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# ANALYSIS OF THE WATER POLLUTION ABATEMENT COSTS IN REGION XI: A FINAL REPORT[1]

Department of Environment and Natural Resources

*Philippine Economic – Environmental and Natural Resources Accounting System*

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# ANALYSIS OF THE WATER POLLUTION ABATEMENT COSTS IN REGION XI: A FINAL REPORT[1]

ENRAP IV TECHNICAL PAPER

by

Michico Venus A. Adarayan-Navaluna[2]

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[2] The author, Michico Venus Navaluna is a Supervising Environmental Management Specialist at the Environmental Management Bureau. The author acknowledges the participation of Noela C. Lasmarias, ENRAP Consultant, Adele Casorla, Research Assistant, ENRAP and the assistance of DENR Region XI-Environmental Sector.

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# I. INTRODUCTION

The environment plays a major role in man's survival. In recent years, however, it has become increasingly apparent that the onslaught of development has resulted in a certain degree of environmental degradation and depletion of natural resources. Rapid industrialization and urban population growth in the Philippines has adversely affected the quality of the country's water resources. Despite stringent wastewater regulations, the water pollution problem continues to worsen thereby threatening water supply, fisheries, aquatic life and human health. Hence, to address the growing surface water pollution, the government has proposed the use of economic instruments to complement the current regulatory procedures. One of the innovative initiatives concerning the use of economic instruments for pollution control was undertaken by the World Bank for the Laguna Lake Development Authority (LLDA) in 1993. In 1996, the LLDA has adopted the recommendations of the World Bank and implemented its own pollution charge program within the Laguna de Bay region.

Learning from the experience of LLDA, the Department of Environment and Natural Resources (DENR) proposed the implementation of a national pollution charge system. The Environmental Management Bureau, with assistance from the Philippine Economic-Environmental and Natural Resources Accounting (PEENRA) unit of the DENR and the Environment and Natural Resources Accounting Project (ENRAP), has recommended the revision of the wastewater permitting rules and regulations to incorporate the "polluters-pay-principle". Under the proposed permitting rules and regulations, no industrial and commercial establishment shall be allowed to discharge wastewater into a river body without paying the corresponding wastewater discharge permit fee. The permit fee is computed based on pollution loading, current ambient environmental quality and classification of the water body where the effluent will be discharged. Initially, they will be charged for effluent containing biological oxygen demand (BOD) for organic wastes and total suspended solids (TSS) for inorganic wastes.

In the process of formulating the wastewater discharge fees, a survey of industries was conducted to obtain updated information on water pollution abatement costs to derive a rational load-based fee rate. This paper presents the results and analysis of the survey conducted in Region XI.

# 2. CURRENT REGULATORY APPROACH ON WATER POLLUTION AND PROFILE OF WATER POLLUTIVE FIRMS IN REGION XI

Current water management efforts in the country rely on the command-and-control approach. They are based on the implementation of Presidential Decree No. 984 (Pollution Control Law). The implementing rules and regulations for water pollution control are specified in two DENR administrative orders (DAO) namely : DAO 34 (Series of 1990) for water usage and classification / water quality criteria and DAO 35 (Series of 1990) for effluent standards.

DAO 34 identifies the beneficial uses for Class AA to Class D water. Water bodies classified as Class AA are considered pristine waters and are used primarily for drinking. Class D is a low-grade water used for industrial cooling and irrigation. DAO 35 applies to all industrial and commercial establishments and regulates conventional pollutants (color, temperature, biological oxygen demand, total suspended solids, etc.) as well as toxic and hazardous substances (heavy metals, cyanide, PCB, etc.). It specifies that the effluent to be discharged should always conform

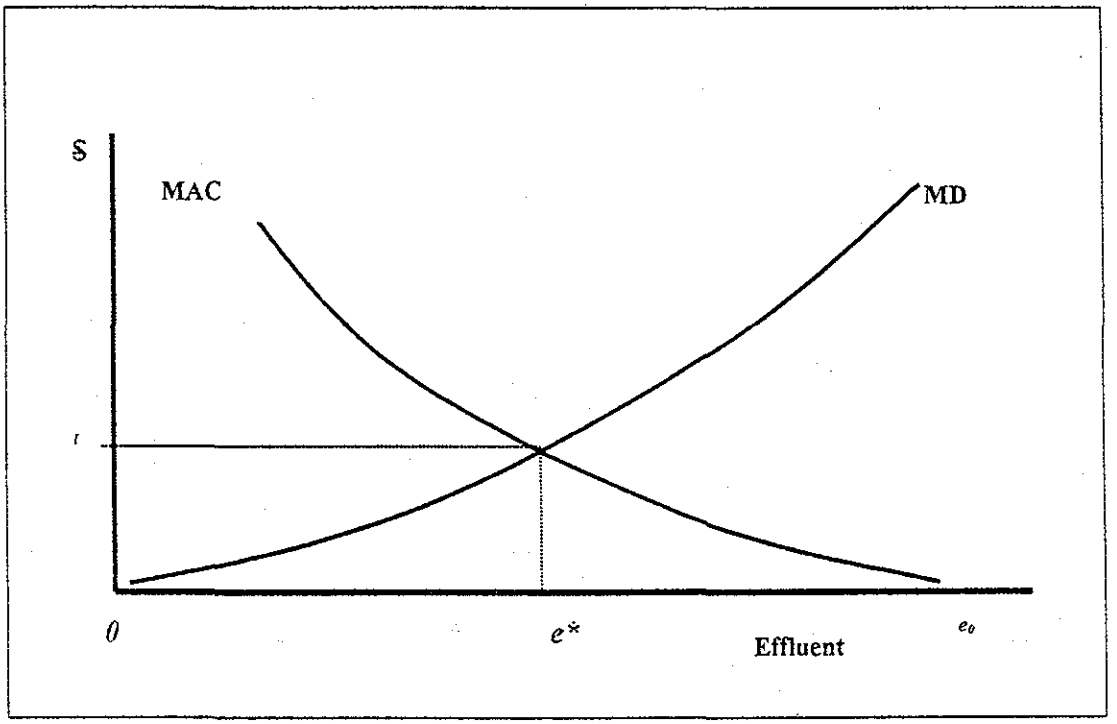
to the prescribed standards. In addition to the enforcement of the two DAOs, a system of compliance monitoring and fines and penalties has also been instituted.

As of the second semester of 1998, there was a total of 732 water pollutive firms in Region XI comprised of the provinces of Southern Mindanao, Davao City, Davao del Norte, Davao del Sur, Davao Oriental General Santos City, South Cotabato and the Saranggani Province. Out of this total, an average of 54.2% is fully complying. For Davao City alone, there are 101 water pollutive firms with 48.5% full compliance (Table I).

## 3. CONCEPTUAL FRAMEWORK OF A MARKET-BASED MECHANISM FOR WATER POLLUTION CONTROL

The environment serves certain functions and services. Water resources, for instance, provide valuable services for life support, waste sink, recreation and aesthetics. Water resources have been generally considered "free" and this has resulted in their wanton abuse and misuse. Economists assert that environmental degradation is a result of the failure of the market system to put a value on the environment although the environment does provide services and benefits. In this regard, the general environmental policy advocated by economists in dealing with pollution problems is to subject them to market-based mechanisms to internalize environmental externalities and make firms recognize and pay for the environmental consequences of their activities (Beder, 1993). However, firms that attempt to unilaterally internalize these costs by controlling their residuals could find themselves at a competitive disadvantage due to higher production costs. Not only does the unimpeded market fail to generate an efficient level of pollution control, it also penalizes those that might attempt to control them (Tietenberg, 1996). "Without some government intervention, therefore, there is no strong incentive to control pollution among those that generate them." (Lasmarias, et al, 2000).

One way of correcting this market failure is for the government to create a charge on effluent discharges by firms (Hagler Bailly, 1996). Incentive-based environmental policies are usually evaluated using economic efficiency or cost-effectiveness criteria. The optimal level of pollution or economic efficiency is attained at the level at which the cost to the company of cleaning up the pollution equal the cost of environmental damage caused by that pollution (Beder, 1993). One way of achieving this is to impose a legal limit for each pollutant at the point where the marginal cost of control equals the marginal damage caused, i.e., at $e^*$ in **Figure 1**. The other approach would be to internalize the cost of pollution control by setting a pollution tax or charge for each unit of emission equal to the point where the marginal cost equals the marginal damage, i.e., at $t$ in Figure 1 (Lasmarias and Mendoza, 2000a).



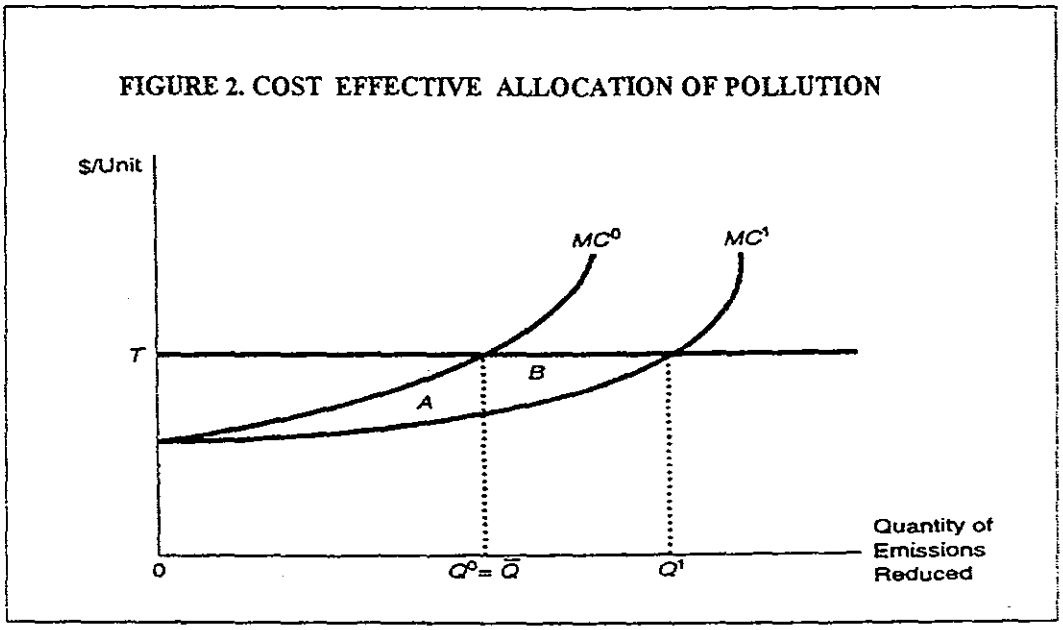

Source: Lasmarias, N. and N. Medoza, "Design and Analysis of a Wastewater Discharge Permitting System in the Philippines", 2000.

*Figure 1. Efficient Allocation of Pollution*

According to Baumol and Oates, as cited by Lasmarias and Mendoza (2000a), determining the efficient level of effluent is very difficult to implement in practice because of the data requirements. Information on the abatement cost of each generator of the pollutants and the damages incurred from these pollutants is needed before the level of pollution at which the two marginal curves meet can be determined. In many situations, there is very little information on control costs and scanty information on marginal damages. Thus, the cost-effectiveness criterion is usually followed.

The cost-effectiveness criterion is achieved when the level of marginal costs of control is equalized among firms, rather than the level of control. While this achieves the same level of aggregate control as a uniform standard, the burden is shared differently among firms by reallocating the pollution control burden among sources. Thus, firms with lower control costs take on proportionately higher share of the control responsibility than firms with higher control costs (Stavins and Whitehead 1991 as cited by Lasmarias and Mendoza 2000). This is a cost-effective outcome because fewer resources are used to achieve the same level of control (Figure 2).

If a pollution charge is levied to all pollution sources, each source will choose the most cost-effective allocation of control responsibility and has the incentive to develop newer, cheaper means of controlling emissions. As long as the firm can reduce its pollution at a marginal cost ($MC^i$) lower than the tax, $T$, it pays to adopt the new technology (Tietenberg 1996 as cited by Lasmarias and Mendoza 2000a).




Source: Lasmarias and Mendoza (2000a).

*Figure 2. Cost Effective Allocation of Pollution*

## 4. RESULTS AND ANALYSIS OF THE SURVEY ON WATER POLLUTION ABATEMENT COSTS CONDUCTED IN REGION XI

A survey of industries was conducted in Region XI, specifically in Davao City, to determine the current water pollution abatement cost in Region XI. Data from the survey were used to derive the marginal abatement cost of firms, and further in estimating the load-based fee rate. The site was selected because Davao City is a highly industrialized area that can appropriately represent the Mindanao region.

There are 97 industries surveyed in Davao City and out of that total, only 31 wet industries submitted complete and substantial information, which were considered in the computation of pollution load, although only 30 were included in the statistical analysis. Table 2 shows that out of the 31 industries considered, eight (8) and five (5) industries are engaged in hog farming and refined coconut and other vegetable oil manufacturing, respectively. These two types of industries already contributed 76% of the BOD load discharged in river systems in one year with refined coconut and other vegetable oil manufacturing sharing a huge 54% followed by hog farming at 22%. Therefore, if the implementation of the proposed pollution charge were to be phased-in, priority should be given to these two industry types.

Using regression analysis, the following marginal abatement cost (MAC) for BOD was derived :
**MAC (BOD) = (1119.4885) ( INFBOD$^{-0.498649}$) ( TXEFF $^{0.537675}$)**

**REGRESSION ANALYSIS, REGION 11**

LS // Dependent Variable is LNTAC
Included observations: 30
White Heteroskedasticity-Consistent Standard Errors & Covariance

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 7.711076 | 2.032382 | 3.794108 | 0.0008 |
| LNINFBOD | 0.501351 | 0.174535 | 2.872497 | 0.0078 |
| LNTXEFF | 0.537675 | 0.55883 | 0.962144 | 0.3445 |

| | | | |
|---|---|---|---|
| R-squared | 0.264182 | Mean dependent var | 13.08695 |
| Adjusted R-squared | 0.209677 | S.D. dependent var | 2.127651 |
| S.E. of regression | 1.891485 | Akaike info criterion | 1.369363 |
| Sum squared resid | 96.59827 | Schwarz criterion | 1.509483 |
| Log likelihood | -60.10861 | F-statistic | 4.846921 |
| Durbin-Watson stat | 0.499589 | Prob(F-statistic) | 0.0159 |

Notes:
1. lnTAC: natural log of the Total Abatement Cost = Annualized Capital Cost of Abatement + MOE
2. LNINFBOD: natural log of the influent BOD5 load (Kgs)
3. LN TXEFF : natual log of the efficiency BOD5 removal of the wastewater treatment facility

Marginal Abatement Cost (MAC) =1119.4885 * (INFBOD^ -0.498649)* (TXEFF^ 0.537675)

Source: Lasmarias N. and N. Mendoza, "Design and Analysis of a Wastewater Discharge Permitting System in the Philippines, " 2000

From the total abatement cost function, the MAC was derived and computed for each firm. On the average, this is estimated to be PhP12.10 per kilogram of BOD. At the proposed fee rate of PhP15.00 per kilogram of BOD, 94% of industries have a lower MAC than the said rate. This indicates the percentage of firms that would likely reduce BOD load some more. At PhP10.00, only 84% would likely conduct additional BOD reduction measures.

The marginal abatement cost obtained from the survey is comparable to other studies. The Integrated Environmental Management for Sustainable Development (IEMSD) project of the DENR derived PhP7.45 per kg. BOD for primary treatment using 1992 data from the Laguna Lake Development Authority. Based on the computations by Lasmarias and Mendoza (2000), this would be approximately PhP19.00 per kg. of BOD at constant 1998 prices. On the other hand, using the Industrial Environmental Pollution Control (IEPC) project survey, ENRAP III used average abatement cost of PhP4.00 per kg. of BOD at constant prices of 1992 (with base year 1998), which would be approximately PhP10 kg per BOD at constant 1998 prices (Lasmarias and Mendoza 2000a).

## 5. CONCLUSION

Given the deteriorating state of our water resources, it is high time that the government considers the nationwide implementation of the concept of "polluters-pay-principle" in environmental management. Under the proposed permitting system, the incentives of a market-based mechanism as actualized through a pollution charge system would be integrated to complement the command-and-control strategy. Technical and administrative requirements as well as financial and enforcement schemes must, however, be instituted for successful implementation.

## TABLE I. PROFILE OF WATER POLLUTIVE FIRMS
### Region XI

| PROFILE AND COMPLIANCE | Davao City | TOTAL (Davao City and the rest of Region XI provinces) |
|---|---|---|
| PROFILE | | |
| No. of water pollutive firms | 101 | 732 |
| No. of firms with WPCD[1] | 79 | 644 |
| -With PO[2] | 49 | 397 |
| -W/o PO | 30 | 244 |
| No. of firms without WPCD | 22 | 88 |
| PERCENTAGE COMPLIANCE | | |
| Fully complying[3] | 48.5 | 54.2 |
| Partially complying[4] | 29.7 | 33.3 |
| Not complying[5] | 21.8 | 12.0 |

Source : Region XI-Environmental Management Sector

[1] Water Pollution Control Device
[2] Permit to Operate
[3] Fully complying = No. of firms with WPCD and with corresponding PO / No. of water pollutive firms
[4] Partially complying = No. of firms with WPCD but without PO / No. of water pollutive firms
[5] Not complying = No. of firms without WPCD / No. of water pollutive firms

TABLE 2. Total BOD Load in Various Waterbodies in Region XI by Industry Sector, 1998

| Type of Industry | PSIC | No. of Firms | Volume of Wastewater (cum yr) | Total BOD Load Influent (kg yr) | Total BOD Load Effluent (kg yr) |
|---|---|---|---|---|---|
| Hog Farming | 02100 | 8 | 536,764.45 | 1,874,787 | 62,731 |
| Slaughtering and meat packing | 15110 | 3 | 120,954.00 | 322,326 | 3,366 |
| Production, processing and preserving of meat and meat products | 15120 | 1 | 12,480.00 | 8,611 | 688 |
| Canning packing and preserving of fruits and fruit juices | 15141 | 1 | 840 | 20,409 | 689 |
| Manufacture of refned coconut and other vegetable oil | 15152 | 5 | 112,404.72 | 4,726,824 | 166,622 |
| Manufacture of starches and starch products | 15410 | 1 | 3,675.00 | 151,018 | 1,810 |
| Manufacture of malt liquors and malt | 15530 | 1 | 286,000.00 | 314,600 | 2,028 |
| Manufacture of softdrinks | 15541 | 2 | 742,082.00 | 508,423 | 19,616 |
| Manufacture of snack products | 15640 | 1 | 23,040.00 | 22,140 | 129 |
| Sugar refining | 15720 | 1 | 698,500.00 | 96,475 | 440 |
| Manufacture of desiccated coconut | 15930 | 2 | 371,630.40 | 423,929 | 328,430 |
| Manufacture of containers and boxes of paper and paperboard | 21020 | 2 | 1,400.40 | 152,369 | 410 |
| Manufacture of rubber | 251 | 1 | 15,724.80 | 1,601 | 65 |
| Depot | | 1 | 3,662.10 | 16 | 5 |
| Fishing Port | | 1 | 3,600.00 | 48,240 | 36,180 |
| TOTAL | | 31 | 2,932,757.87 | 8,671,768 | 623,209 |

Source : Lasmarias, N. Design and Analysis of a Wastewater Discharge Permitting System in the Philippines. 2000.

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