ECONOMIC EVALUATION OF FISHERIES POLICIES IN LAMON BAY, PHILIPPINES

MARIA REBECCA CAMPOS, BLANQUITA PANTOJA, NERLITA MANALILI and MARIDETH BRAVO, Southeast Asia Ministers of Education Organization-Regional Center for Graduate Study and Research in Agriculture (SEAMEO-SEARCA), lamonbay@agri.searca.org, cmaribec@yahoo.com

ABSTRACT

Lamon Bay is one of the most important fishing grounds in the Philippines. In spite of this, most fishermen in the area live in poverty, and their plight is getting worse, not better. Fish catch is declining by 13.5 % a year, more than double the decline experienced elsewhere in the country. Current fisheries policies for the area have failed to improve the situation but no research has been done to find out why. Are the policies poorly designed? Or have they not been adequately enforced? 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 Lamon Bay's 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. This system of individual tradeable quotas or permits has been very successful in New Zealand. The typical Lamon Bay fisherman lies below the poverty level, has almost no secondary source of income and finds his household members willing but unable to obtain work. Efforts to reduce overfishing in the bay should therefore be complemented with measures to promote alternative sustainable livelihoods.

INTRODUCTION

Declining fish stocks is a major environmental problem all around the world – one that is jeopardizing the livelihoods of many coastal communities. For policy-makers dealing with this problem, the most pressing challenge is to design regulations that balance the needs of conservation with those of the fishing communities. This study about an important fishing area in the Philippines has found that current regulations to deal with overfishing are neither cost-effective nor address the underlying problems of overexploitation of fish stocks and open access to fishing areas. The report suggests that a tradable quota system may provide an answer to the problem and suggest policies that would back up such an approach.

RESEARCH OBJECTIVES

The general objective of this research was to use economic evaluation in assessing fisheries policies that can be implemented in Lamon Bay.

The specific objectives of this research were to :

- Evaluate some of the existing local fisheries policies;
- Assess the changes in benefits and costs of municipal fishermen using different fisheries policies;
- Evaluate the changes in fisheries resource quality of the area using different fisheries policies;
- Determine the major factors that influence trends in fishery catch under different fisheries policies, using a bioeconomic model;
- Recommend further enhancements, where necessary, to the fisheries policies considered.

METHODOLOGY

Hypotheses

The following are the hypotheses of the study:

- The implementation of fisheries policies have improved the fisheries resource quality of the area.
- Fisheries policies have increased productivity and income of fishermen.
- The total number of sustenance fishermen affected by a particular fishery policy, the type of fishing gear employed by the fishermen and the average price by fish species are the factors which determine the fishing effort in Lamon Bay.

Two existing fisheries policies scenarios: (1) banning the use of electric shiners; and (2) regulating the use of fish cages were covered in this study under Republic Act 8550. Moreover, the resolution on the seasonal closure for gathering milkfish fry was included in the study.

Research Methodology

Policy Aspect

After identifying and gathering all relevant and existing national and municipal policies, local executives and stakeholders were interviewed to assess the effectiveness and efficiency of these policies.

Effectiveness was measured by comparing the objectives and targets of the policies with the outputs. In this case, meeting the objectives of providing municipal and small scale fishermen a wider area to operate fishing boats of three gross tons or less, and to increase their catch per unit effort. The results of the fisheries resource quality aspect was also used in this component. An increase in catch per unit effort is an indication of improved fisheries resource quality. Aside from this, improved fisheries resource quality occurs hand in hand with an increase in the size of fish catch and in the number of fish species harvested. Acceptability of the policy from the point of view of stakeholders (municipal fishermen, traders, policy implementors) was also analyzed.

Efficiency was analyzed by comparing the costs of implementation (including transfer costs) on the part of the LGUs, the Coast Guard, BFAR and other entities with the benefits of the policy to different stakeholders. This was taken from the benefit cost analysis (BCA) of the Economic Aspect of the study.

Regulatory provisions were evaluated for functionality and pragmatism. Review of other related policies was done in order to determine the gaps and constraints, as well as conflicting provisions.

The output of the Economic Aspect on the socio-economic profile of households of municipal fishermen was utilized as inputs to possible alternative livelihood projects for municipal fishermen (e.g., milkfish fry gatherers) in the area. Key informant interviews were conducted in the Institutional Assessment of this study to evaluate the acceptability of various fisheries policies.

Fisheries Resource Quality

Inventory of fishermen

An inventory of fishermen was conducted since the data from the LGUs is incomplete and needed updating. A survey of fishermen was also conducted by the Infanta Integrated Community Development Assistance, Inc. (ICDAI) and Cope Foundation, both NGOs in 1995 but this does not tally with the inventory taken by LGUs. For each coastal barangay (or village) covered, complete enumeration of each type of fishing gear was done. This involved listing down the names of all fishermen in the barangay and the fishing gear/s they own or co-own. Additional information pertaining to seasonality of use (e.g., months the gear is used, number of trips per year) was also gathered. 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

Daily fish landing survey for 10 months from November 2000 up to August 2001 was conducted to provide inputs to the Bioeconomic Model (discussion is in the following section). The original plan was to collect data from strategic fish landing stations in each municipality: Infanta, Real, and 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, which is equivalent to the farmgate 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 researcher to join the fishing trips. Information on monitoring landings by gear type, species composition of the catch, gear design and dimensions, area and time of operations were instead gathered at the fish landing points.

Criteria for the selection of the municipal fishing gears were based on the following: (1) target beneficiary of a particular fisheries policy; (2) frequency of use or popularity among fishermen; (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).

Bioeconomic Model

A bioeconomic model was used to compute fish catch by fishing gear and by fish species. The resulting catch (or yield) was used as inputs to the BCA of the Economic Aspect of this study. The model incorporates both biological and economic units, which 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:

$$G = G(X);\ G(X) >/< 0 \text{ for } X >/< K,\ ?G/?X >/< 0 \qquad \text{(Eq. 1)}$$

For X >/< maximum sustainable yield, $?^2G/?X^2 < 0$ 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:

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

$Y = r(X); ?r/?X > 0, ?^2 r/?X^2 < 0$, for $E = \bar{E}$ (Eq. 3)

If we combine Eq. 2 and Eq. 3, the fishery production function is:

$Y = F(E,X); ?F/?E > 0, ?^2F/?X^2 > 0, ?F/?E < 0, ?^2F/?X^2 < 0$, (Eq. 4)

The fish stock (X) in the fishery production function (Eq. 5) is assumed to be constant ($X = \bar{X}$) and eliminated from the equation as an explanatory factor of variations in catch, hence,

$Y = f(E,X)$ (Eq. 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 is represented by number of boats and fishing gear while labor is represented by population and number of fishermen. The fishermen 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 or demand for fish. With a given demand, poor catch would lead to an increase in price and 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) (Eq. 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 such as regulation of milkfish fry gatherers, ban of electric shiners, and ban on fish cages

FTECH = level of fishing technology which includes hook and line, multiple hook, and 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:

$?^j j/?POP > 0$ 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.

$?^{j}j/?$ FMEN >0 — An increase in the number of fishermen will increase the rate of resource extraction in terms of manpower.

$?^{j}j/?$FTECH > 0 — A direct pressure on the fishing effort will be caused by an increase in the rate of resource extraction (number of boats).

$?^{j}j/?$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 through increase in population, sustenance fishermen, and boats in operation, and unregulated fishing would likely result in a declining output. Increasing prices, on the other hand, would enable the fishermen to double their effort to catch more fish but with 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 OMAs of Real, Infanta and Polillo, and by BFAR in 1995, and the daily fish monitoring conducted by this project were used. 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 by the time it takes to make one fishing trip.

Economic Aspect

Data Collection

A survey of 450 sample municipal fishermen in Infanta, Real and Polillo was conducted. From the list of fishermen in each municipality, 150 samples were chosen randomly. Using a structured questionnaire, information on the cost of operation and income of the fishermen for the year 2000 was generated, as well as their socio-demographic profile, perceptions and production or level of fish catch, and daily fish prices by species from September 2000 to June 2001. The survey period captured the lean months (October-January), peak months (March-August) and spawning period (April-June) in Lamon Bay. Results of the survey were used in the BCA of the implementation of selected fisheries policies in Lamon Bay, particularly in the computation of economic efficiency indicators. Due to errors in the list of fishermen in the three municipalities, a validation of respondents with village officials and/or PO leaders was made prior to the conduct of the survey in the sample *barangays*. This procedure was done to ensure that the respondents are residents of their respective village. With the validation, some respondents had to be replaced right away since some of them have migrated to another area; a few have died; while others are unknown or are not residents of the particular village.

To complement the survey data, information from secondary sources was also taken. These include the list of municipal fishermen which was taken from the respective OMA of the three towns covered. Additional information were gathered in two *barangays* (i.e., Sibulan, Polillo and Ungos, Real) and ICDAI. These information were used primarily for the sampling of respondents.

Method of Analysis

BCA of the different fisheries policies in the following scenarios: a) no regulation, and b) with regulation (low and high levels of implementation and monitoring) from the point of view of the municipal fishermen was done. Levels of implementation and monitoring are dependent on the budget allotted by LGUs. The results of the survey of fishermen, and key informant interviews; as well as the yield results of the bioeconomic model of the Fisheries Resource Quality Aspect of this study were used in the computation of economic efficiency indicators. Economic efficiency indicators are used in comparing alternative investments, in this case, with and without seasonal policies. These indicators include the IRR, NPV, and BCR. Comparison of measures of economic efficiency was done after computing the above.

RESULTS AND DISCUSSION

An unsustainable catch

The study looked at Lamon Bay, 160 km south of Manila. Although Lamon Bay is one of the top ten fishing grounds in the Philippines, its fish catch has been declining by 13.5 % annually – more than twice the national average of 5.4 %. This fact, linked with the high exploitation rates and small length of fish caught in the bay, has raised concern that fishing in Lamon Bay has exceeded its sustainable limits.

In the light of this, several fishery management and conservation policies have been implemented in the Bay. However, no study had been conducted to determine the efficiency and effectiveness of these policies. To fill in this information gap- and to investigate what else might need to be done – the researchers, looked in detail at three municipalities – Infanta, Real and Polillo.

The situation in Lamon Bay is part of a country-wide trend. Throughout the Philippines, fish stocks are threatened by overfishing and habitat destruction and fish catch has declined since the early 1990s.

Fishing for information

Figure 1. Location of Lamon Bay, Philippines.

The research team first investigated the scope of fishing in Lamon Bay (**Figure 1**) and found that three methods were used: hook and line, multiple hooks, and gill net. Using a structured questionnaire, the researchers also gathered information on the economics of fishing operations in 2000 and 2001. They then investigated current fisheries policies, which include a ban on electric shiners over a certain wattage and the regulation of fish cages. These policies are in place because electric shiners, used to attract fish at night, attract fry that have not yet grown to harvestable size, while fish cages can destroy the breeding grounds of milkfish.

The team also found out that a two-year moratorium on the harvesting of milkfish fry is being called for in some areas. This is because milkfish fry gatherers also catch the fry of other fish species and throw them away to die. Other policies included the establishment of sanctuaries and the implementation of permits and licenses.

Effective policies?

Local leaders and stakeholders were interviewed to assess the effectiveness and efficiency of these policies. The researchers found that although awareness varied greatly, most people felt that the existing policies were slightly effective. Exceptions were those relating to sanctuaries, permits and licenses which were perceived as being ineffective. This last finding was backed up by the fact that 84 % of respondents were themselves operating without fishing licenses. However, after assessing the productivity data, the researchers concluded that the perception that some conservation policies were effective was not borne out by fact. Instead they found general declining resource quality in the bay and so, policy failure.

In light of these results, the team set out to find why policies were failing. They found that many policies were not supported by the fishing communities of Lamon Bay because people could not appreciate their relevance to the problems of everyday life. The researchers also analyzed the local institutions involved in fisheries policies. They found that they were constrained by lack of funds, political will and technical know-how. This in turn led to poor policing and enforcement. The significance of poor policy implementation was backed up by further analysis, which showed that the laws banning electric shiners and regulating milkfish gatherers would have some effect if the regulations were fully enforced.

The impact of the policies were determined using the bioeconomic model, the resulting yield of which was run into a benefit cost analysis.

Fishing Effort

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 to a decline in fish catch. In the 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 of the input gill nets on mackerel is (-.14) is negative which means that one additional unit of boat using gill net will decrease 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.

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, R^2, except for banning of fish cages.

The log-linear model for fish catch of municipal fishing gears represented the present or existing scenario where regulations had been on hand but with very minimal violators apprehended, like 23 electric shiners in the whole Lamon Bay. The yield equation for mackerels for instance has a R^2 of .95 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 decline in productivity. The presence of the three fish cages are not significant, meaning that they 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 R^2 (.97) and F value (41.98).

The results of the second model was a regulation scenario for banning of electric shiners. The R^2 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 the 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 R^2 ranging from 0.16 to 0.48. 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 involves culture of milkfish as compared to the other municipal gears which engage in capture fishery.

The results for seasonal regulation of milkfish fry gatherers showed that the R^2 values are high and significant, ranging from 0.73 to 0.99. 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, R^2 ranging from 0.83 to 0.95. The effect of fish cages is also insignificant. All significant values are at one percent level of probability.

Costing fish conservation

The team then looked at whether regulation made economic sense. Two scenarios were investigated: “business as usual” situation in which the current annual expenditure (PHP 30,000; USD 560) for the implementation and monitoring of the policies was maintained; and a second scenario in which enough money was spent to fully implement fishery conservation policies. It was found that a substantial investment (PHP 614,000 per year; USD 11,500) would be required to ensure compliance. However, the benefits of achieving high levels of compliance would exceed costs by only a tiny margin.

The analysis also showed that full policy implementation would not necessarily conserve fish stocks. Instead, it could create a situation in which increasing numbers of people would be forced to spend larger amounts of effort and money to comply with various fishing restrictions. However, they would, in all likelihood, harvest no fewer fish.

According to the research, the underlying problems in Lamon Bay (**Figure 2**) are open access and overfishing. Indeed, their analysis showed that a 100 % increase in the level of fishing effort would not increase yield but instead produce a decline in fish catch. This shows that the fish stock is already overexploited, a situation exacerbated by the fact that fishermen from outside the region can come in and fish the bay with little or no hindrance.

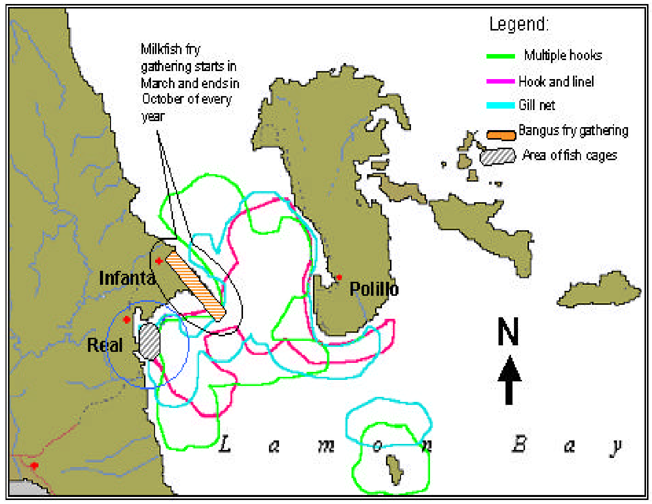

Figure 2. Area of operation of municipal fishing gears, Lamon Bay

Benefit Cost Analysis

Yield results of the bioeconomic model in the Fisheries Resource Quality Assessment were used as inputs to the BCA. Two scenarios were considered: without any regulation and with regulation. Regulation called for the following policy options: ban on shiners, regulation of fish cages, and ban on both shiners and fish cages. Furthermore, in imposing these policy options, two levels of investment were looked into: (1) low level of enforcement which is the current practice, and (2) high level of enforcement where additional investments have to be made. The former refers to the current procedure where the LGUs allot a certain amount (PhP 30,000) for implementation and monitoring in order to apprehend violators, as attested by the OMA during the key informant interview. On the other hand, the second case pertains to the condition wherein the LGU will be providing PhP 614,500 in order to implement the policies fully. This is the proposed budget of the OMA for full implementation which is allocated as follows: per diem (PhP 365,000), labor (PhP 54,000), fuel/oil (PhP 109,500), supplies (PhP 12,000), litigation (PhP 24,000), and training (PhP 50,000). It was brought up during the survey as well as in KIIs that because of the limited funds being utilized in policy implementation and monitoring, the laws hardly have any impact at all. Hence, the option of full implementation and monitoring (accompanied by the needed resources and additional funds) was also considered in the analysis (**Table 1**). The BCA was done for five years from 2002 to 2006.

Benefits

Benefits consist of sales from fish catch, which was derived by multiplying price and volume of fish catch. Prices were based on the average price per fish species taken during the survey. Volume of fish catch for the different scenarios were taken from the yield results of the bioeconomic model, which has the following explanatory variables: human population of the Lamon Bay watershed, number of fishermen affected by a particular fisheries policy, number of fishing gears (specified as either milkfish fry gatherer, hook and line, multiple hook, gill net, electric shiner or fish cage), and average price of fish. Yield results varied by scenario since fish regulation would affect the number of fishermen and fishing boats plying Lamon Bay. Fish commonly caught in Lamon Bay are: mackerel, barracuda, yellowbelly thread fin bream, thumbprint emperor, grouper, flame colored snapper, goat fish, sardines and trevally.

Without any regulation
Without regulation, it was assumed that the apprehended boats and fishermen would still be catching fish in Lamon Bay. Municipal records show that the average number of apprehensions annually was 39. The yield results of the bioeconomic model for the no regulation scenario is 413 mt in 2002.

Table 1. Projected fish catch from Lamon Bay, with and without regulation, 2002-2006.

POLICY	YEAR				
	2002	**2003**	**2004**	**2005**	**2006**
No regulation	413	358	309	267	231
With Regulation					
Shiner ban					
L	423	376	335	299	268
H	423	432	440	449	458
Fish Cage ban					
L	415	360	313	272	236
H	415				
Both shiner/fish cage ban					
L	424	378	338	303	273
H	424	435	446	457	468

With regulation
In the scenario where regulation is imposed, yield estimates for low level of enforcement were based on the present situation where 39 violators were apprehended. Under this scenario, three policy options were tested: with ban on electric shiners, fish cage regulation, and regulation of both electric shiners and fish cages.

For high level of enforcement, it is assumed that all people fishing today would continue to fish as long as they purchase individual transferable permits (ITPs) from the LGUs. This includes both licensed and unlicensed fishermen. At present 84 % of fishermen are operating without permits and licenses, as derived from the household survey.

The proposed ITPs will be issued by the LGUs to resident-fishermen of the three coastal municipalities. One ITP is allotted for each fisherman. It is further assumed that the existing total number of fishermen shall remain because their number is limited by the ITP. No new fisherman can enter the industry unless one with an ITP agrees to sell it to him. It is no longer viable to accept another fisherman, as revealed by the results of the bioeconomic model where the marginal productivity of all fishing gears for all fish is declining. This means that an additional unit of boat results to a decrease in average catch per boat.

Costs
Costs include the expenses involved in the implementation of the policy and monitoring the bay, plus the expenditures of all fishermen: operating cost of fishing; fuel; oil; ice; bait; rental of banca/boat, fishing gear, among others; labor; repair; licenses; mayor's permit, sticker, barangay permit; registration and others. The cost of implementation and monitoring is PhP 30,000 under the existing practice, while it amounts to PhP 614,500 at high level of implementation, as proposed by the OMA. The remaining costs would vary depending on the fishing gear and on the policy scenario. These were taken from the household survey.

Without any regulation

Without any regulation, losses are incurred by fishermen. In the BCA, it is notable that the NPV is negative (PhP 14.6 million), as shown in Table 8. The losses could be attributed to the declining fish catch in the bay. Accordingly, the BCR is only 0.85 while the IRR is less than zero. (Indeterminate or zero IRR in this scenario and in the succeeding cases are due to the fact that even on the first year of operation, fishermen already incur positive net income on the first year of operation, unlike in most business operations.) This implies that with no regulation at all, fishermen are losing income.

With regulation

Under this scenario, three policy options were tested: ban on electric shiners, fish cage regulation, and regulation of both electric shiners and fish cages.

Ban on electric shiners

Low level of implementation. If the local government will go on allotting a meager amount for the implementation and monitoring of fisheries laws, fish catch will continue to decline in the area. This scenario of low level of enforcement will result to a negative net benefit of PhP 10.8 million, a BCR of .89 and a negative IRR. Banning shiners alone will not give returns on the investment of the government for monitoring and implementation. Fishermen's income will increase slightly than without regulation, although they are still at a loss.

High level of implementation. In contrast, high level of enforcement or provision of additional funds in policy implementation and monitoring will yield positive gains. It is worth noting that NPV for this condition is PhP 1.4 million. The BCR is 1.01 and the IRR, 62%.This is a better deal than enforcement level, however the government is not getting much from its investment on implementation. Fishermen's income are positive and increasing slightly.

Fish cage regulation

Low level of implementation. The results show that fish cage regulation is not as effective as banning shiners. It is worth noting that with the current level of investment, there is hardly any difference in NPV, BCR and IRR compared to the results obtained in the no regulation scenario. The impact of fish cage regulation is nil since there are only three existing in the area, which do not affect fishermen's catch.

High level of implementation. Pouring in additional funds or high enforcement improved the NPV (PhP .2 million), but still the government is not getting more out of its investment as shown by the BCR of 1.00 (where benefits are just equal to the costs). Fish cage regulation is not an effective measure, which is also justified by the its insignificant contribution to yield in the bioeconomic model.

Regulation of both electric shiners and fish cages.

Low level of implementation. Imposition of both controls yielded best results. Nevertheless, with the current investment levels or low enforcement, outcomes of the NPV (-Php10.4 million), BCR (0.89) and IRR (less than 0 %) are still not favorable. This is because the increase in fish catch brought about by the implementation of law is quite small to offset the diminishing productivity of the bay.

High level of implementation. Provision of additional resources or high enforcement indicates that the government is not getting more out of its investment, as shown in the BCR of 1.02 and 1.01. The benefits exceed the costs, but only by a slight margin.

Bigger fish to fry

Given the failure of current policies and the economic inefficiency of full regulatory implementation, the researchers investigated other approaches to conserving fish stocks. According to Campos' team, a potentially more effective policy- one that deals with the key 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 Lamon Bay's fishermen. Although the imposition of a Total Allowable Catch is stipulated in the new Fisheries Code, no effort has yet been made to implement this in the country.

To make implementation of this policy easier, the researchers suggest that initial reductions could be made by revoking the permits of fishermen who contravene fishing regulations, e.g. regarding permissible catch size or seasons. To allow flexibility, the allocated quotas might be tradable. Among other things, this would allow new fishermen to enter the industry – but only by buying a quota from an existing quota holder. Such a system of individual tradable quotas or permits has been very successful in New Zealand.

At the same time, the researchers point out that many fishermen will have to find other means of employment and should be given help to do this. They recommend that a tradable quota system should be complemented by alternative livelihood projects to wean fishermen and their families off of fishing. Most fishermen in Lamon Bay are poor and have no other sources of income. In light of this, the researchers conclude that an integrated coastal management plan is imperative. Such a plan should seek to develop alternative sources of income that will reduce fishing pressure on the bay, making both fishing and the wider local economy sustainable.

REFERENCES

ADB, 1994, Financing Environmentally Sound Development, Philippines.

ADB, 1990, Economic Policies for Sustainable Development.

Baum, W.C. and Tolbert, S.M, 1985, Investing in Development, Lessons of World Bank Experience, World Bank and Oxford University Press, USA.

Binangonan del Ampon***:*** Ecological Profile Infanta, Quezon, 1999, Infanta Integrated Community Development Assistance, Inc.

Bureau of Fisheries and Aquatic Resource 1998, 1998 Philippine Fisheries Profile.

Carpenter, R.A. and Maragos, E, 1989, How to Assess Environmental Impacts on Tropical Islands and Coastal Areas.

Coastal Resource Assessment of the Municipalities of Real, Infanta and Gen. Nakar, Province of Quezon, Hayuma Foundation, Inc. (Los Banos, Laguna: March 1999).

Department of Agriculture, 1990, Fisheries Administrative Order No. 172.

IDRC, 1991, Research. Knowledge in the Pursuit of Change.

ISNAR, August 2000, Research Report 17, Evaluating Capacity Development in Planning, Monitoring, and Evaluation. Netherlands.

Land Use Plan of Infanta, Quezon, Technical Working Group and Development Catalyst, Inc, 1999.

McGregor, M, 1984, Technology: A Third Level Course Complexity, Management and Change, Applying a Systems Approach, Curtin University, Australia.

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.

Naughton, J, 1993, Soft Systems Analysis: An Introductory Guide, The Open University Press, Melton Kefner, Great Britain.

Sajise, P. E. et al, 1996, Environmentally Sustainable Rural and Agricultural Development Strategies in the Philippines.
Tierney. J, A Tale of Two Fisheries, New York Times Magazine: August 2000.
Warford, J. J., Munasenghe, M., Cruz, W, 1997, The Greening of Economic Policy Reform. The World Bank and Economic Development Institute, Washington, D.C.