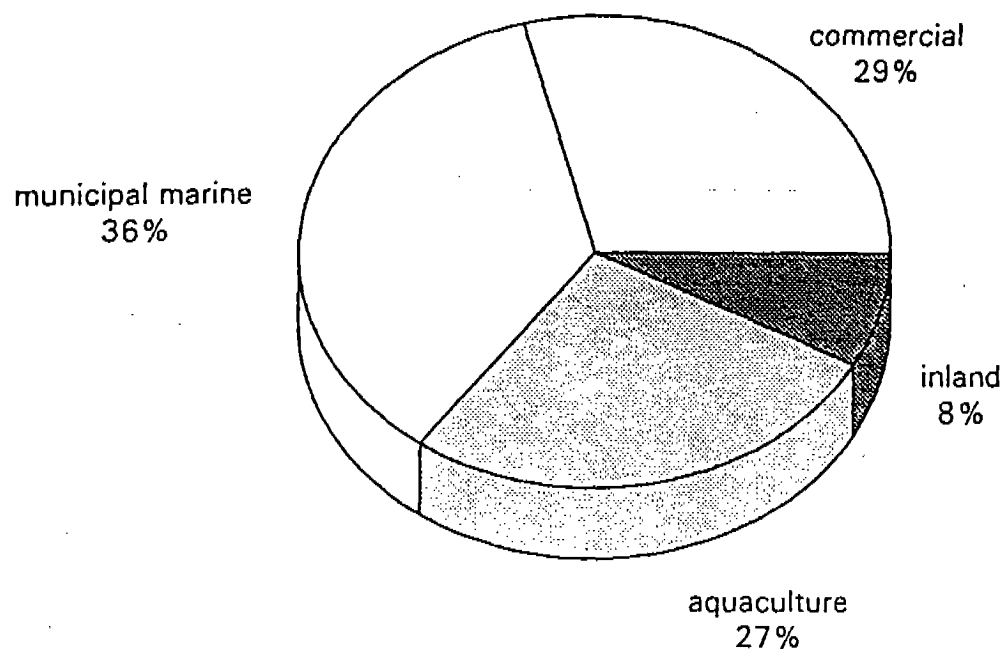
Based on species-based data from past studies, the overfishing problem in the marine fisheries can be summarized as follows (Table 3). Over time, the catch per unit effort, or CPUE, for both small pelagic and demersal species has steadily fallen so that by 1984, it was only approximately a third of the 1965 figure. In contrast, fishing effort has risen in 1984 to

Table 1: Quantity (Thousand MT) and FOB Value (Million P) of Fish Production in the Philippines, by Sector, 1981-94.

Year	All Sectors		Commercial		Municipal Marine		Aquaculture		Inland Fishing	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1981	1,774	13,955	495	4,125	710	6,264	340	2,866	229	700
1982	1,896	15,064	526	4,355	708	6,488	392	3,393	270	828
1983	2,110	18,982	519	4,643	771	7,463	445	4,799	375	2,077
1984	2,080	25,650	513	6,521	790	10,291	478	7,266	299	1,572
1985	2,052	31,297	512	7,857	785	12,796	495	8,724	260	1,920
1986	2,089	37,331	546	9,248	807	14,611	471	10,832	265	2,640
1987	2,213	37,350	591	9,821	816	14,217	561	11,421	245	1,891
1988	2,270	42,118	600	10,272	838	14,693	600	15,213	232	1,940
1989	2,371	45,094	637	11,033	883	16,182	629	15,673	222	2,206
1990	2,504	52,177	701	12,411	895	16,736	671	20,466	237	2,564
1991	2,599	60,034	760	15,245	914	19,614	692	22,656	233	2,519
1992	2,626	65,443	805	16,801	855	19,444	736	25,986	230	3,212
1993	2,647	71,058	845	18,365	803	20,118	772	30,508	227	2,067
1994	2,686	81,229	883	21,130	787	22,327	791	35,280	223	2,492
Ave. Annual Growth Rate (%)	3.30	14.84	4.62	13.76	0.88	10.77	6.87	22.01	0.69	16.87

Source: BAS. "Selected Fisheries Statistics".

Figure 1. Distribution of Employment in the Fishery Sector, 1990



Source of basic data: BFAR

Table 2: Quantity (MT) and FOB Value (Million P) of Exports and Imports of Fishery Products by the Philippines, 1981-94.

Year	Exports		Imports		Net Exports	
	Quantity	Value	Quantity	Value	Quantity	Value
1981	83,736	1,251	46,850	288	36,886	963
1982	68,265	1,120	83,445	444	(15,180)	676
1983	75,589	1,593	23,038	111	52,551	1,482
1984	63,055	2,179	6,097	50	56,958	2,129
1985	95,077	3,496	28,755	118	66,322	3,378
1986	101,453	4,883	69,085	386	32,368	4,497
1987	111,830	6,442	104,936	637	6,894	5,805
1988	128,903	9,599	164,575	1,312	(35,672)	8,287
1989	145,099	10,248	197,966	1,424	(52,867)	8,824
1990	143,038	11,529	196,115	1,854	(53,077)	9,675
1991	144,939	14,048	193,635	2,323	(48,696)	11,725
1992	131,915	11,090	221,545	2,496	(89,630)	8,594
1993	163,745	14,074	208,895	2,249	(45,150)	11,825
1994	172,080	15,027	241,194	2,505	(69,114)	12,522
Ave. Annual Growth Rate (%)	7.03	23.33	45.77	40.87	-41.90	26.99

Source: BAS. "Selected Fisheries Statistics".

Table 3: Fishing Effort and Catch Per Unit Effort for Small Pelagic and Demersal Fish Species in the Philippines, 1965-85.

Year	Small Pelagics		Demersals	
	Effort ( <sup>000</sup> Hp)	CPUE (Mt/Hp/y)	Effort ( <sup>000</sup> Hp)	CPUE (Mt/Hp/y)
1965	105	2.50	182	1.13
1966	194	2.00	203	1.09
1967	210	1.55	264	0.20
1968	203	1.76	337	0.89
1969	166	2.11	431	0.65
1970	157	2.69	494	0.56
1971	155	2.93	536	0.53
1972	313	2.08	610	0.54
1973	292	1.74	676	0.51
1974	280	1.82	718	0.52
1975	266	1.94	653	0.46
1976	259	2.01	524	0.69
1977	280	2.03	509	0.73
1978	363	1.64	534	0.68
1979	416	1.20	534	0.68
1980	371	1.21	677	0.55
1981	491	1.13	677	0.47
1982	625	0.92	777	0.47
1983	621	0.85	946	0.40
1984	557	0.84	976	0.42
1985	558	0.84	-	-
Ave. Annual Growth Rate (%)	11.93	-4.07	10.04	10.83

Sources: Silvestre and Pauly (1987) and Dalzell et.al. (1987).



greater than five times the 1965 level. Thus, clearly, while more and more effort has been dedicated to catching fish, the yield per unit has been fast declining.

A graphical presentation of the overfishing data, however, indicates that there were actually years when fishing effort declined (**Figure 2**). For small pelagic species, for instance, fishing effort decreased in the late sixties, early seventies, mid-seventies and mid-eighties. For the demersal species, on the other hand, effort fell in the middle and late seventies. While this was so, on the other hand, there is no mistaking that the overall general trend of fishing effort has been increasing over the whole period.

A similar case can be observed about the CPUE (**Figure 3**). As can be seen, for small pelagic species, it increased in the early and late seventies while for demersal species, it rose in the late sixties and middle seventies. Again, however, the overall trend of the CPUE has been falling over the whole period.

## **4. The Theory and Models of Overfishing**

### **4.1 Basic Theory**

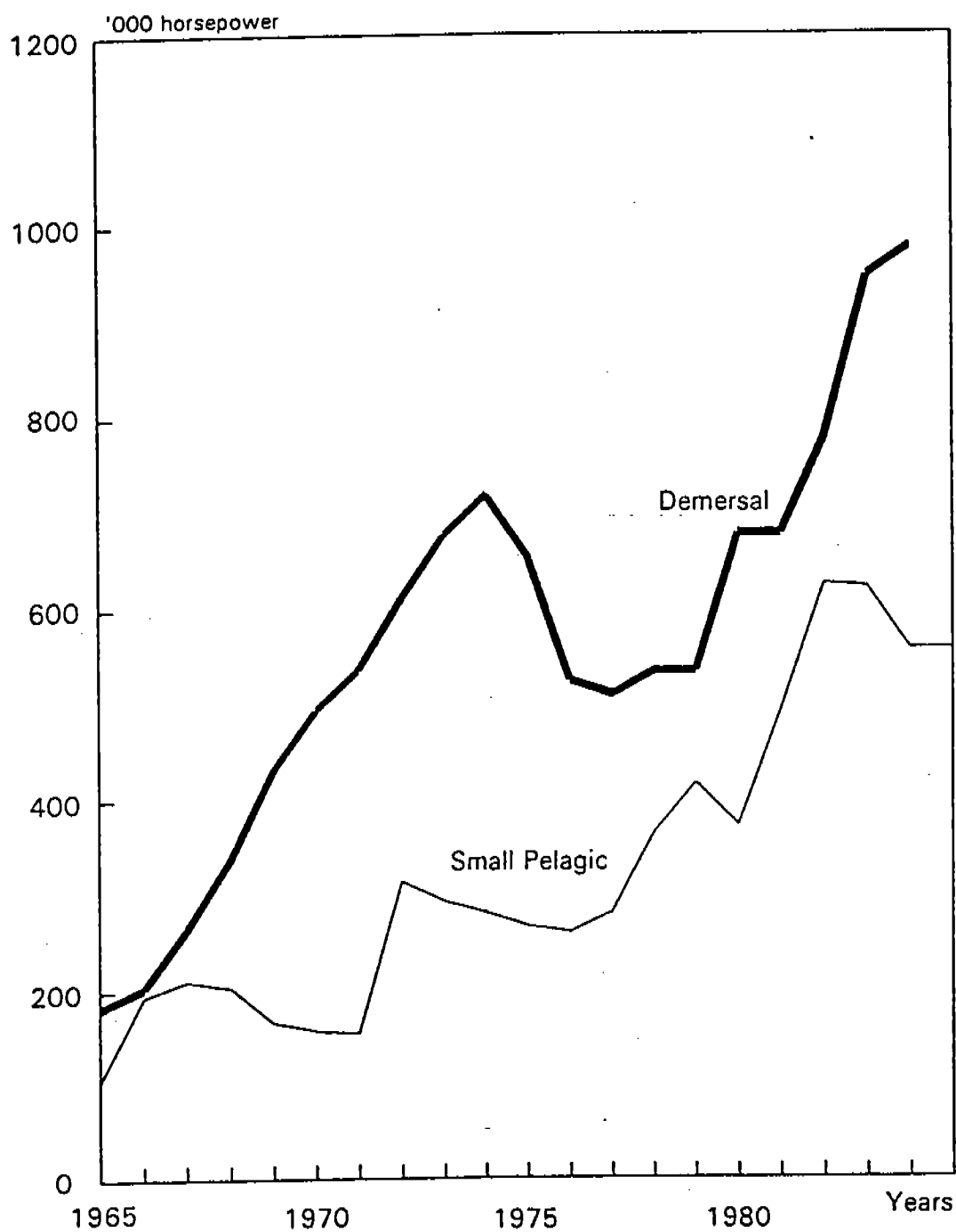
In general, overfishing can be classified into four categories (see e.g. Pauly 1987). One is growth overfishing which occurs when the fish are caught even before they have a chance to grow. Another is recruitment overfishing which happens when the adult fish population is caught in large numbers so that reproduction is impaired. The third is ecosystem overfishing which takes place when the decline in a once abundant fish stock due to fishing is not compensated for by an increase in the stocks of other species. Finally, the fourth category is economic overfishing which occurs when increases in the fishing effort leads to profit levels which are below the desired maximum.

Of the above categories of overfishing, economic overfishing may be of most interest to fisheries managers and planners. This is because fisheries resources are primarily viewed as economic resources, i.e. as generators of food and employment. As such, any disruption in fisheries will be analyzed eventually in terms of how much it impacts on its role as an economic sector.

The basic theory behind marine overfishing is already well discussed in the literature (e.g. Cunningham et al. 1985; Panayotou and Jetanavanich 1987; Schatz 1991). In summary, it starts with the notion of a fishery resource, the sea, that is owned by no one and whose exploitation is open to everyone. Before the entrance of man into the fishery, the stock of fish,  $P$ , is assumed to grow at a net natural rate,  $r$ , between two time periods. This  $r$  is equal to the recruitment of young fish joining the stock plus the growth of original fish in the stock less the natural fish mortality.

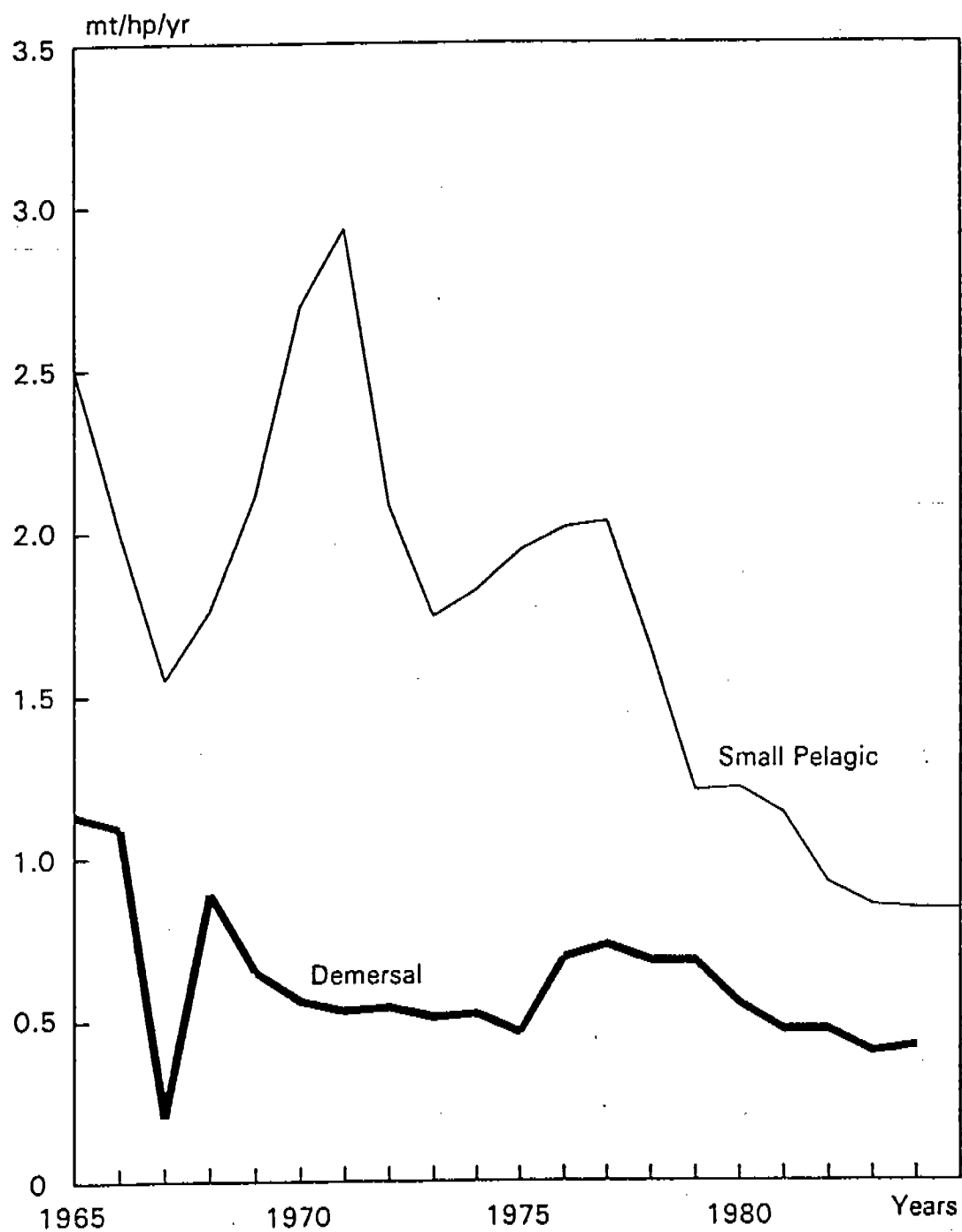
As man enters the fishery and starts to prey on the fish, the situation evolves. By definition,  $r$  is now also the volume of fish,  $y$ , that can be caught by man in a sustained way without affecting the size of the stock. It is sustainable because with all of the natural growth in the stock captured by man, total stock will not grow but remains

Figure 2. Total Fishing Effort for Small Pelagic and Demersal Fishes, 1965-1985



Source of basic data: Table 3.

Figure 3. Catch Per Unit Effort for Small Pelagic and Demersal Fishes, 1965-1985



Source of basic data: Table 3.

constant over time. Also, since man preys on fish and adds to their mortality, his activity may eventually lead to the reduction of  $P$ . This implies that the relationship between fishing effort,  $E$ , and  $P$  is inverse.

From the above relationships, a more in-depth examination will reveal that a U-shaped relationship exists between  $r$  or  $y$  and  $E$ . The relationship is one where at lower effort levels, the fish stock is high and this causes overcrowding and slow growth. As fishing effort rises, the stock declines and crowding is lessened, hence, causing faster growth. Finally, at too much effort, there is smaller stock to reproduce and growth slows down again.

In the U-shaped relationship between  $r$  or  $y$  and  $E$ , the point at which the level of effort yields the maximum  $r$  is the maximum sustainable point. Here, the fish catch by man is the biological optimum, the so-called maximum sustainable yield or MSY.

The biological theory summarized above, however, will not be a sufficient basis for marine resource planning and management where, as mentioned, economic concerns are important. Hence, the biological theory has to be transformed into an economic theory. This transformation is facilitated by incorporating prices for fish catch and fishing effort to turn the biological parameters into economic parameters.

In brief, to illustrate the economic theory, the total revenue, or  $TR$ , is first generated by multiplying fish catch by the price of fish and the total cost, or  $TC$ , is derived by multiplying fishing effort by the price of effort per unit of time. If the prices of fish and effort are assumed constant, the resulting  $TR$  curve will be U-shaped while the  $TC$  curve is a straight line sloping upward (Figure 4).

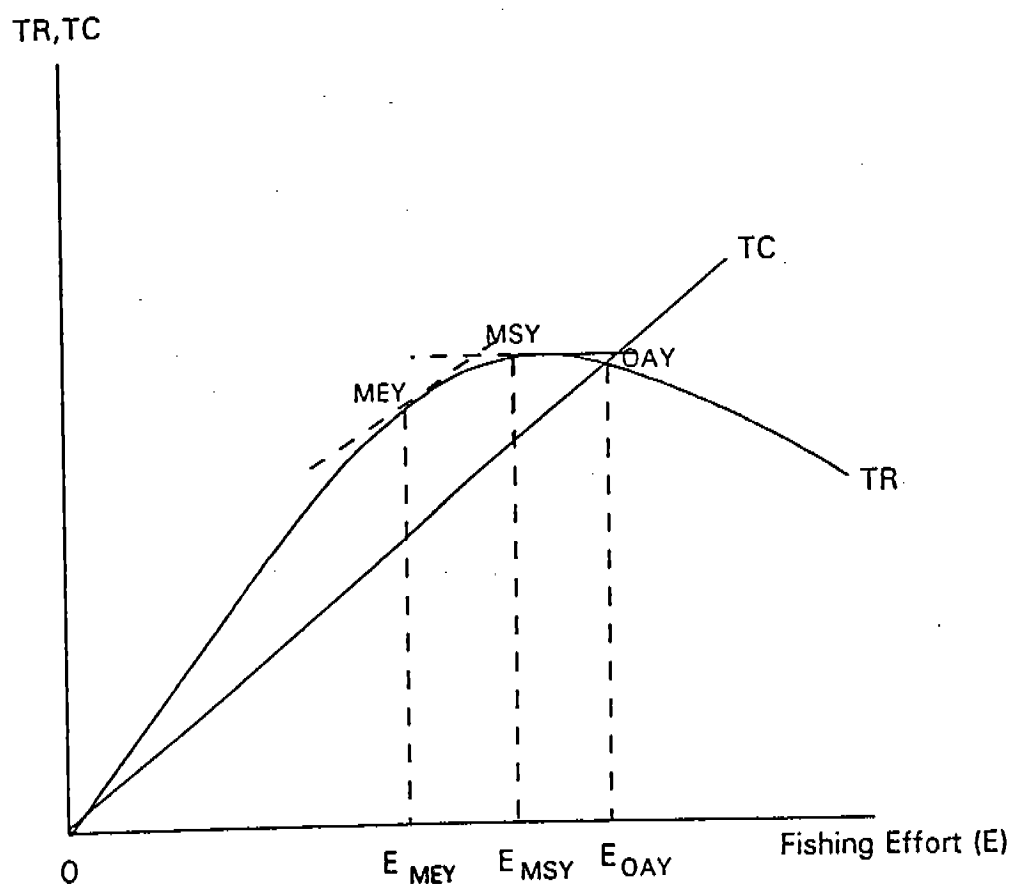
Initially, the economic theory explains that as  $E$  increases,  $TR$  also increases but at a decreasing rate. Thus, continued increases in  $E$  brings the level of  $TR$  first to the economic optimum, the maximum economic yield or MEY. At MEY, the standard economic condition for profit maximization is met. Hence, from the economic standpoint, MEY is the most desirable exploitation level for the fishery.

If the fishery is efficiently run, fishing should stop at MEY where profits are at maximum. However, with complete open-access, fishing continues beyond MEY as more and more fishermen, motivated by the existence of profits, get into the fishery. This situation pushes the level of fishing past the economic optimum into the next optimum, the MSY, which as already mentioned is the biological optimum of the fishery.

At the MSY level, positive profit still exist as  $TR$  remains greater than  $TC$ . This profit induces further fishing until, finally, the open access yield, or OAY, is reached. At this point, positive profits are gone and, without any incentive to continue fishing, further human predation stops. The OAY is the long-run equilibrium point of the fishery.

In addition to the MEY, MSY and OAY concepts, an economic indicator that is often used to measure sustainability in the fishery is the economic rent or ER. This indicator is defined as the net return that occurs when the fishery is used in an

Figure 4. The Basic Economic Theory of Overfishing



economically optimal way and is equal to the excess profits which is the difference between the overall economic value of the goods produced from the activity less the economic cost of production, where the cost is inclusive of normal profits (Schatz 1991, p. 3). Thus, ER is simply the profits at MEY. In this study, a clarification in the definition of economic rent is made. Here, the term "maximum economic rent" or MER is used to imply the profits at MEY. On the other hand, ER means the excess profit at any of point of exploitation of the fishery.

## 4.2 Models

There are four general types of models which can be applied in the analysis of overfishing. These are the single species and constant price models, single species and variable price models, multiple species and constant price models and multiple species and variable price models. The single species and constant price type of models is selected for this study primarily due to data constraints.

There are two single species and constant price models which are employed popularly in empirical research, the Gordon-Schaefer, or GS model, and the Fox Model. The GS model originated from Gordon (1953) and Schaefer (1954, 1957) while the Fox model has its beginnings in Fox (1970). Mathematically, the GS model is specified as

$$Y = aE + bE^2 + u \quad (1)$$

or

$$Y/E = a + bE + u \quad (2)$$

where Y is fish catch, E is defined as before, a is the intercept, b is the coefficient and u is the error term. On the other hand, the Fox model is specified as

$$Y = E e^{a + bE} + u \quad (3)$$

or

$$Y/E = e^{a + bE} + u \quad (4)$$

where c and d are the intercept and coefficient, respectively, e stands for exponent and the other symbols are the same as before.

## **5. Commercial Fisheries Data**

### **5.1 Sources of Data**

This study used secondary time-series data covering the period 1948-1994. The sources of data were the Bureau of Fisheries and Aquatic Resources (BFAR), Bureau of Agricultural Statistics (BAS) and past studies. The basic data for the subperiod 1948-87 were mainly from the BFAR while those for 1988-94 were from the BAS.

The relevant publication of the BFAR was the "Fisheries Statistics of the Philippines". Those of BAS were the "Fishery Statistics", "Commercial Fishery Production Statistics" and "Selected Fishery Statistics".

### **5.2 Fish Catch Data**

The available time-series catch data from the sources for the two subperiods, 1948-87 and 1988-94, were inconsistent and thus necessitated some adjustment. In particular, catch data for the first subperiod were underestimated while those for the latter were overestimated (see Dalzell et al. 1987; Padilla and de Guzman 1994). To address this, the data were adjusted using a regression-based procedure. The final catch data for the whole 1948-94 period are shown in Table 4. A more detailed explanation of the data used in the study is contained in Israel and Banzon (1996).

### **5.3 Fishing Effort Data**

In past works, the most commonly accepted measure of fishing effort was fleet horsepower. This study used a modified measure for fishing effort, the details of which were also explained earlier (Ibid). In summary, fishing effort was estimated as the sum of engine and labor horsepower in the catch and carrier fleets of commercial fisheries, adjusted for learning effects.

Some problems were encountered in generating engine horsepower data for the commercial catch fleet. For the whole 1948-87 subperiod, for instance, BFAR did not gather information on the engine horsepower of catch vessels but instead collected data on the tonnage and number of gears in earlier years. To address this inconsistency, the engine horsepower data series for the catch fleet was constructed based on the available raw data by using a regression-based procedure. For 1988-94 subperiod, on the other hand, no BAS data were available at all on which a measurement of engine horsepower of catch vessels can be based. To address this problem, the engine horsepower data were extrapolated using a procedure based on ratios and proportions.

Once the engine horsepower for the catch fleet was accounted for, the labor horsepower was computed. As there were no available data which can be used to directly measure it labor horsepower, it was estimated by taking it as ratio of engine horsepower by using data from Trinidad et al. (1993) and Karim (1985).

Table 4: Catch, Effort and Catch Per Unit Effort in the Philippine Commercial Fisheries, 1948-94.

Year	Catch (Mt)	Effort (Hp)	CPUE
1948	85,653	24,247	3.5325
1949	113,310	41,889	2.7050
1950	133,235	57,485	2.3177
1951	161,584	83,800	1.9282
1952	180,787	104,359	1.7324
1953	178,539	101,839	1.7531
1954	192,090	117,487	1.6350
1955	191,270	116,509	1.6417
1956	189,295	114,170	1.6580
1957	183,684	107,651	1.7063
1958	208,102	137,381	1.5148
1959	214,935	146,332	1.4688
1960	214,877	146,256	1.4692
1961	227,180	163,063	1.3932
1962	243,969	187,437	1.3016
1963	271,604	231,158	1.1750
1964	279,811	245,002	1.1421
1965	300,074	310,237	0.9672
1966	314,899	392,013	0.8033
1967	330,922	422,195	0.7838
1968	406,794	409,450	0.9935
1969	368,727	439,560	0.8389
1970	381,877	484,615	0.7880
1971	382,276	460,943	0.8293
1972	424,754	553,994	0.7667
1973	465,422	634,416	0.7336
1974	470,675	620,618	0.7584
1975	498,617	601,506	0.8289
1976	508,197	633,966	0.8016
1977	518,165	549,419	0.9431
1978	505,840	577,953	0.8752
1979	500,747	712,080	0.7032
1980	488,478	775,780	0.6297
1981	494,768	900,325	0.5495
1982	526,273	981,712	0.5361
1983	519,316	1,055,844	0.4918
1984	513,335	969,779	0.5293
1985	511,987	1,003,392	0.5103
1986	546,230	983,919	0.5552
1987	591,192	1,077,893	0.5485
1988	599,995	1,149,098	0.5221
1989	637,138	1,265,398	0.5035
1990	700,564	1,428,673	0.4904
1991	759,815	1,597,473	0.4756
1992	804,866	1,756,049	0.4583
1993	845,431	1,918,635	0.4406
1994	885,446	2,091,899	0.4233



In the case of the commercial carrier fleet, engine horsepower data for earlier years were directly generated from Dalzell et al. (1987). To estimate data for latter years, engine horsepower was projected based on the average annual growth rate for earlier years. On the other hand, data for carrier labor horsepower were measured using the same procedure used for estimating labor horsepower for the catch fleet..

After the engine and labor horsepower data for the catch and carrier fleets were generated, these are adjusted for learning effects. This final adjustment was done by using the learning factors developed by Silvestre et al. (1986) and later applied in Silvestre and Pauly (1987).

The fishing effort data used in the study are also provided in Table 4. Dividing the catch data by the fishing effort data gives the CPUE data which are likewise presented in the same table.

#### **5.4 Price of Fish and Fishing Effort Data**

For this study, the price of commercial fish was estimated by averaging the market wholesale prices for major commercial fish species for 1994, based on BAS data. The price of fish used was P49,742 per metric ton. On the other hand, the cost of effort was based on 1988 data from Trinidad et al. (1993). The price was scaled upwards to 1994 figures to account for inflation. The price of fishing effort used was P16,043 per horsepower.

### **6. Findings**

#### **6.1 Results of Estimation**

The results of the estimation of the biological specification of the GS and Fox models are provided in Table 5. As shown, the GS model had a higher adjusted coefficient of multiple determination. Both models generated the expected signs and significance for the coefficients thus indicating that the commercial fisheries as a whole are overfished.

Using the results for the GS model, the MEY, MSY and OAY levels were computed (Table 6 and Figure 5). The MSY was at 785,706 metric tons valued at P39.084 billion and produced at the fishing effort of 1,833,191 horsepower. When these figures were compared with catch and effort values in Table 4, the MSY level appeared to have occurred back in the early nineties.

The MEY, on the other hand, was at 674,476 metric tons valued at P33.550 billion and produced at the effort level of 1,143,447 horsepower. Comparing with the figures in Table 4, this level appeared to have been attained back in the late eighties and early nineties.

**Table 5: Regression Results for the Gordon-Schaefer and Fox Models in the Philippine Commercial Fisheries, 1948-94**

Specification (a)	Model	a1	a2	Adjusted R2
Catch = a Effort + b Effort <sup>2</sup>	Gordon-Schaefer	.8572* (21.676)	-.0000002338* (-8.654)	0.85
Catch = Effort Exp (c + d Effort)	Fox	.4588* (7.760)	-.000000888* (-12.154)	0.76

Figures in parenthesis are t-values.

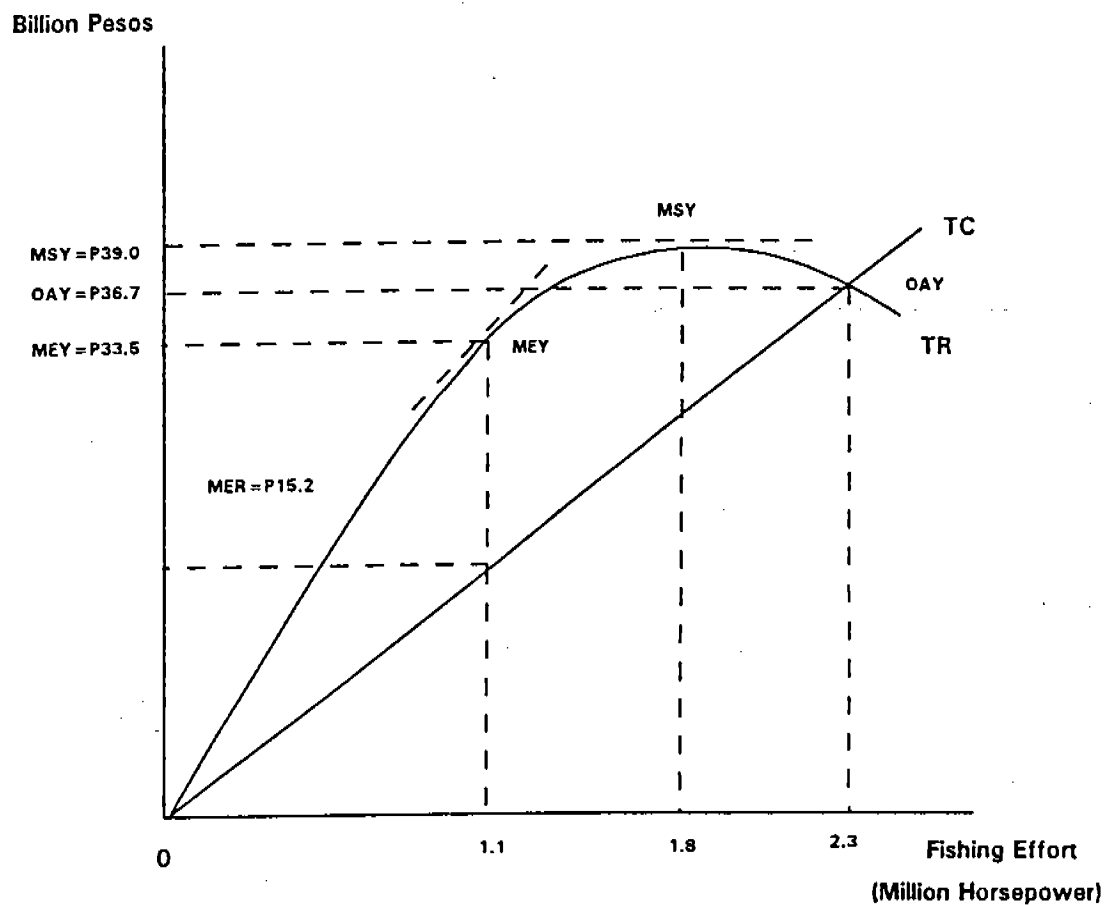
\*means significant at the 1 percent level.

(a) Catch and effort are in quantity terms.

**Table 6: Key Indicators Using the Gordon-Schaefer Model Results in the Philippine Commercial Fisheries, 1994.**

Indicator	Volume of Catch (Metric Tons)	Total Revenues (Pesos)	Amount of Effort (Pesos)	Total Costs (Pesos)	Maximum Economic Rent/ Economic Rent
Maximum Sustainable Point	785,706	39,082,565,981	1,833,191	29,409,879,384	9,672,686,597
Maximum Economic Point	674,476	33,549,785,675	1,143,447	18,344,318,773	15,205,466,902
Open Access Point	735,579	36,688,637,546	2,286,894	36,688,637,546	0

**Figure 5. Results of the Estimation of the Gordon-Schaefer Model for the Commercial Fisheries, 1948-1994**



The OAY was at 737,579 metric tons valued at P36.687 billion and produced at effort level of 2,286,894 horsepower. Comparing with figures in Table 4, This level has yet to happen, implying that with open access, further exploitation in the sector will likely occur.

Expressed in terms of quantity, the MER that can be had from the commercial fisheries per year amount to 305,677 metric tons. This estimate is generally consistent with results of previous studies. Dalzell et al. (1987) measured that MER from small pelagic fisheries was about 366,000 metric tons. On the other hand, Silvestre and Pauly (1986) estimated the MER from the demersal fisheries at approximately 125,000 to 200,000 metric tons or 162,500 metric tons on average per year. When summed up, the computed MER from the small pelagic and demersal fisheries was at 528,500 metric tons.

Little is known about how much of small pelagic and demersal catch came from commercial fisheries. However, the average share of commercial fisheries catch to total marine fisheries catch from 1990 to 1994 was 48 percent (see Table 1). Using this as a rough basis, the commercial fisheries share of the MER coming from the small pelagic and demersal fisheries was about 253,680 metric tons a year.

There is no information about the MER from large pelagic fisheries, much less the portion of this that goes to commercial fisheries. At any rate, it can be assumed that the difference between the figure of 253,580 metric tons from past studies and the figure of 305,677 metric tons computed by this study represents the rent from large pelagic fisheries.

## **6.2 Employment Impact of Reduction of Fishing Effort**

Based on the above results, fishing effort needs to be reduced from the 1994 level of 2,091,899 horsepower (Table 4). In percentage terms, effort in the commercial fisheries sector will have to be reduced by about 45 percent to arrive at MEY. To attain the MSY, on the other hand, it will have to be lowered by approximately 12 percent.

A reduction in fishing effort to attain MSY or MEY is expected to raise the productivity of commercial fisheries. However, it may result to unemployment among the fishermen who will be eased out, at least in the short-run. While it is difficult to exactly estimate employment effects of a reduction in effort, it is attempted here and the results are provided in Table 7.

Based on the 1990 figure of about 1 million total fishermen and fishfarmers, the percentage of commercial fishermen to the total and the annual growth rates of the general population thereafter, the estimated number of commercial fishermen in 1994 is 319,937. As mentioned, to attain MSY, fishing effort must be decreased by 12 percent. If this is applied equally to labor and engine horsepower, then commercial fishermen will be reduced by 38,392. To arrive at MEY, on the other hand, effort must be lowered by 45 percent. Again, if this is applied equally to labor and engine horsepower, then commercial fishermen will be reduced by 143,972.

**Table 7: Estimated Employment Impacts on a Reduction of Fishing Effort to Attain MSY and MEY, 1994.**

Maximum Sustainable Yield			Maximum Economic Yield		
Percent Decrease in Effort	Current Number of Fishermen (a)	Decrease in Employment	Percent Decrease in Effort	Number of Fishermen (a)	Decrease in Employment
12	319,937	38,392	45	319,937	143,972

(a) To derive the figures for the number of fishermen, general population growth rates were taken from the NCSO "Philippine Statistical Yearbook". Then the 1994 fishermen population was computed based on the growth rates and the 1990 ratio of commercial fishermen to the total provided in Figure 1.

From the above estimation, therefore, a large number of commercial fishermen will lose their jobs if efficiency and sustainability is to be achieved in the commercial fisheries. Since the Philippines already has a serious unemployment problem, this fishery management concern cannot be ignored.

## **7. Conclusions, Recommendations and Areas for Future Research**

### **7.1 Conclusions**

To recapitulate, the results of the study indicate that the commercial fisheries as a whole is overfished and that the overexploitation may have started way back in the eighties. Furthermore, substantial gains in terms of economic rent can be had if the sector is operated at sustainable levels. These conclusions are generally consistent to those of past species-based studies.

The results further imply that substantial reduction in fishing effort will be required to reach sustainable levels of operation of the commercial fisheries. To attain MEY, for instance, current effort may have to be decreased by as much as 45 percent. Because of this, unemployment, at least in the short-run, will be a serious negative side-effect of sustainable operation. In particular, approximately 144,000 commercial fishermen will lose their jobs if the MEY level is attained.

From the above results, there is clearly the need to immediately address the problem of overfishing in the commercial fisheries if the sector is to survive as an economic base. On the other hand, the solution to the problem must be sensitive to the potentially large unemployment impacts it may bring.

### **7.2 Recommendations**

Based on findings of the study, some recommendations for the improvement of the management of the commercial fisheries sectors are suggested. First and foremost, since commercial fisheries as a whole is already overfished due to excessive fishing effort, this overexploitation must be immediately addressed by controlling total effort. At present, the Fisheries Sector Program (FSP) is in the process of devising an approach to actually do this. Suffice it to say at this point that the incoming recommendations of the FSP regarding effort reduction in the commercial fisheries must be seriously considered, if not immediately implemented by the authorities.

Without pre-empting the efforts of the FSP, some important points can be raised here in the search for a long-term way of reducing fishing effort. Firstly, any future reduction must be done in such a manner that the expected costs of reduction, such as administrative costs, rent seeking costs, etc., will be less than the expected gains, such as increased public revenues, production efficiency, etc.

Another point that can be raised is that in the search for immediate solutions to overfishing, a practical approach which can be considered is to substantially raise the

license fee rates now imposed in the commercial fisheries. At present, the license fees are very low to effect any real effort reduction (see e.g. Schatz 1991). Using the license system to help reduce effort has a distinct advantage in that the fishery authorities already have long experience in using it.

There is doubt, however, that the licensing system will be effective in reducing fishing effort in the long-term. This is because there is the danger that the burden of higher license rates will just be transferred by commercial fishermen to the final consumers via higher prices for the catch. Thus, it becomes necessary that over the long-term, other measures should be considered by the fishery authorities (see e.g. Panayotou 1995; Pearse 1991). A management system similar to the ITQ in New Zealand and adjusted to accommodate local conditions, for instance, might work here.

It should also be remembered that while the commercial fisheries sector may have a high MER computed in this study, the actual economic rent it has been enjoying may be much less, given that the subsector is operating close to open access equilibrium. So as not to encourage sudden dislocation and closure among the commercial fishermen, any effort reduction scheme must be applied gradually, for instance, if higher licence rates are to be imposed, the established new set rates must be set way below what can capture the whole MER initially. In addition, the increases in licence rates have to be done gradually to allow adjustment among the fishermen. In the first year of implementation, for instance, the rates may not be more than, say, 20 percent of the final targeted maximum rates for the attainment of sustainability. Then, the rates can be increased at the same percentage every two years or so thereafter.

The problem of displaced commercial fishermen once an effective effort reducing scheme is in place should be a matter of serious concern. As many fishermen have limited skills outside of their profession, it will be difficult to employ the displaced in other economic sectors. Hence, a retraining and employment program may be necessary. A potential option is for the national government and private sector to pool their resources together to organize such a program. Moreover, if the need arises, probably an alternative livelihood program similar to those developed for municipal fisheries will have to be put up to accommodate at least the most disadvantaged commercial fishermen.

Over and above what has already been suggested, it must be emphasized that the use of instruments to reduce fishing effort must be accompanied by strong reforms in the enforcement side. In particular, the illegal underground economy in fisheries, e.g. commercial operators using unlicensed duplicate boats, must be curtailed. Furthermore, reducing the poaching by foreign vessels in local waters is a necessity. It also goes without saying that penalizing the offenders strictly according to law is a must to discourage future unlawful activities.

Finally, although the commercial fisheries as a whole may be overfished, there may subsectors within, e.g. specific fishing areas and commercial species, which currently remain underexploited. The development of these subsectors must also be afforded priority in fisheries management. It is the challenge of government, therefore,



to be able to control overexploitation at the national level but at the same time promote further development in certain pockets in the commercial fisheries.

To wrap up, this study argues that at this point in fisheries development, serious fishing effort reduction must be done at the national level if our commercial marine fisheries resources are to last into the long future. However, the objective of effort reduction and sustainable development in fisheries must not be attained at the exorbitant price of imposing iniquitous burden on poor segments of the population who were forced by economic realities to hitch their lives on the fisheries sector.

### **7.3 Areas for Future Research**

Finally, before ending, some caveats regarding the methods and results of the study have to be discussed. Firstly, it is clear that the results, e.g. exploitation levels and economic rents, generated here depend to a large extent on the price data assumed. For instance, a decrease in the assumed price of fish or an increase in the cost of effort may substantially reduce the value of the estimated economic rent, etc. In the study, the used prices of fish and effort were considered the best estimate given data constraints. However, a future study using more accurate price data will be useful. Furthermore, a study that will assume variable, instead of fixed prices, will be welcome.

Secondly, it must be emphasized that some of the annual data on catch and effort were simply estimates. This again raises concern about the reliability of results. Suffice it to say that another study can be conducted, if and when more accurate data can be had from the institutional sources.

Thirdly, the GS and Fox models are partial models in that they only consider effort as the factor influencing catch. Although in this study, learning and hence in a way technology, has been imputed as a factor, other diverse determinants of fish catch were excluded, such as fishery regulations and seasonal bad weather, for instance. The extent by which these and other factors influence catch has not been investigated and should be looked into in future studies.

Finally, there is the need to study overfishing in terms of specific areas and species, especially the most commercially important and endangered ones. This study will help identify areas and species whose exploitation need to be closely controlled or further developed.

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