ECONOMIC EVALUATION OF FISHERIES POLICIES IN THE PHILIPPINES

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Abstract

The Philippines is surrounded with many fishing grounds. In spite of this, most fishermen in the area live in poverty, and their plight is getting worse, not better. Current fisheries policies for the area have failed to improve the situation but no research has been done to find out why. This report attempts to fill this information gap about the reasons for policy failure. Drawing on data from secondary sources and an original survey, it uses a bioeconomic model to simulate the effects of changes in the enforcement levels of three current policies: ban on electric shiners, fish cage regulation, and regulation of both electric shiners and fish cages. Investments of the government on different levels of enforcement were assessed using benefit cost analysis. The report assesses the effects of enforcing current fisheries policies more stringently. It finds that a substantial investment (PHP 614,000 per year) would be required to ensure compliance with regulations and that the benefits of achieving high levels of compliance would exceed costs by only a tiny margin. The situation would be transformed into one in which large and perhaps increasing numbers of people would continue to fish, expending larger amounts of effort to comply with various gear restrictions but, in all likelihood, harvesting no fewer fish.

Because the bay is already overfished, catch per unit effort and marginal productivity would decrease. Any additional fishing effort in the bay will result in a decrease in the average catch of all fishermen. Enforcement of current policies will not address the underlying problems of open access and the overfishing it leads to. One policy to deal with the problems of open access and overfishing is to set a limit on the total number of fish that can be caught and divide this quota among fishermen. Over time, the total allowable catch might be reduced. (The easiest way to make the initial reductions would be to revoke the permits of fishermen who contravene fishing regulations, e.g. regarding permissible catch size or seasons). To allow flexibility, the quotas allocated to individual fishers might be tradeable.

INTRODUCTION

“In those days," as a local saying goes, "fishes could trigger dog barks. Fishermen did not have to go far out into the sea. A non-motorized boat would do. They got more with less capital and labor input. The catch was more than enough for their subsistence needs. They had surplus to sell and earned cash for their other needs. Those were the days of plenty.”

Competition for, access to and use of coastal fisheries in the tropics have noticeably increased in recent decades. Areas that traditionally have been the sole preserve of artisan or small-scale fishermen using such time-tested techniques as hook and line, traps and gill nets come under increased pressure from modern gear types (Smith, 1983). Hardin (1968) has termed the motivation for many of man's actions as the philosophy of the Commons. He illustrates this philosophy by citing an example: "Visualize a pasture open to all, in which a number of herdsmen are free to graze their stock. Each as an independent entrepreneur will attempt to keep as many stocks as possible in this common ground. Few problems arise until the total number of stock reaches the carrying capacity of the pasture. The rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another, and another… but this is the conclusion reached by each and every rational herdsman sharing a commons. Therein lies the tragedy."

Man's exploitation of natural environment usually results in unsatisfactory environmental quality. Hence, one has to recognize the scarcity of environmental resources and legislate some means of allocating these resources among competing users (Dewees, et. al., 1975). Although at the national level, Republic Act No. 8550 or the New Fisheries Code of 1998 calls for the protection of fisherfolks in municipal waters, each municipality is required to come up with its own implementing guidelines through a local/municipal ordinance specific to its needs, as stipulated in the Local Government Code. Several ordinances in Infanta, Real and Polillo have been passed catering to municipal fisherfolks for a number of reasons. Among these are, the increasing population (2.3 percent annually) in the municipalities surrounding Lamon Bay has increased the fishing pressure on the bay. Together with these developments both commercial and municipal fishing gears have proliferated. Symptoms of overexploitation have started to be manifested in the declining catch, smaller fish sizes and decrease of economically viable fish species (Provincial Fisheries Management Unit, Department of Agriculture Region IV).

These ordinances include banning of the use of electric shiners, and regulating the use of fish cages. The resolution on the seasonal closure for gathering milkfish fry is another policy option. There are a number of other ordinances/resolutions that can be classified under prohibition of illegal fishing activities, and protection of fisheries and aquatic resources.

The study determined whether implementation of these policies have indeed improved the fisheries resource quality of the bay using bioeconomic modeling.

METHODOLOGY

Inventory of fishers

An inventory of fishers was conducted since the data from the Local Government Units (LGUs) is incomplete and need updating. A survey of fisherfolks in the project site was also conducted by Infanta Integrated Community Development Assistance, Inc. (ICDAI) and Community Organization of the Philippines Enterprise (COPE) Foundation (both non-government organizations) in 1995 but these do not tally with the inventory taken by LGUs. For each covered coastal barangay (or village), complete enumeration of each type of fishing gear was done using the gear inventory form. This involved listing down the names of all fisherfolks in the barangay and the fishing gear/s they own or co-own, in which case the name of the co-owner was also indicated to prevent double counting. Additional information pertaining to seasonality of use (e.g., months the gear is used, number of trips per year), among others, was also obtained. Estimates of the number of units by gear type for Lamon Bay was obtained by summing up the estimates in each barangay. The seasonality of use (i.e., number of trips per year) by gear type was obtained by averaging all responses.

Fish Landing Survey

The fish landing survey was conducted to provide inputs to the Bioeconomic Model). Fish landing data was monitored daily from November 2000 up to August 2001. The original plan was to collect data from strategic fish landing stations in each municipality, i.e., Infanta, Real, Polillo. However, during the reconnaissance survey, it was discovered that municipal boats do not go to the fish landing ports where commercial fishing boats go. Instead, they dock near their houses so that there are as many fish landing points as there are municipal fishing boats.

Fish landing data on price and volume of fish catch were collected since this is equivalent to the farm gate price (for agricultural products) being the point of first sale. Municipal boats carry one passenger (the operator) at most so that it was virtually impossible for the research assistant to join any of the fishing trips. Otherwise the research assistant would be displacing the fish catch. Thus, both volume and prices were gathered at the fishing landing points. Particular emphasis was given to the following information in monitoring landings by gear type: total catch and catch per unit effort, species composition of the catch, gear design and dimensions, area and time of operations.

The municipal fishing gears that were monitored were based on the following: (1) target beneficiary of a particular fisheries policy in the project site; (2) frequency of use or popularity among fishers; (2) relative contribution to fish production; (3) gear efficiency; (4) potential impact on resource sustainability; (5) use in or near a critical habitat of interest; and (6) accessibility to periodic monitoring. The sample size was obtained using the Sample Size Calculator developed by Creative Research Systems (http://www.surfeysystem.com/sscalc.htm.

The results of the fisheries monitoring conducted by the Office of the Municipal Agriculturists of Real, Infanta and Polillo, and by the Bureau of Fisheries and Aquatic Resources in 1995 were used to validate the changes in fisheries resource quality: species caught, size of fish catch, etc.

Bioeconomic Model

Both biological and economic units are included in models of fishery economics.
The biological unit consists of a growth function relating natural growth (reproduction plus individual growth minus mortality) to the fish population size or fish stock. Such relationship is the logistic biological growth function:
$G = G(X); G(X) >/< 0$ for $X >/< K$, $\partial G/\partial X >/< 0$ (1)
For $X >/<$ maximum sustainable yield, $\partial^2 G/\partial X^2 < 0$ throughout
Where G = natural growth measured in weight of biomass
X = fish stock also measured in weight of biomass
K = natural equilibrium stock or carrying capacity of the environment
The economic unit consists of the relationship between output (catch) and inputs (fishing effort) known as the production function:

$Y = j(E)$; $\partial j/\partial E > 0$, $\partial^2 j/\partial E^2 < 0$ for $X = \bar{x}$ (2)

This equation implies that, for any given X, the larger the effort (E), the greater is the catch (Y). Conversely, for any given E, the larger the fish stock, the greater is the catch:

$Y = r(X)$; $\partial r/\partial X > 0$, $\partial^2 r/\partial X^2 < 0$, for $E = E$ (3)

If we combine equations (2) and (3), the fishery production function is:

$Y = F(E,X)$; $\partial F/\partial E > 0$, $\partial^2 F/\partial X^2 > 0$, $\partial F/\partial E < 0$, $\partial^2 F/\partial X^2 < 0$, (4)

The fish stock (X) in the fishery production function (5) can be assumed to be constant ($X = X$) and eliminated from the equation as an explanatory factor of variations in catch, hence,

$Y = f(E,X)$ (5)

Fishing effort is itself an output of various fishing inputs or it is a composite input that can be broken down into its component elements such as capital and labor. Capital may be represented by number of boats and fishing gear while labor can be represented by population and number of fisherfolks. The fisherfolks or fishing units produce effort and each fisher's catch depends not only on his own effort but also on the effort applied on the given fish stock by fellow fishermen.

Similarly, an increase in fish prices, without any change in costs, would induce entry into the fishery until all profits are dissipated. Changes in fish prices occur as a result of shifts in the supply of or demand for fish. With a given demand, a poor catch would lead to an increase in price and a higher catch to a fall in price. With a given supply, increasing demand (due to population growth or increasing incomes) would lead to increasing fish prices. Catch rises in the short run but falls in the long run if the fishery is biologically overexploited. Daily or seasonal fluctuations or prices may or may not affect the equilibrium level of effort depending on the level of exit and re-entry (including the availability of alternative employment for labor and capital).

Combining the above elements will produce catching power so that

E = j(POP, FMEN, FTECH, PR) (6)

Where E = is the fishing effort which can be in the form of labor and capital inputs

POP = population in the fishing community

FMEN = total number of sustenance fishermen affected by a particular fisheries policy ; specified as : MFGAT (total number of sustenance fishermen affected by milkfish fry gatherers), ESHINER (total number of sustenance fishermen affected by users of electric shiners), FCAGE (total number of sustenance fishermen affected by fish cages)

FTECH = level of fishing technology employed by the fishermen. In order to increase catch, they increase the number of boats. Specified as HNLINE (hook and line), MHOOK (multiple hook), GNET (gill net)

PR = average price of a fish species in pesos/kg

The aforementioned model was run for the different three policy scenarios. Cross section data on E, POP, FMEN, PR and FTECH taken from the daily monitoring survey were in the model.

The hypothesized values of the partials are:

$\partial 2j/\partial POP > 0$ An increase in the population of the Lamon Bay watershed will increase fishing effort since the main livelihood of the people in the coastal areas is fishing. Fishing is an open access livelihood which makes it the primary source of income in the area. Aside from this, fish is the major source of protein of the coastal villages.

$\partial 2j/\partial FMEN > 0$ An increase in the number of fishermen will increase the rate of resource extraction in terms of manpower.

$\partial 2j/\partial FTECH > 0$ A direct pressure on the fishing effort will be caused by an increase in the rate of resource extraction (number of boats).

$\partial 2j/\partial PR > 0$ An increase in the price of fish will increase the rate of resource extraction.

In an overexploited natural resource system, continuous exertion of efforts in the form of an increase in population, number of sustenance fishermen, number of boats in operation and unregulated fishing would likely result in a declining output. Increasing prices, on the other hand, would enable the fisherfolks to double their effort to catch more fish but considering an exploited resource, stock would become extinct. The model was run for each of the three policies.

Assessment of Fisheries Resource Quality

Indicators of improved fisheries resource quality are increased fish catch, increased number of fish species caught, and decreased fishing effort in the regulated area. Decreased fishing effort in the regulated area will give time for the new stock to grow until the next fishing season. The results of the fisheries monitoring conducted by the Office of the Municipal Agriculturists of Real, Infanta and Polillo, and by the Bureau of Fisheries and Aquatic Resources in 1995, and the daily fish monitoring conducted by this project (number of fish caught per unit time) were used. The increments in fish catch, number of fish species caught and fishing effort during the different scenarios (before and during implementation of the policies) were computed and analyzed. Catch per unit effort was computed as the number of fish caught divided per unit time (in this case, one fishing trip).

RESULTS AND DISCUSSION

A Profile of the Lamon Bay Fishery

Fishery Productivity

Lamon Bay is one of the traditional fishing grounds in the Philippines. The fisheries of Lamon Bay is multispecies. The fisheries resource quality assessment recorded a total of 108 species. The most prevalent fish in the bay are Nemyptherus bathybus and Sardinella spp. which are commonly called "bisugo" and "tamban", respectively. They comprise 33 percent of the total municipal fish catch in the bay. Of these, 22 percent or 89 metric tons per hectare are caught annually by hook and line.

A comparison of the length (or recruitment size) and exploitation rate parameters for several species occurring in Lamon Bay for Philippines stocks was conducted. Length (in cm) refers to the asymptotic length of the fish from the snout to the tail during recruitment. Exploitation rate is the ratio of fishing mortality through recruitment to the total mortality which is the sum of the recruitment and natural mortality. Exploitation rate values ranging from 0.3 to 0.5 suggest that the stocks are exploited optimally (Gulland, 1971 and Pauly, 1984). The results showed that the stock for Sardinella spp. is optimally exploited (0.42). The length analysis shows that those caught in Lamon Bay have the shortest recruitment size among the localities surveyed by the University of the Philippines-Marine Science Institute (UP-MSI). This means that there is overexploitation of the species in the area because it is reduced to a point that they may no longer reproduce fast to maintain current populations.

There is cause for concern that fishing in Lamon Bay is over its sustainable limits. The other species, Nemyptherus bathybus, Selar crumenopthalmus, and Caranx sexfaciatus in Lamon Bay all have small length and high exploitation rates compared to those existing in other localities. Some indications are the high exploitation rate values and the overexploitation of selected species through the use of hook and line, and multiple hook which target Nemyptherus bathybus. These are indications of overfishing in the bay.

About nine species in Lamon Bay were analyzed for growth and exploitation rates. Municipal fisheries catch shows over 398 metric tons were extracted from the bay for a period of ten months, from November 2000 to August 2001. This provides an estimated yield of around 478 metric tons per year.

The increasing population in the municipalities surrounding Lamon Bay has increased the fish pressure in the bay. Together with these developments, municipal fishing gears have proliferated.

In Polillo, there are at least 17 coastal barangays which are actively engaged in the municipal fishing industry, while in Infanta and Real, there are five and ten, respectively. Of these clusters of communities, there are at least 948 fishing vessels known to operate in Lamon Bay. Notably 63 percent (or 596) of the total fishing vessels are hook and line, 15 percent (or 145) are multiple hooks, 14 percent (or 135) are gill net, while the rest (eight percent or 72) are a combination of the aforementioned. Most of the fishing gears are from Real (414), followed by Polillo (350) then Infanta (175). Most of the municipal fishermen use only the simplest traditional way of fishing such as hook and line, multiple hooks, and gill nets.

Productivity of Capture Fishery

It is important to analyze the bay fishery in the context of its productivity. Several parameters were used to measure the productivity of the bay by fishing gear and by species caught: volume of fish catch, relative abundance and catch per unit effort (CPUE). Relative abundance is a rough estimate of the population density of a given species. It is calculated from the number of individuals of a certain species caught over a certain period of time in a particular place, divided by the total of all species in a community. Here, relative abundance is expressed in percentage by fishing gear used. CPUE is the volume of fish caught per unit time in a fishing trip, expressed as kg per hour.

Municipal Fishery

Three types of municipal fishing gears were recorded in the bay. The municipal fishing gears used in the bay are: hook and line (or "kawil"), multiple hooks (or "kitang"), and gill net (or "lambat").
About 596 hook and line were recorded in the study. Hook and line is the most widely used fishing gear in the locality. One person on board a non-motorized boat casts a single hook and line with a bait to capture fish. These usually ply in shallow waters compared to the other gears (See Figure 1). The average catch per unit effort is 2.27 kilograms per hour. The dominant species caught by the hook and line are Sardinella spp. (22 percent relative abundance or 58 metric tons during the 10-month period of monitoring), and Selar crumenopthalmus (14 percent relative abundance or 38 metric tons).

There are about 145 multiple hooks in the bay. Fisherfolks use either motorized or non-motorized boat. Nemyptherus bathybus and Auxis thazard comprise nearly half of the total catch (54 percent or 50 metric tons) with an average catch per unit effort of 0.96 kilograms per hour.

The gill net is used by about 135 fisherfolks in the bay. It captures fish through entanglement of the operculum and gills against the net. Drift net and bottom set net are the two most commonly used in the area. Two persons on board a motorized or non-motorized boat deploy the net and retrieve them 3 to 4 hours later. The average catch per unit effort is 9,52 kilograms per hour. The dominant species caught by the gill net are Sardinella spp (18 percent relative abundance or 11 metric tons) and Stolephorus spp. (13 percent or 8 metric tons).

Milkfish fry gathering is practiced along the coastline of Infanta during the spawning months of March to October. The gatherers walk in pairs, one person holding either side of the net. They traverse the stretch of the coastline. The net catches milkfish fry and other juvenile fishes. At the end of the walk, the pair scoop the milkfry fry with their bare hands and place them in containers, while culling the unwanted juvenile fish. If the size of the fish is too small for home consumption or for sale, these are either returned to the sea or thrown in the sand. The mortality rate of the culled fish is very high. Resolution No. 1 (1998) of the Municipality of Infanta bans gathering of milkfish fry for two years. During the monitoring months of March to August 2001, about 14.7 million pieces of fry were gathered. However, the culled fish as well as other juvenile fishes caught were unaccounted for. These could have commanded a higher price if they were left to grow to maturity.

About three fish cages were found in the cove between the boundary of Infanta and Real. A total of 1.2 metric tons are harvested. Municipal Ordinance No. 1 (1997) orders demolition of illegal fish cages.

Compared to BFAR historical data, the average productivity per boat per fishing trip has been declining. In 1965, it was 1.86 kg for the hook and line, and 52 kg for the gill net. Ten years later, the figures dropped by half, 0.687 kg for hook and line, and 19 kg for gill nets, respectively. This study recorded Since 1995, only 23 fisherfolks using electric shiners were caught, that is in Polillo. Shiners are used at night in any of the municipal fishing gears to attract fish. The total annual fish catch of these violators is about 9.7 metric tons of fish of varied species. Municipal Ordinance No. 5 (1995) and No. 9 (1996) of Polillo and Infanta, respectively ban the use of electric shiners.

Hook and Line

The hook and line is the simplest fishing gear used in Lamon Bay. A non-motorized boat is used by the fisherman to ply the waters. He casts out his line in the fishing ground where he thinks fish abound. This requires a lot of patience because the bait may be taken by the fish without being caught, and different kinds of bait are required for different species.

More than half of the catch from hook and line in Lamon Bay consist of sardines, big eye scad, yellow belly threadfin bream, trevally and barracuda. The rest are mackerel and varied species.

Multiple hook

The declining productivity of the bay caused by man's exploitation has prompted the fisherfolks to make use of more innovative fishing implements. One of these is the multiple hook, which is a variation of the single hook and line. Multiple hooks range from 100 to 1,000 hooks attached to a long line. The fisherman's wife cleans each hook when he arrives from the sea, afterwhich she painstakingly attaches a bait to each hook. This is a very tedious process for it keeps the wife occupied most of the day The common species that are caught by hook and line, and multiple hook are the yellowthread fin bream, thumbprint emperor, grouper, flame colored snapper, goatfish and the big trevally. Note that the peak months of harvest using both gears are the same for the following: thumbprint emperor (March), flame colored snapper (January) and goat fish (November). For yellowthread fin bream, the lean month occurs in May for both fishing gears. The hook and line was not able to catch any goatfish nor thumbprint in February.

Gill net

The average catch per effort in gill nets is 9.52 kg per hour. The average catch from gill nets by fish species. Sardines accounts for 18 percent of the total fish catch from gill nets.

Milkfish Fry Gathering

During the months of March to October, milkfish fry gathering occurs in the coastline of Infanta. Monitoring months of the project was only up to August, as approved in the timetable of activities.

ESTIMATED YIELD EQUATIONS

The preceding discussions showed that fishery production in Lamon Bay is constantly declining. The blame has been put on many factors yet the actual effects of each of these factors had not yet been determined empirically. This section will help settle the issue on the real determinants of the declining productivity of Lamon Bay. Separate analysis were done on the different fish species commonly caught by municipal gears like hook and line, multiple hook, and gill net using the present or existing scenario, and also with regulation (banning of illegal fish cages, seasonal regulation of milkfish fry gatherers, banning of electric shiner devices) in order to identify the parameters that would likely affect their exploitation.

The logarithmic transform of all variables given by a Cobb-Douglas functional form and stochastic specification were used in order to estimate the yield equations. The Ordinary Least Squares (OLS) regression technique was used in the estimation which explained the change in yield in relation to changes in some of the identified parameters.

Multicollinearity among the independent variables was observed in the initial attempt of estimation. Several equations were run and the estimated results were evaluated with respect to the statistical significance of individual regression coefficients, the hypothesized a priori signs and the R2 values (coefficient of determination) which measure the proportion of variability explained by the regression on the independent variable.

Models were run for the present or existing scenario, banning of electric shiners, regulation of fish cages, seasonal regulation of milkfish fry gatherers, and combined regulation of fish cages and banning of electric shiners). The explanatory variables found to have significant effects on fish yield were number of boats in operation and price of fish.

The equations estimated included the following explanatory variables, namely: POP (population of the Lamon Bay communities), MFGAT (number of fisherfolks affected by milkfish fry gathering) , ESHINER (number of fisherfolks affected by electric shiners), FCAGE (number of fisherfolks affected by fish cages) , HNLINE (number of hook and lines), MHOOK (number of multiple hooks), GNET (number of gill nets), PMACK (price of mackerel), PBARRA (price of barracuda), PYELLOW (price yellowbelly thread fin bream), PTHUMB (price of thumbprint emperor), PGROUPER (price of grouper), PFCSNAPPER (Price of flame colored snapper), PGOAT (price of goatfish), PSARDINE (price of sardine) AND PBTREV (price of bigeye trevally).

Fishing Effort

The variables MFGAT, ESHINER, FCAGE, HNLINE, MHOOK and GNET (which are proxy variables for the fishing effort of milkfish fry gatherers, electric shiners, fish cages, hook and line, multiple hooks and gill nets, respectively) are negatively related to yields of mackerel, barracuda, yellowbelly thread fin bream, thumbprint emperor, grouper, flame colored snapper, goatfish, sardines, and bigeye trevally from milkfish fry gathering, electric shiners and fish cages reflecting the fact that Lamon Bay is overexploited. Referring back to the standard economic model of fishery, the coefficient shows that Lamon Bay has already reached the maximum sustainable yield. A 100 percent increase in the level of fishing effort did not increase yield in all fishing gears but instead resulted in a decline in fish catch. Tin hook and line, the decline in catch is 45 percent for mackerel, 40 percent for barracuda, 22 percent for yellowbelly thread fin bream, 21 percent for thumbprint emperor, 33 percent for grouper, 14 percent for flame colored snapper, 22 percent for goat fish, 24 percent for sardines and 25 percent for trevally.
In the existing or present scenario, the results showed that a 100 percent increase in the level of fishing effort did not increase yield in all fishing gears but instead resulted in a decline in fish catch.

Mackerel catch from gill net would decline by 11 percent, barracuda by 20 percent, goat fish by 14 percent, sardines by .2 percent, and trevally by 22 percent , if a 100 percent increase in the level of fishing effort is made. The results are all significant. These estimated values can supply the necessary information in the calculation of the marginal productivity of the fishing gear. The marginal product (MP) of the input GNET on mackerel is (-.14) or (QMACK/GNET) in the case of fish is negative which means that one additional unit of boat with gear as gill net will decrease the fish catch by this amount. These coefficients proved to be all significant. This assertion can also be evidenced by a decreasing average catch per boat. The same holds true for all other fishing gears and fish species.

In classical economic theory, price is a single valued function of output. An increase in the price of the commodity will motivate the producers to produce more of that particular good. The response equations are in accord with this standard theory as evidenced by the positive coefficients of the variables PMACK, PBARRA, PYELLOW, PTHUMB, PGROUPER, PFCSNAPPER, PGOAT, PSARDINE and PBTREV, which are all significant. This implies that an increase in the prices of the different fish species caught incites the fisherfolk to increase their catch. For hook and line fisherfolks, a 100 percent increase in the level of fishing effort resulted to a decline in fish catch.

General Assessment of Yield Equations

All equations gave the characteristics of a good fit as evidenced by the consistency signs of coefficients, statistical significance of coefficients, high values and high coefficient of determination, R2, except for banning of fish cages.

The results of the log-linear model for fish catch of municipal fishing gears using the present or existing scenario where regulations had been on hand shows that very minimal violators were apprehended, like 23 electric shiners in the whole Lamon Bay. The yield equation for mackerels for instance has an R2 of .953 which implies that 95 percent of the variation in mackerel yield is explained by all explanatory variables included in the model. The high F-value (25.84) connotes that the random impact of unspecified variables is less, therefore, the derivation of the curve from straight line is likewise less. In the case of other fish caught in Lamon Bay, more or less the same independent variables appear to affect the decline in the productivity. The presence of the three fish cages are not significant, meaning that there are so few that they do not affect yield of other fish species like mackerel, barracuda, yellowbelly thread fin bream, thumbprint emperor, grouper, flame colored snapper, goat fish, sardines and bigeye trevally. Milkfish is cultured in these fish cages. The sardines equation gave the best fit of data with a high R2 (.972) and F value (41.98).

The results of the second model is a regulation scenario for banning of electric shiners. The R2 are all significant and high. As in the first model, the presence of fish cages remain to be insignificant. The best fit is seen in yield of yellowbelly thread fin bream with F-value of 38.74.

For regulation of fish cages, the log-linear results are all insignificant, with very low R2 ranging from .159 to .477. This implies that there are more unexplained variables that have been unspecified in the equation. The fish cages in the project site have no impact on fish yield in the bay. Besides, they are located in inland waters and involve culture of milkfish as compared to the other municipal gears which engage in capture fishery.

Seasonal regulation of milkfish fry gatherers was also computed. The R2 values are high and significant, ranging from .729 to .987. Only the presence of fish cages remain insignificant.

Combination of regulation of fish cages and banning of electric shiners show very high coefficient of determination, R2 ranging from .829 to .952. The effect of fish cages is also insignificant.
All significant values are at one percent level of probability.

CONCLUSIONS AND POLICY IMPLICATIONS

The cost of licenses (Coast Guard and mayor's permit) ranges from Php 56 to 1,270 per year which at this point in time cannot be further increased because of the low income of the municipal fishermen. The number of legally registered municipal fishing boats should be closely monitored so that pressure on the bay would not be further increased.
With the present multiple uses of the bay, e.g. for fishing and for tourism/recreation, the poverty stricken fishing communities are the great losers. As the economic pressure in the watershed increases, the voice of dissatisfaction from the much affected fishermen also increases. The multiplicity of human and development activities creates scarcities

requiring the need to determine the optimum use of the bay's resource to ensure sustainability.

If the bay resource will be tapped for fishery, there is a need, therefore, for a unified policy on fishery management. In the past, the overall perspective of fishery development and management initiated in Lamon Bay bogged down due to the proliferation of institutions with their own mandates and programs on fishery. In this context, there must be proper coordination of activities among concerned agencies such as BFAR, LGUs, and NGOs under FARMC.

As mentioned earlier, once the maximum sustainable yield of fishery is attained, everyone will resort to more efficient methods of fishing. This will not only hurt the less efficient fishermen but also the natural biota of the bay. To remedy this problem, Bantay Dagat and Coast Guard should closely monitor the fishing operations of the fishermen to avoid the use of illegal fishing methods. The violators of regulations set forth must be subject to some disciplinary measures.

To lessen the fishing pressure exerted on the bay and to uplift the socioeconomic status of the coastal families, livelihood projects must be developed which can be a good source of additional income of subsistence families.

A unified fishery management approach is recommended for the three municipalities. A comprehensive management plan, therefore for Lamon Bay and its watershed, must be formulated by the LGUs in cooperation with NGOs and POs. The plan will protect the bay's resources and environment and ensure the optimum development of the bay for its intended uses. Added to this the policy programs of the three municipalities must be more oriented towards environmental protection (e.g. watershed conservation through reforestation of denuded areas, adoption of soil conserving cropping techniques and installation of sewerage systems) rather than resource development to ensure that the development activities in the watershed will not create adverse effects on the bay resource.

As suggestions for further research, the optimum number and size of boats (municipal boats as well as fish cages, milkfish fry gatherers) that should be allowed in the bay must be examined based on the present fish catch of the bay. This will rationalize the fishing industry. To strengthen researches on Lamon Bay, an efficient data collection system must be established to fully understand the biological and economic status of the bay.

REFERENCES

Department of Agriculture. 1990. Fisheries Administrative Order No. 172(Series of 1990). Establishing a five-year closed season on the operation of commercial fishing boats and the employment of hulbot-hulbot by both commercial and municipal fishing boats in Polillo Strait and a portion of Lamon Bay, Quezon province.

Binangonan del Ampon: Ecological Profile Infanta, Quezon. Technical Working Group, Infanta Integrated Community Development Assistance, Inc., Philippine Partnership for Development of Human Resources in Rural Areas and Development Catalyst, Inc. July 1999.

Bureau of Fisheries and Aquatic Resources. 1998. 1998 Philippine Fisheries Profile.
Coastal Resource Assessment of the Municipalities of Real, Infanta and Gen. Nakar, Province of Quezon. Hayuma Foundation, Inc. (Los Banos, Laguna: March 1999).
Land Use Plan of Infanta, Quezon. Technical Working Group and Development Catalyst, Inc. 1999

Municipality of Real, Quezon. 1995. Ordinance No. 005,S-1995. Illegal fishing ordinance.

Municipality of Real, Quezon. 1995. Resolution No. 96-212. A resolution approving that 40 percent cash incentive derived from penalty from any illegal activities be awarded to any NGOs, POs, and PS who shall apprehend anybody engaged in illegal undertakings.

Municipality of Infanta, Quezon. 1997. Ordinance No. 97-001. Demolition of fish cages ordinance, saplad and baklad in the waters of Infanta, Quezon.

Municipality of Infanta, Quezon. 1999. Ordinance No. 99-119. An ordinance regulating fish mesh size to a maximum of 3 cm.

Municipality of Real, Quezon. 1995. Ordinance No. 96-006. Establishment of a fish sanctuary in Real, Quezon.