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Colombia's Discharge Fee Program: Incentives for Polluters or Regulators?

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June 2005 • Discussion Paper 05-31

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Allen Blackman

Abstract

Colombia's discharge fee system for water effluents is often held up as a model of a well-functioning, economic-incentive pollution control program in a developing country. Yet few objective, up-to-date evaluations of the program have appeared. Based on a variety of primary and secondary evaluative data, this paper finds that that the program has been beset by a number of serious problems including limited implementation in many regions, widespread noncompliance by municipal sewage authorities, and a confused relationship between discharge fees and discharge standards. Nevertheless, in several watersheds, pollution loads dropped significantly after the program was introduced. While proponents claim the incentives that discharge fees created for polluters to cut emissions in a cost-effective manner were responsible for this success, this paper argues that the incentives they created for regulatory authorities to improve permitting, monitoring, and enforcement were at least as important.

Key Words: environment, economic incentive, market based instrument, discharge fees, water pollution, Latin America, Colombia

JEL Classification Numbers: Q53, Q56, Q58, O13, O54

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Colombia's Discharge Fee Program: Incentives for Polluters or Regulators?

Allen Blackman *

1. Introduction

Over the past two decades, a robust debate has emerged among policy makers and academics about the advantages and disadvantages of using economic incentive (EI) policies instead of—or along side—command-and-control (CAC) policies to control pollution in developing countries (Lyon 1989; Panayotou 1994; Barde 1994; Serôa da Motta et al. 1999; Blackman and Harrington 2000; Bell 2003; West and Wolverton in press). The workhorse of environmental regulatory regimes worldwide, CAC policies typically require polluting facilities to use specified abatement devices and/or to cap emissions at specified levels. By contrast, newer EI policies create economic incentives for firms to cut pollution without actually dictating how much they should cut or how they should do this. The two EI policies that have received the most recent attention are discharge fees wherein firms pay a fee per unit of emissions and marketable permits wherein firms are assigned emissions allowances that they may trade with other firms. Proponents argue that these two instruments are more efficient than CAC policies, a property that makes them particularly attractive in developing countries where resources available for pollution control are relatively scarce. But critics argue that these EI instruments are difficult to implement in developing countries for a variety of reasons, including a pervasive scarcity of requisite administrative and regulatory capabilities.

Happily, empirical evidence is increasingly available to test to these arguments—a growing number of developing countries are experimenting with discharge fees and marketable permits. Some of the experiments, particularly marketable permit programs for air emissions, have had mixed or minimal success (e.g., O'Ryan 2002, Anderson 2002). Some discharge fee programs have received positive reviews, however (e.g., Wang and Wheeler 2005). Among the

* Blackman (blackman@rff.org) is a fellow at Resources for the Future (RFF). Parts of this paper were culled from a report on Colombian environmental policy financed by the Japan Policy and Human Resources Development (PHRD) Fund at the World Bank and administered by the Colombian Ministry of Environment, Housing, and Territorial Development. I am grateful to Juan Carlos Garcia for research assistance and to Ernesto Sánchez Triana for helpful comments.

latter, perhaps the best know is Colombia's wastewater discharge fee program. The program was initiated in1997. Evaluations commissioned or conducted by a variety of organizations—including the World Bank, Colombia's Ministry of the Environment (*Ministerio del Medio Ambiente*—MMA), the UN Economic Commission for Latin America and research institutes in Colombia—have concluded that it has been successful or mostly successful (World Bank 1999; Castro et al. 2001; Acquatella 2001; MMA 1998; CAEMA various years).[1] Yet many of these evaluations were based on preliminary data from the first several years of the program. Also, the authors of several of these reports include personnel involved in the design of implementation of the discharge fee program. Few objective, up-to-date evaluations have appeared. This paper purports to fill this gap.

The analysis relies on primary and secondary evidence including: interviews with a variety of stakeholders conducted in Colombia in 2004; data provided by MMA, other national agencies, and regional environmental regulatory authorities; and detailed reports by several Colombian and international institutions. I find that that Colombia's discharge fee program has been beset by a number of serious problems including: slow implementation in many regions, widespread noncompliance by municipal sewage authorities, and a confused relationship between discharge fees and discharge standards. Nevertheless, the weight of available evidence suggests that in a several watersheds, pollution loads dropped significantly after the program was introduced. While proponents claim the incentives that discharge fees created for polluters to cut emissions in a cost effective manner were responsible for this success, this paper argues that the incentives they created for regulatory authorities to improve permitting, monitoring, and enforcement were at least as important.

The remainder of this paper is organized as follows. Section 2 briefly reviews the literature on EI instruments and their application in developing countries. Section 3 presents background information on water pollution in Colombia and on the country's CAC water pollution control policies. Section 4 discusses the history and design of the discharge fee program. Section 5 presents evaluative data on discharge fees. Section 6 discusses these data. Finally, Section 7 offers conclusions.

[1] In 2003, MMA was merged with the Ministry of Development and the Ministry of Housing to create the Ministry of Environment, Development, and Housing (*Ministerio del Ambiente, Vivienda y Desarrollo Territorial*). To avoid confusion, I will refer to the Ministry of the Environment as MMA throughout this paper regardless of the time frame.

2. Literature

This section briefly summarizes the debate on the advantages and disadvantages of discharge fees compared to conventional CAC when applied in developing countries.

2.1. Theoretical Advantages of Discharge Fees

The literature on the advantages of discharge fees focuses on their efficiency, flexibility, and revenue generating properties (see e.g., Bohm and Russell 1985; Sterner 2003).

2.1.1. Efficiency

The literature distinguishes between "static" and "dynamic" efficiency. Static efficiency refers to the cost of emissions reductions during in the short- to medium-term when abatement technologies are fixed. Discharge fees are said to enhance static efficiency for two reasons. First, they leave firms free to choose abatement strategies that minimize costs given their individual circumstances. By contrast, under CAC technology standards, the regulator more or less dictates that whole classes of firms choose certain technologies. The same is true of discharge standards to the extent they are "technology forcing."[2] Second, and probably more important, discharge fees create incentives for individual firms to choose levels of abatement that minimize the aggregate private costs of cutting collective emissions to a given level. They do so by encouraging firms with relatively low marginal abatement costs to shoulder more of the burden of cutting emissions: facilities whose marginal abatements costs are lower than the discharge fee have incentives to cut emissions while remaining facilities do not—they are better off paying the discharge fee instead. In theory, all facilities' abatement costs are eventually equated at the margin (because each facility cuts discharges until its marginal abatement costs equal the discharge fee). This is a necessary condition in the standard theoretical model for minimizing the aggregate abatement costs. For a CAC policy to achieve the same result, the regulator must know the marginal abatement costs of every polluter and must set facility specific standards, which is extremely unlikely in practice.

Dynamic efficiency has to do with the cost of emissions reductions over time when innovation in abatement technology is possible. Although advocates of discharge fees generally

[2] For example, in the United States, emissions standards on point sources administered under the Clean Water Act (e.g., effluent guidelines) are developed with reference to the abatement capabilities of specific technologies. Firms adopt these technologies to minimize the risk of being found in violation of the standards. Hence, *de jure* emissions standards amount to *de facto* technology standards.

focus on their static efficiency advantages, their dynamic efficiency advantages may be of greater long-run importance. Because firms in discharge fees programs can always increase profits by finding inexpensive ways to reducing emissions, these programs provide continuing incentives for emissions-reducing innovation. By contrast, in a CAC system, incentives to innovate are often dampened by enforcement risks associated with using a nonapproved technology.

2.1.2. Flexibility

Compared to CAC, discharge fees are said to more easily accommodate change, whether in environmental quality standards, economic conditions, or abatement technologies. In a CAC system, the regulator usually formulates and promulgates rules concerning many different types of polluters. These rules may be changed in response to changing technologies or economic conditions. By contrast, in a discharge fee system, the regulator typically sets a single fee that applies to all emissions sources and firms retain control over facility-specific abatement decisions. As a result, changes in response to new technologies and economic conditions are spontaneous and decentralized. In principle, changing the environmental quality standard is also relatively simple— it only involves changing the level of discharge fees.

2.1.3. Revenue

Finally, unlike CAC policies, discharge fees generate revenue. This revenue may be earmarked for environmental expenditures. Earmarking is popular because it makes discharge fees more politically palatable by returning revenue to those disadvantaged by the fees, and because it is seen as a means of correcting for market failures that prevent firms from obtaining the investment credit.

2.2. Implementation Issues

The literature includes a growing number of case studies of discharge fee systems in developing and transitioning countries including: China (Blackman and Harrington 2000; Wang and Wheeler 2005); Mexico (Serôa da Motta et al. 1999 and 2000), Brazil (Freitas 1994; Serôa da Motta et al. 1999), Korea (O'Connor 1994), and many countries in the former Soviet Union and Eastern Europe (Bluffstone and Larson 1997). These case studies highlight a number of common problems in implementing discharge fee systems outside of the industrialized West.[3]

[3] For a review of the European experience with discharge fees for water pollution, see Kraemer (2003).

2.2.1. Weak Environmental Regulatory Infrastructure

Many of the developing and transitioning countries that have experimented with discharge fees lack the infrastructure needed to set fees, monitor emissions, invoice polluters, and collect payment. This infrastructure includes reasonably capable environmental regulatory, judicial, and legislative institutions and political support for enforcing discharge fees. In countries with limited regulatory capacity, discharge fees are often invoiced, but collection rates are low.

2.2.2. Low Fee Levels

To maximize efficiency, economic theory dictates that discharge fees be set at the level where marginal abatement costs are equal to marginal environmental damages. In practice, however, developing countries have not been able to follow this prescription because they lack requisite information about pollution abatement and environmental damage functions. Probably just as important, political pressure from water polluters limits their ability to set substantive fees. Hence, in many countries, discharge fees have not been high enough to create incentives for pollution abatement and have mainly served as a mean of raising revenue.

2.2.3. Two-Tiered Systems

Most discharge fee systems in developing countries complement CAC discharge standards. Typically, polluters pay one fee (in some cases zero) for discharges below the standard and another higher fee for discharges above the standard. Such two-tiered systems dampen the static efficiency property of a uniform discharge fee. Some polluters pay a lower fee than others and as a result, abatement costs are not equated at the margin.

2.2.4. Adverse Distributional Impacts

Finally, in several countries, critics have charged that discharge fees are regressive, that is, they have a disproportionate impact on the poor.

3. Background

3.1. Water Pollution in Colombia

Many of Colombia's most important rivers—including the Bogotá, Cali, Cauca, Medellín, de Oro, Lebrija, Pasto, Pamplonita, Combeima, and Otún—are severely polluted (IDEAM 2002a).[4] Although comprehensive up-to-date analysis of the principal causes of surface water pollution at the national level do not exist, all available evidence suggests that among point sources, the domestic sector, not the industrial sector, is the leading contributor to water pollution.[5] For example, in 1999, the domestic sector generated over three quarters of the total biochemical oxygen demand (BOD) discharged from all point sources (IDEAM 2002a). The largest sources of BOD are the cities of Bogotá, Barranquilla, Bucaramanga, Cali, Cartagena, Manizales, and Medellín (IDEAM 2002a).

The domestic wastewater problem has several dimensions. First, a significant percentage of this wastewater is not collected into municipal sewer systems. For example, a quarter of Colombia's urban population—which comprises three-quarters of its total population—does not have access to sewer systems (Blackman 2005). Second, many municipalities lack any type of wastewater treatment. As of 1999, only 16% of Colombia's 1,089 municipalities had operating treatment plants. Nationwide, less than one percent of municipal wastewater is treated (Contraloría 2000). Third, many of the existing wastewater treatment plants operate poorly. The Ministry of Development found that in a sample of 40 municipal wastewater treatment plants, 60% were not in compliance with national regulations that require the removal of 80% of BOD and 65% of total suspended solids (TSS). Nineteen percent of total flows into these plants were not treated at all (Contraloría 2000). Cost is a fourth component of Colombia's urban wastewater treatment problem. MMA estimated that the cost of the investments in municipal wastewater treatment needed during the period 2001–2010 at $US 2.5 billion—or $US 2.5 million per year (IDEAM 2002b).

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[4] Although systematic information on groundwater quality is lacking, some aquifers are clearly polluted. This is especially concerning given that 40 of Colombia's municipalities rely on aquifers for drinking water (IDEAM 2004). Key sources of groundwater pollution include agricultural run off, septic tanks, land fills and the infiltration of coastal aquifers by seawater (IDEAM 2002a).

[5] In Colombia—as in most countries with significant agricultural sectors—nonpoint sources are responsible for the majority of certain types of water pollution. Unfortunately, nonpoint sources are particularly difficult to control. As a result, policy makers tend to focus on point sources.

Municipal wastewater aside, most of Colombia's industrial wastewater also is not treated. According to IDEAM (2002b), a report on the state of environmental quality in Colombia's urban areas, in 66% of 66 cities studied, no industries treated wastewaters. In 23% of the cities, less than 50% did. In 7.5% of the cities between 50 and 100% did, and in only 3.1% of the cities did 100% of the industries treat their wastewater. Among industrial activities, the leading sources of water pollution include manufacturers of beverages and alcohol, industrial chemicals, cardboard and paper (Carrasquilla and Morillo 1992)

3.2. Command-and-control policies

Colombia has a decentralized environmental management system. At the national level, MMA is the principal environmental regulatory authority. Its responsibilities include formulating, managing, and coordinating water quality policies and programs. The principal regional environmental authorities are 33 Regional Autonomous Corporations (*Corporaciónes Autónomas Regionales*—CARs) along with four Urban Environmental Authorities (*Autoridades Ambientales Urbanas*—AAUs) in Colombia's most populous cities. Endowed with considerable fiscal and policy autonomy meant to insulate them from interest group pressures, the CARs and AAUs are the front line of pollution control in Colombia—they are responsible for implementing and enforcing MMA programs and policies. Like many decentralized environmental regulatory systems, Colombia's is characterized by lapses in control and coordination. By all accounts, some of the regional environmental authorities are far more capable than others (Blackman et al. 2005).

Colombian CAC water quality regulation is conventional. All dischargers of liquid wastes are required to register with and obtain a permit from their regional environmental authorities. Most permits are essentially simply permissions to discharge and do not specify pollution abatement methods, equipment or strategies. In addition, all dischargers are subject to 1984 effluent concentration standards for 22 organic and inorganic substances. Dischargers that began operating after 1984 are required to remove at least 80% of TSS and at least 80% of BOD from their waste streams. Older facilities are allowed to adhere to slightly less stringent requirements. None of Colombia's discharge standards are industry-specific. CARs and AAUs

are responsible for enforcing the discharge standards. In doing so, they may inspect discharging facilities at any time to sample their effluents and check their equipment.[6]

3.3. Performance of Command-and-Control Policies

Regulatory capacity varies dramatically across CARs and AAUs and CAC water pollution control policies have preformed better in some than in others. In general, however, these policies have preformed quite poorly.

Historically, well-functioning discharge permit systems have been the exception rather than the rule. Three problems have been common. First, inventories of dischargers have often been inadequate. Since Colombia does not have a national-level database or recent study of water discharges, CARs and AAUs have been the principal repositories of such information. Yet, as late as 2001, 40% of CARs did not have an inventory of wastewater discharges (Contraloría 2002). Among the 60% that did, most inventories were outdated and partial, a situation that is partly attributable to the prevalence of small, unlicensed and unregistered polluters (Blackman 2005). Second, permitting has been incomplete. In 2002, CARs permitted just 31% of all facilities requiring permits. Finally, permitting in Colombia has been inefficient. It has been characterized by copious red tape and long delays; requirements that are not consistent across CARs; and in some cases, corruption. For example, the staff of a well-regarded CAR that surrounds Bogotá reported that permitting typically take one to two years (Blackman 2005).

Just as permitting in many jurisdictions has been inefficient, so too has monitoring and enforcement of discharge standards. As noted above, the lion's share of both municipal and industrial wastewater violates discharge standards. In the early 1990s, even in relatively well functioning CARs and AAUs, less than half of polluting facilities were inspected (Sánchez Triana and Medina 1994). The situation persists. For example, the AAU for Bogotá (*Autoridad Ambiental Urbana de Santafé de Bogotá*—DAMA) is generally considered a strong institution. Nevertheless, its goal in 2003 was to monitor and control just 30% of *registered* industrial discharges in its jurisdiction (IDEAM y Alcada Mayor de Bogotá 2002). Furthermore, CARs lack the personnel and equipment needed to monitor compliance with discharge standards. Forty

[6] A final component of Colombian CAC water quality policy is a set of requirements for environmental licenses. Prior to construction, polluting facilities in certain sectors are required to obtain a license from either their regional environmental authority or from MMA that specifies how discharges will be controlled. To obtain a license, the facility may have to conduct an environmental impact assessment and hold a public hearing.

percent of the country's CARs have no environmental laboratories or have infrastructure that does not function (Contraloría 2002).

4. Discharge Fee Program

4.1. Legal Foundation

Colombia's first comprehensive environmental law—Law 2811 of 1974—establishes the legal foundation for discharge fees. This law and the principal two Decrees regulating it (Decree 1541 of 1978 and 1594 of 1984) contain provisions that allow regulatory authorities to charge fees to for-profit operations to cover the cost of mitigating any damages they inflicted on natural resources. These provisions were rarely used until subsequent legislation was passed, however.[7]

Colombia's second major comprehensive environmental law, Law 99 of 1993, also includes provisions for discharge fees. Article 42 mandates that CARs and AAUs charge "retributive charges" (*tasas retributivas*) for water effluents. The fees differ from those contained in previous regulations in that they are to be are charged to both for-profit and nonprofit facilities. In addition, in determining the level of the fees, regulatory authorities are supposed to take into account a broad range of factors, not just administrative costs.

Decree 901 of 1997 regulates Article 42 of Law 99.[8] The design of the fee system set forth in this Decree draws heavily on seminal environmental economics literature on how regulatory authorities should set fees when they lack the facility-level information on the marginal costs of pollution abatement and environmental damages (Baumol 1972; Baumol and Oates 1975). The basic strategy set forth in this literature is to first set pollution reduction goals in each watershed and then use trial and error to adjust fees until the goals are met. Political constraints dictate that regulators start with relatively low fees and ratchet them up over time.

[7] An exception was a discharge fee system administered by the Corporación Autónoma Regional del Valle del Cauca (CVC), a regional economic development authority modeled after the Tennessee Valley Authority in the United States. The CVC used discharge fees to raise funding for the Salvajina Hydroelectric Project on the grounds that the dam would augment river flow and thereby dilute pollution. The fee was charged on BOD, TSS and chemical oxygen demand. Pollution loads fell significantly following introduction of the fees, although it is not clear whether the fees were responsible. (Sanchez-Triana and Ortolano forthcoming).

[8] Some of the specifics of the fee system were changed by recent regulations—Decree 3100 of October of 2003 and Decree 3440 of October of 2004 (see Blackman 2005 for details). Because the program established by these regulations is too new to be evaluated, we focus on the system put in pace by Decree 901 of 1997.

Although not welfare maximizing, such a strategy ensures that the pollution reduction goals are met at least cost. Accordingly, Decree 901 includes the following key provisions:

- Discharge inventory and baseline. CARs and AAUs are to develop comprehensive inventories of all facilities discharging BOD and TSS and to establish baseline discharge levels for each pollutant.[9]
- Pollution reduction targets. CARs and AAUs are to delineate water basins in their jurisdictions and set five-year pollution reduction goals for aggregate discharges into each basin. The goals are to be set by the boards of directors of each CAR or AAU, institutions that comprise a variety of stakeholders including representatives of national and local governments, key productive sectors, and environmental nongovernmental organizations. As specified in Law 99, the pollution reduction goals are to take into account the environmental and social damages generated by pollutants as well as differences across regions in pollution assimilation capacity, socioeconomic conditions, and the opportunity costs of resources.
- Fee setting. MMA is to establish a minimum discharge fee for all facilities in the entire country. This fee can be adjusted upwards in each water basin based on a specified formula (see Appendix 1 for details). In essence, the formula adjusts the fee upwards by a multiplicative factor of 0.5 for each semester (six-month period) that the pollution reduction target is not met.
- Monitoring and invoicing. CARs and AAUs are to monitor facilities' discharges every six months relying on facility self-reports (based on approved sampling methods) verified by random checks. Invoices and payments are to be made monthly.
- Relationship between discharge permits and fees. Paying discharge fees does not exonerate facilities from the responsibility of complying with permits or CAC emissions standards. In theory then—that is, assuming that dischargers are complying with emissions standards—discharge fees only apply to those discharges remaining *after* the standards have been met. For example, for facilities established after 1984 that are required to remove 80% of BOD from their waste streams, discharge fees only apply to the remaining 20% of BOD.

[9] Actually, Decree 901 does not specify which pollutants would be covered by the fees. It only states that MMA is to make this determination. Subsequent to the Decree, MMA selected BOD and TSS.

- Reporting. Each semester, CAR and AAU directors are obliged to present to both their board of directors and to MMA a report detailing pollution loads, invoicing and collections.

4.2. Technical Assistance for Implementation

Subsequent to Decree 901 of 1997, MMA undertook a number of different initiatives aimed at implementing the discharge fee system. First, it established minimum national fees (Table 1). Note that resolution 0372 of 1998 mandated an automatic annual adjustment for inflation instead of an annual discretionary adjustment.

Second, in 1997, the Office of Economic Analysis (OEA) in the MMA initiated a technical assistance program to help CARs and AAUs implement discharge fees. The details of the program are summarized in an "implementation manual," actually a compendium of documents written by a variety of experts (MMA 1997). As detailed in this document, the technical assistance program comprised seven thrusts:

- Developing a detailed implementation plan. The OEA designed the plan with input from the World Bank.
- Providing as-needed technical assistance to regional environmental authorities. When requested, the OEA met with administrators of regional environmental authorities and private- and public-sector water polluters.
- Promoting implementation in the most capable regional environmental authorities first. Initially, the OEA focused its assistance efforts on the strongest regional environmental authorities in hopes of generating early successes.
- Disseminating best practices. The OEA catalogued lessons learned from CARs and AAUs that had successfully implemented the program.
- Developing expert groups. The OEA organized expert groups to provide solutions to implementation problems. For example, at the time the program was established, guidance on self-monitoring of BOD and TSS was lacking despite the fact that 1984 discharge standards required such monitoring. Therefore, an expert group was formed to create the requisite guidance.
- Regional technical assistance seminars. The OEA presented a series of four regional workshops (in Barranquilla, Rionegro, Cali, and Bogotá) aimed at disseminating

technical information and best practices, as well as obtaining feedback from regional environmental authorities.

- Building program credibility. To ensure that the discharge fee program was widely perceived as credible, the OEA enlisted the support and advice of the World Bank and held a series of workshops and meetings at national chambers of commerce representing key private-sector program participants including the National Federation of Coffee Growers (*Federación Nacional de Cafeteros de Colombia*—FEDECAFE), the National Association of Public Utilities (*Asociación Nacional de Empresas de Servicios Públicos Domiciliarios y Actividades Complementarias e Inherentes*—ANDESCO), and the National Chamber of Commerce (*Asociación Nacional de Empresarios de Colombia*—ANDI).

The implementation manual identifies a series of tasks that CARs and AAUs need to accomplish to implement a discharge system, and provides guidance on each. The tasks included

- developing a complete inventory of dischargers;
- registering all dischargers;
- creating system rules and guidance;
- creating an information management system;
- characterizing discharges from participating water uses;
- calculating of pollution loads;
- identifying water bodies and water body sections;
- setting total pollution load goals for each of water bodies or sections;
- communicating the pollution load targets;
- developing a system of collection and charges;
- developing a system of managing fee revenue;
- developing a system of monitoring; and
- developing a system to evaluate regional factor (whether targets achieved).

In addition to the aforementioned vertical, top-down technical assistance program led by the OEA, in 1998, the MMA also created a horizontal, peer-to-peer system among CARs and AAUs. The key idea was for the three CARs with the most successful programs—CVC,

CORNARE, and CARDER—to mentor other regional environmental authorities. Towards this end, the program organized number of workshops in the summer and fall of 1998.

Finally, MMA promulgated guidance on how fee revenue ought to be spent. Law 99 of 1993 allows CARs to determine how to use their self-generated revenue, including that from discharge fees. Nevertheless, in late 1998, responding to charges that CARs and AAUs were misusing program revenue, MMA issued voluntary guidelines recommending CARs use the discharge fee revenue to create regional funds to co-finance wastewater treatment infrastructure. The MMA guidance documents recommend that fee revenue be allocated as follows: 50% for financing master plans for municipal wastewater treatment; 30% for industrial environmental management; 10% for science and technology projects; 10% of to administration of the discharge program.

5. Program Implementation

5.1. Problems

Implementation of the discharge fee program has been marred by the following six problems.

5.1.1. Slow or Limited Implementation in Some Regional Environmental Authorities

Some regional environmental authorities initiated discharge fee programs earlier than others and some have made far more progress in implementation than others. Table 2 details when each CAR began actually invoicing and collecting fees.[10] In 1997, the year of Decree 901, only one CAR invoiced or collected. Since then, four to six more CARs each year have begun invoicing. Collection has lagged behind invoicing. In 2002, 24 CARs invoiced and 21 collected.

For the purposes of characterizing progress in implementing discharge fees programs, MMA has placed regional environmental authorities into three groups.[11] Group A comprises nine CARs and AAUs that have operated a discharge fee program for at least three semesters (18 months), have fulfilled all the principal requirements of Decree 901, and have completed all of

[10] Unfortunately, existing data collection systems for regional environmental authorities typically exclude AAUs.

[11] As of 2002, the three groups were comprised as follows: Group A: CVC, Cornare, CDMB, Corolima, CRC, DADIMA, AMVA, Coralina and Corpourabá; Group B: DAMA, Carder, CAS, CAM, Codechoco, Corponor, Corantioquia, Corpoboyaca, Corpocaldas, Corporinoquía, Cormacarena, CRQ, and Cardique; Group C: CVS, CAR, Corpochivor, Corponariño, Carucre, CRA, CSB, DAGMA, Corpamag, and Corpoguajira.

the implementation tasks listed in Section 4.2 above. Group B comprises 13 CARs and AAUs that are invoicing and collecting revenue, but that have implemented the program in an incomplete or inconsistent manner. Group C includes 11 CARs and AAUs that have begun implementation but have yet to collect fees.

5.1.2. Significant Differences in Pollution Reduction Goals

Table 3 presents five-year goals established by each CAR for total reductions of BOD and TSS from point sources. Clearly, some goals are far more ambitious than others. For example, Cormacarena's BOD goal is 80% while Cardique's is 3%. As noted above, Decree 901 explicitly mandates heterogeneity in goal setting. CARs are supposed to take into account, among other things, socio-economic factors, abatement costs, and the quality of receiving waters and their ability to assimilate pollution—all factors that vary widely across and within CARs. Nevertheless, the tremendous disparity in goals begs the question of whether the goal setting process in some CARs was captured by industrial interests. Some have suggested that lobbying by well-organized trade associations does, in fact, account for a significant fraction of this variation (Enríquez 2004). As noted above, boards of directors purport to comprise all elements of society. But considerable evidence suggests that industrial interests have more sway than other parties. Environmental nongovernmental organizations are supposed to be the principal representative of the victims of pollution, but in many CARs, they are quite weak or altogether nonexistent (Blackman et al. 2005).

5.1.3. Incomplete Coverage of Dischargers

Just as not all water users that should be permitted actually are, not all water users that should participate in the fee programs actually do. The second problem is closely related to the first. As Castro et al. (2001) report, implementation of the discharge fee program has entailed renewed and expanded efforts to permit dischargers. Unfortunately, this effort has not been completely successful. Table 4 presents CAR-level data on the percentage of water users covered by the discharge fee system that are actually invoiced. The percentage of ranged from 100% reported by four CARs to a low of 0% reported by four other CARs (that presumably did not have operating invoicing systems in 2002). On average, less than half of participants were invoiced. Although, this average mixes CARs that had operating fee systems with those that did not, note that many of the CARs with operating systems had low participation rates.

5.1.4. Fee Collection Rates in Some CARs Are Low

Table 2 above provides self-reported CAR-level data on invoicing and collection of discharge fees between 1997 and 2002. Several patterns are noteworthy. First, in most CARs, a significant percentage of fees that are invoiced are not collected. Between 1997 and 2002, just 27% of all fees invoiced were actually collected. Collection rates vary dramatically across CARs ranging from a low of 1% for Carsucre, Corpoamazonía and Corpocesar to a high of 95% for CDMB. Note, however, that after CDMB, the next highest collection rate was 54% reported by Cornare. Second, in any given year, a small number of CARs are responsible for the lion's share of all charges collected. For example, in 2002, all participating CARs collected 9.1 billion pesos. However, three CARs—CAS, CDMB, and CVC—were responsible for roughly three-quarters of the total. Third, for most CARs, invoicing increases over time as their program is implemented and, presumably, more firms are brought into the system. However, after the first few years, invoicing levels out.

5.1.5. Noncompliance by Leading Dischargers: Municipal Sewage Authorities

As in many developing countries, Colombia's municipal sewage authorities are leading sources of BOD and TSS and also leading violators of water quality regulations. Table 5 presents data on the role of municipal sewage authorities in invoicing and recovery of the discharge fees between 1997 and 2002. Two patterns are notable. First, sewage authorities are the key player in the discharge fee program. They were invoiced for over one-third (34%) of all discharge fees. Second, collection rates for municipal sewage authorities were low in absolute standards. Of the total amount they were invoiced between 1997 and 2002, utilities only paid 40% (this figure is derived from the data in the table, but is not included in it). Finally, however, recovery rates for utilities were higher than for industry. Although utilities were invoiced for 34% of all wastewater fees between 1997 and 2002, they contributed 52% of all fees actually collected.

Nonpayment of fees by municipal sewage authorities has generated considerable controversy. The authorities have argued that they simply do not have the financial wherewithal to pay discharge fees or to invest in treatment plants that would enable them to avoid the fees because in many cases, they are unable to pass the fees on to their customers. ANDESCO, the national trade association for municipal sewage authorities, has lobbied against implementation

of the discharge fee program and has initiated several lawsuits to derail it.[12] Some regional environmental authorities have taken legal action in response to nonpayment. For example, DADIMA, the urban environmental authority of Barranquilla, at one point took control of the city's sewage authority until it agreed to pay a 2.5 billion peso debt (Guzmán Castro 2003).

Nonpayment and general resistance by municipal sewage authorities have been key barriers to the successful implementation of the program. They have generated three widely publicized problems. First, water polluters in industry and agriculture have complained bitterly about being made to pay fees when many of the largest and most visible polluters have refused or failed to do so. For example, ANDI, the national industrial trade association, has repeatedly made an issue of inequities in enforcement (Guzmán Castro 2003). Some industrial polluters have felt justified in withholding fee payment themselves.[13]

This contentious situation has been greatly aggravated by the fact that noncompliance by municipal sewage authorities has prevented many water basins from meeting five-year total pollution load reduction targets and, as mandated by Decree 901 of 1997, has led to steep fee increases in these water basins. Table 6 shows the dramatic increase in fee rates for a water basin that repeatedly misses its compliance targets. (Note that the fee rate in the first row is that established for 2003). Given this burden, industrial dischargers have argued that they are being punished for the failure of municipal sewage authorities to control their discharges.

Second, some have argued that discharge fee system has had a regressive impact, that is, it imposes a disproportionate financial burden on the poor (e.g., Enríquez 2004). The main reason is that some municipal sewage authorities have passed the fees on to their customers in the form of higher utility bills. This has resulted in significant increases in bills in smaller cities where the utilities are not able to spread the new costs over a large number of customers. To the extent these smaller cities are home to poorer citizens, the fees are regressive. Table 7 presents data on sewage bill increases due to discharge fees in a sample of 114 municipalities of varying sizes. Although on average discharge fees only raised sewage bills by 6% in all the

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[12] The lawsuit argues that the program can not be applied to municipal sewage authorities because Colombian public utilities law does not make sufficiently clear how these authorities can pass the fee burden onto their customers.

[13] Students of environmental regulation have argued persuasively that building a "culture of compliance" is the key to successful implementation of any pollution control policy (Bell 1997, Russell, Harrington and Vaughn 1986). Agents comply because they believe others are doing the same, and furthermore, they believe that noncompliance will be identified and punished expeditiously and consistently. Noncompliance by some polluters inevitably breeds noncompliance by others.

municipalities, the increase was 31% in municipalities with fewer than 2,500 persons, and 21% in municipalities with 2,500–12,000 people.

Finally, the difficulties experienced by some municipal sewage authorities in paying discharge fees appear to have exacerbated the severe shortage of sewage and wastewater treatment infrastructure. Many municipalities are now reluctant to develop treatment plants or to assume ownership of plants that have already been built because the discharge fees associated with the plants would make operating them unprofitable (Blackman 2005). According to Grigg et al. (2004), "the fee structure for wastewater permits, while meant to be an incentive to provide treatment, has actually created a disincentive to construct treatment facilities." A similar rationale applies to municipalities' incentives to build new sewer lines. For Colombia's many municipalities without adequate wastewater treatment facilities, building sewer lines that connect new pollution sources to the system increases the system's total pollution load and, therefore, increases total fees charged to the municipality.

5.1.6. Relationship between Discharge Fees and Discharge Standards

As discussed in Section 4 above, Decree 901 of 1997 explicitly states that paying discharge fees does not exonerate users from the responsibility of complying with discharge standards. As a result, in theory—that is, assuming that polluters are complying with discharge standards—discharge fees only apply to those discharges remaining *after* the discharge standards have been met. The obvious problem with this regulation, however, is that, as discussed in Section 3.3, noncompliance with discharge standards is rampant in some CARs and AAUs. In these jurisdictions, uncertainty about how to resolve the situation has created significant controversy. Industry lobbyists have predictably argued that regardless of a facility's compliance, discharge fees should only be charged on those emissions that would remain if the discharge standard were met (Castro et al. 2001). Clearly, such a policy would dramatically dampen the incentives that discharge fees create for pollution control.

MMA has attempted to resolve this problem by issuing guidance stating that in cases where a facility is not in compliance with discharge standards, the CAR or AAU should negotiate a plan with the facility that specifies a schedule of activities and investments designed to bring the facility into compliance. At a maximum, facilities would have five years to complete the plan. In the interim, discharge fees should cover all of the facility's BOD and TSS effluents. Despite this guidance, some CARs and AAUs continue to charge noncompliant firms only for those emissions that would remain if the discharge standard were met (Castro et al. 2001).

5.2. Fee Revenue

Law 99 of 1993, which created Colombia's decentralized environmental management system provides CARs (but not AAUs) with a number of mechanisms for self-financing, including energy fees, resource use taxes, discharge fees, and a claim to a share of municipal property taxes. For virtually all CARs, property taxes are the most important source of revenue (Blackman et al. 2005). Table 8 presents data on the revenue that discharge fees generated in 2002 and the contribution of this revenue to total revenue from all sources. For all CARs, discharge fees contributed 1% of total revenue. Note, however, that if collection rates were improved, discharge fees could contribute far more: invoices for discharge fees amounted to 4% of total revenue. Although even this average is relatively modest, for some CARs, it is quite sizable. For example, invoices accounted for 30% of Corpourabá's total revenue.

As noted above, in 1998, MMA issued voluntary guidelines that recommended CARs use the discharge fee revenue to create regional funds that would co-finance wastewater treatment infrastructure. According to MMA, 15 of the 33 CARs have established such funds (Enríquez 2004).

5.3. Impacts on Water Quality

Unfortunately, up-to-date comprehensive data on BOD and TSS discharges from point sources covered in the discharge fee program are not publicly available. Nevertheless, the evidence that is available strongly suggests that—despite the six implementation issues discussed above—water quality improved significantly in a number of CARs and AAUs following the introduction of discharge fees. This section reviews three types of evaluative data.

5.3.1. National-Level Data on Total Pollution Loads

According to a 2002 evaluation of the discharge fees program conducted by the MMA's OEA, discharge fees were effective in reducing BOD and TSS in the first five years of the program. Nationwide, total BOD discharges from point sources covered in the program fell 27% from 117,000 tons per semester to 85,000 tons per semester, while total TSS discharges from point sources covered in the program fell 45% from 162,000 tons per semester to 88,000 tons (Gómez Torres 2003).

These statistics—as well as those reported in the next subsection—are not necessarily as impressive as they appear for two reasons. First, they are based on data that is self-reported by dischargers. These data are subject to verification by CARs, MMA and the Contraloría, a government inspector general. However, the effectiveness of this verification varies across CARs. Second, as discussed in detail below, the reductions in BOD and TSS are not necessarily

due solely to economic incentives generated by discharge fees—they also reflect the impact of CAC and pollution prevention programs. Despite these two caveats, however, the size of the measured reductions in BOD and TSS are so large that is unlikely that the program did not have a significant impact.

5.3.2. Self-Reported CAR-Level Data on 2002 Total Pollution Loads

Table 9 presents self-reported CAR-level data on the performance of discharge fee program, specifically, 2002 reductions in total BOD and TSS discharges versus 2002 annual targets established in conjunction with five-year targets. The average percent of the annual goals met is quite high: 180% for BOD (that is, CARs exceeded this target by 80%) and 84% for TSS. However, these averages mask several features. First, five CARs reported having exceeded their BOD reduction goals (CAR, CAS, Coralina, Corpocaldas, Corporuba, and CVC) while twelve achieved 0% of their goals. Note that Coralina reported having exceeded its goal by 2000%. As for TSS, seven CARs (CAS, Coralina, Corpocaldas, Corpouraba, CRC, CRQ, and CVC) reported having exceed their TSS goals while twelve achieved 0% of their goals.

5.3.3. 2001 CEPAL Study

Castro et al. (2001) evaluated the impact of the fee program on discharges in three jurisdictions: CVC, Cornare, and DADIMA (Barranquilla's AAU) using data from first semester of 1997 through second semester of 2000. In each case, Castro et al. find that the discharge fee program was responsible for significant reductions in BOD and TSS.

CVC. Created in the image of the Tennessee Valley Authority in 1954, CVC is Colombia's oldest CAR and is widely recognized as a relatively capable institution, particularly with regard to water resources management. Prior to its discharge fee program, CVC made significant efforts to enforce CAC discharge standards and rates of compliance were high. Therefore, discharge fees were charged only on BOD and TSS emissions not covered by discharge standards. In the three years between 1998 and 2000, total BOD discharged by point sources participating in fee program fell 32% while TSS discharges fell 69%. The report acknowledges that reductions in discharges from sugar processing plants and the paper industry due to implementation of pollution prevention measures and clean technologies (versus end-of-pipe treatment) contributed to these results.

Cornare. Cornare is also recognized as one of Colombia's stronger CARs. Like CVC, Cornare strictly enforced discharge standards before it began setting up its discharge fee program for the Negro River in late 1997 and before it began invoicing in 2000. Therefore, as in CVC, discharge fees were only charged on emissions not covered by discharge standards. Between

1997 and 2000, total BOD discharged by point sources participating in fee program fell 62% while TSS discharges fell 90%. The report takes care to mention that these reductions may have been partly due to a series of clean production agreements signed with water dischargers immediately before the discharge fee program began.

DADIMA. DADIMA, Barranquilla's AAU, is quite different from CVC and Cornare. It was created by Law 99 of 1993 and has relatively limited regulatory capacity. In this regard, it is probably more representative of the "average" CAR. Before it began to implement a discharge fee program for a section of the Magdalena River in 1998, DADIMA did not enforce discharge standards and the majority of polluters had not invested in treatment plants. Therefore, in implementing its program, DADIMA negotiated compliance plans with discharging facilities and applied pollution fees to all of their discharges. The impact of the discharge fee in DADIMA's industrial sector has been notable. In two years, the program resulted in 47% decreases in the total BOD loads and 62% decreases in total TSS loads.

6. Conclusion

I have argued that that Colombia's discharge fee program has been beset by a number of serious problems including slow or limited overall implementation in some CARs and AAUs; significant differences in pollution reduction goals across regional environmental authorities; incomplete coverage of point sources; low fee collection rates in some CARs and AAUs; widespread noncompliance by municipal sewage authorities; and a confused relationship between discharge fees and discharge standards. Yet, the weight of available evidence also suggests that in a significant number of regional jurisdictions, BOD and TSS discharges dropped significantly following the program in 1997.

To what extent is the discharge fee program responsible for these emissions reductions? Not surprisingly, proponents award it virtually all of the credit. Moreover, many attribute this success to the theoretical properties of discharge fees—specifically, the efficiency advantages described in Section 2—that supposedly make them less burdensome to polluters than CAC discharge standards. Although these claims are not baseless, the whole truth is far more complex. The principal reason is that implementation of the discharge fee program was accompanied by simultaneous important improvements to the basic regulatory infrastructure needed to implement all types water pollution control instruments—including both CAC and EI instruments. More specifically, implementation was accompanied by significant improvements in permitting, monitoring, and enforcement of both discharge fees and emissions standards.

As discussed in Section 3.3 and 4.2, prior to 1997 permitting, monitoring, and enforcement of water pollution regulation was inadequate in virtually all CARs and AAUs. To set up discharge fee programs, CARs and AAUs had to remedy these deficiencies. They had to develop a complete inventory of dischargers; register all dischargers; create an information management system; characterize discharges from participating water uses; calculate facilities' pollution loads; and develop a system of monitoring. Each one of these tasks is a precursor to effective implementation of emissions standards as well as discharge fees. As a result of this effort, in many jurisdictions emissions standards had a far greater impact after 1997 than before. Hence, one cannot be certain whether the reductions in emissions that occurred after 1997 were due to (a) the economic incentive and efficiency properties of the new discharge fee program or to (b) improved permitting, monitoring, and enforcement of both the new discharge fees and existing emissions standards. Although these factors are virtually impossible to disentangle empirically, intuition alone suggests the second factor was critical—again, reasonably effective permitting, monitoring, and enforcement constitute the foundation upon which effective CAC and EI pollution control systems must be built.

Why did the advent of the discharge fee system bolster permitting, monitoring, and enforcement? At least three factors appear to have contributed. First, implementation of the discharge fee system was accompanied by considerable publicity, fanfare, and controversy. Vertical (top-down) and horizontal (CAR-to-CAR) programs were created to help CARs and AAUs implement discharge fees. This type of concerted nationwide effort was never devoted to promoting discharge standards. Second, the new discharge fee program entails more transparency and accountability for regulatory authorities than did the old discharge standards program. CARs and AAUs are required to report to both to their boards of directors and to MMA their progress on a number of fronts including: program implementation, pollution reduction targets, pollution loads, invoices and collections. Hence, when the program was initiated, CARs and AAUs were for the first time held to "performance standards" for water pollution control. Prior to the discharge fee program, few CARs and AAUs consistently kept records of—and in any case were infrequently held accountable for—discharges of water users in their jurisdictions. Finally, the discharge fee program creates an economic incentive for CARs and AAUs to enforce their water pollution control laws. These authorities are allowed keep the revenues from these fees, which are quite significant for some CARs and AAUs.

To sum up, proponents of Colombia's discharge fees program claim that the incentives that fees create for polluters—namely continuing significant financial incentives to cut emissions in a cost effective manner—have been responsible for recent reductions in BOD and TSS loads. To some extent this may be true. However, the incentives that the fees created for CARs and

AAUs to improve permitting, monitoring, and enforcement—by enhancing transparency and accountability and by creating financial incentives for strict enforcement—are likely to have been at least as important.

What are the implications of this case study for the debate about the use of EI instruments in developing countries? The most obvious—and also most superficial—conclusion is that discharge fees can indeed be successfully implemented to control pollution in developing countries. But other case studies have already demonstrated this point. More interesting conclusions concern the advantages and disadvantages of relying on discharge fees instead of—or in addition to—CAC to control water pollution.

Discussions of the advantages of discharge fees in the existing literature have focused on the static and dynamic efficiency properties of fees, while discussions of disadvantages have centered on the notion that they are more demanding of scarce regulatory resources than many CAC instruments. Yet, the evidence presented here suggests that other pros and cons of discharge fees may be equally important. As for advantages, the Colombian case study suggests that, as noted above, discharge fees create incentives for regulatory authorities to improve permitting, monitoring, and enforcement.

As for disadvantages, this case study suggests that grossly inadequate municipal wastewater treatment infrastructure—a pervasive problem in many developing countries—is likely to be a key barrier to more effective implementation of discharge fees programs. Among other things, the lack of such infrastructure can greatly hinder efforts to develop a culture of compliance in the discharge fee program, saddle municipal sewage authorities with debts that further complicate plans for new wastewater treatment facilities, and increase utility fees for end users.

In addition, the Colombia experience suggests that the strategy of setting pollution reduction goals for individual water basins and then ratcheting up fees until these goals are met is bound to be problematic when leading dischargers (here municipal sewage authorities) are unable and/or unwilling to undertake the pollution abatement investments required to meet these goals. In such cases, fees will increase continuously regardless of the investments made by lesser polluters, a politically untenable situation that is likely to damage the credibility of the program.

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Appendix: Discharge Fee Formulae in Decree 901 of 1997

Decree 901 of 1997 regulates Law 99 provisions on retributive fees for water discharges. It mandates that the monthly fee for pollutant *j* (BOD5 or TSS), TR_j, is calculated as

$$TR_j = Tr_j \times Cc_j \times T$$

where

Tr_j = a regional adjustment for quantity total discharges of pollutant *j* by all sources ($/kg),

Cc_j = daily pollution load of the substance (kg/day), and

T = number of days of discharge.

Furthermore, Cc is calculated as

$$Cc = Q \times C \times 0.0864 \times (t/24)$$

where

Q_j = average flow(l/s),

C_j = concentration of the contaminating substance (mg/l),

0.0864 = unit conversion factor, and

t = hours per day of discharges (h).

And Tr_j is calculated as

$$Tr_j = Tm_j \times Fr$$

where

Tm_j = minimum rate ($/kg) and

Fr_j = regional factor.

Tm_j is established annually by MMA. The minimum regional factor is equal to 1. It increases by 0.5 each semester (six months) that a preestablished target for total reductions of discharges by all sources is not met.

Tables

Table 1. MMA Resolutions Regarding Minimum Fee Rate ($ = pesos)

Resolution	*Period*	*BOD ($/kg)*	*TSS ($/kg)*	*Adjustment (%)*	*Source*
0273 of April 1997	4/1/97–5/5/98	39.50	16.90	n/a	n/a
0372 of May 1998	5/5/98–12/31/98	46.50	19.90	17.68	DANE - IPC97
0372 of May 1998	1/1/99–12/31/99	54.26	23.22	16.70	DANE - IPC98
0372 of May 1998	1/1/00–12/31/00	59.27	25.36	9.23	DANE - IPC99
0372 of May 1998	1/1/01–12/31/01	64.46	27.58	8.75	DANE - IPC00
0372 of May 1998	1/1/02–12/31/02	69.39	29.68	7.65	DANE - IPC00
0372 of May 1998	1/1/03–12/31/03	74.24	31.75	6.99	DANE _ IPC02

Source: MAVDT 2005.

Table 2. Invoicing and Recovery of the Discharge Fees by CARs, 1997–2002

Entity	*1997*		*1998*		*1999*		*2000*		*2001*		*2002*		*1997–2002*	
	I ($)	*R* (%)	*I* ($)	*R* (%)	*I* ($)	*R* (%)	*I* ($)	*R* (%)	*I* ($)	*R* (%)	*I* ($)	*R* (%)	*I* ($)	*R* (%)
CAM							782.3	1	923.6	3	479.1	14	2,184.90	5
CAR											201.2	17	201.2	17
Carder											733.9	14	733.9	14
Cardique					987.7	NR	1,407.60	NR	1,442.40	NR	750.7	NR	4,588.30	NR
Carsucre											115.1	1	115.1	1
CAS					883	8	1,763.40	32	2,260.00	42	2,678.10	39	7,584.40	34
CDA													NC	NR
CDMB			584.7	100	1,496.60	100	2,096.80	98	2,572.90	97	3,366.60	87	10,117.70	95
Codechocó			191.6	NR	275.3	7	343.5	48	372.9	9			1,183.30	24
Coralina			29.3	24	53.8		160.2	17	218.2	14	306.1	6	767.6	13
Corantioquia									321.7	NR	55	NR	376.7	NR
Cormacarena							21	NR	75.8	NR	88.7	NR	185.5	NR
Cornare	309	69	749.3	57	1,176.90	85	1,739.00	55	1,980.70	42	829.7	31	6,784.60	54
Corpamag							385.9	3	434.3	5	442.1	19	1,262.30	9
Corpoamazonía											58.9	1	58.9	1
Corpoboyacá									895.2	12	1,591.20	2	2,486.50	6
Corpocaldas							2,546.70	9	2,018.10	NR			4,564.90	7
Corpocesar											544.1	1	544.1	1
Corpochivor											52.6	38	52.6	38
Corpoguajira													NC	NR
Corpoguavio													NC	NR
Corpomojana											133.8	6	133.8	6
Corponariño													NC	NR
Corponor					749.2	15	1,547.30	18	1,656.60	20	1,695.20	14	5,648.30	17
Corporinoquía													NC	NR
Corpourabá			124.9	NR	867.5	13	1,143.80	29	1,530.50	21	1,070.30	15	4,737.00	20
Cortolima					427.3	NR	1,416.40	70	1,744.30	63	1,599.40	42	5,187.40	53
CRA													NC	NR
CRC			177.2	47	945.6	38	1,473.30	36	2,014.50	8	114.2	92	5,724.80	22
CRQ									360.6	15	1,163.00	13	1,523.60	13
CSB													NC	NR
CVC			2,936.60	11	6,237.50	8	15,436.20	15	10,829.40	13	12,193.20	23	47,629.90	15
CVS									587.4	4	2,592.30	4	3,179.70	4
Total	309	69	4,790.70	30	14,100.30	27	32,239.10	27	32,263.40	25	33,854.50	27	117,557.00	27
No. invoicing	1		7		11		15		20		24			
No. collecting		1		6		8		14		16		21		

Notes: I = total invoiced million of 2002 pesos; *R* = % of total recovered; NR = does not report information; NC = has not charged; NF = has not invoiced; * = estimated value.

Source: Contraloría 2003.

Table 3. CAR Five-Year Total BOD and TSS Reduction Goals as of 2001

Entity	*BOD goal*	*TSS goal*	*Implementation date*
CAM	18%	23%	Sept/99
CAR	5.7%	10.3%	Feb/00
Carder	9%	120%	Apr/98
Cardique	3.3%	7.7%	Nov/98
Carsucre	N.I.	N.I.	N.I.
CAS	N.I.	N.I.	N.I.
CDA	—	—	—
CDMB	15%	21%	Mar/97
Codechocó	50%	50%	Oct/99
Coralina	50%	50%	Nov/98
Corantioquia	—	—	1999
Cormacarena	80%	65%	Jul/99
Cornare	50%	50%	Sept/97
Corpamag	—	—	Mar/00
Corpoamazonía	—	—	Aug/00
Corpoboyacá	8.4%	8.5%	Apr/99
Corpocaldas	N.I.	N.I.	N.I.
Corpocesar	N.I.	N.I.	N.I.
Corpochivor	N.I.	N.I.	N.I.
Corpoguajira	N.I.	N.I.	N.I.
Corpoguavio	—	—	Mar/00
Corpomojana	N.I.	N.I.	N.I.
Corponariño[a]*	163	279	N.I.
Corponor	16%	16%	Dec/98
Corporinoquía	N.I.	N.I.	N.I.
Corpouraba[b]	10%	10%	Dec/98
Cortolima	23%	29%	Sept/99
CRA	N.I.	N.I.	N.I.
CRC	34.1%	31.7%	Nov/98
CRQ	25%	32.7%	Sept/98
CSB	N.I.	N.I.	N.I.
CVC[c]	31,300	50,700	Dec/97
CVS	—	—	Oct/00

Notes: * = estimated value; a = kg/day; b = goal is average for BOD and TSS; c = kg/semester; N.I. = not implemented.

Source: Contraloría 2001.

Table 4. Participation in Discharge Fee Programs by CAR as of 2002

Entity	*No. of water users potentially covered by fee system*	*No. users that are invoiced*	*% potential payees that are invoiced*
CAM	75	45	60
CAR	491	91	19
Carder	2,900	632	22
Cardique	72	54	75
Carsucre	31	10	32
CAS	91	91	100
CDA	5,418	1	0
CDMB	160	153	96
Codechocó	2,000	70	4
Coralina	49	6	12
Corantioquia	2607	1,825	70
Cormacarena	10	10	100
Cornare	218	218	100
Corpamag	60	59	98
Corpoamazonía	22	9	41
Corpoboyacá	150	104	69
Corpocaldas	2,400	610	25
Corpocesar	54	49	91
Corpochivor	170	121	71
Corpoguajira	21	21	100
Corpoguavio	23	0	0
Corpomojana	12	2	17
Corponariño	207	10	5
Corponor	49	31	63
Corporinoquía	21	0	0
Corpourabá	485	391	81
Cortolima	86	67	78
CRA	76	21	28
CRC	90	80	89
CRQ	7,500	300	4
CSB	24	0	0
CVC	20,000	259	1
CVS	53	16	30
Average	1,383	162	48

Source: MMA 2002.

Table 5. Role of Municipal Sewage Authorities in Invoicing and Recovery of the Discharge Fees by CARs, 1997–2002

Entity	*1997*		*1998*		*1999*		*2000*		*2001*		*2002*		*Total*	
	I	*R (%)*	*I*	*R (%)*	*I*	*R (%)*	*I*	*R (%)*	*I*	*R (%)*	*I*	*R (%)*	*I*	*R (%)*
CAM							782.3	1	923.6	3	479.1	14	2,184.90	5
utilities (%)							0	0	83	23	84	36	53	29
CAR											201.2	17	201.2	17
utilities											87		87	
Carder											733.9	14	733.9	14
utilities											24		24	
Cardique					987.7		1,407.60		1,442.40		750.7		4,588.30	
utilities					41		27		27		26		30	
Carsucre											115.1	1	115.1	1
utilities											94	79	94	79
CAS					883	8	1,763.40	32	2,260.00	42	2,678.10	39	7,584.40	34
utilities					73	0	56	14	58	29	46	23	55	23
CDA													NC	
utilities														
CDMB			584.7	100	1,496.60	100	2,096.80	98	2,572.90	97	3,366.60	87	10,117.70	95
utilities			84	84	82	33	83	83	88	89	85	87	85	86
Codechocó			191.6		275.3	7	343.5	48	372.9	9	-		1,183.30	24
utilities			91		88		89		99				101	
Coralina			29.3	24	53.8		160.2	17	218.2	14	306.1	6	767.6	13
utilities			97	86	96		99	97	100	99	68	98	87	95
Corantioquia									321.7		55		376.7	
utilities									13		41		17	
Cormacarena							21		75.8		88.7		185.5	
utilities														
Cornare	309	69	749.3	57	1,176.90	85	1,739.00	55	1,980.70	42	829.7	31	6,784.60	54
utilities	0		5	0	26	0	40	0	38	0	44	0	32	0
Corpamag							385.9	3	434.3	5	442.1	19	1,262.30	9
utilities							67	1083	97	0	118	0	95	118*
Corpoamazonía											58.9	1	58.9	1
utilities											100	100	100	100
Corpoboyacá									895.2	12	1,591.20	2	2,486.50	6
utilities									44	68	55	1119*	51	291*
Corpocaldas							2,546.70	9	2,018.10		-		4,564.90	7
utilities							37	15	109				69	11
Corpocesar											544.1	1	544.1	1
utilities												20		20
Corpochivor											52.6	38	52.6	38
utilities														
Corpoguajira													NC	
utilities														
Corpoguavio													NC	
utilities														
Corpomojana											133.8	6	133.8	6

Entity	*1997*		*1998*		*1999*		*2000*		*2001*		*2002*		*Total*	
	I	*R (%)*	*I*	*R (%)*	*I*	*R (%)*	*I*	*R (%)*	*I*	*R (%)*	*I*	*R (%)*	*I*	*R (%)*
utilities											0	0	0	0
Corponariño													NC	
utilities														
Corponor					749.2	15	1,547.30	18	1,656.60	20	1,695.20	14	5,648.30	17
utilities						0								
Corporinoquía													NC	
utilities														
Corpourabá			124.9		867.5	13	1,143.80	29	1,530.50	21	1,070.30	15	4,737.00	20
utilities			0		0	0	193	140	0	0	133	130	77	72
Cortolima							1,416.40	70	1,744.30	63	1,599.40	42	5,187.40	53
utilities							76	70	90	94	91	79	86	82
CRA													NC	
utilities														
CRC			177.2	47	945.6	38	1,473.30	36	2,014.50	8	114.2	92	5,724.80	22
utilities				64		15		34		17		155		53
CRQ									360.6	15	1,163.00	13	1,523.60	13
utilities										94		95		94
CSB													NC	
utilities														
CVC			2,936.60	11	6,237.50	8	15,436.20	15	10,829.40	13	12,193.20	23	47,629.90	15
utilities			0	0		0		47		27		42		38
CVS									587.4	4	2,592.30	4	3,179.70	4
utilities										0		0		0
Total	309	69	4,790.70	30	14,100.30	27	32,239.10	27	32,263.40	25	33,854.50	27	117,557.00	27
utilities	35	0	22	39	32	14	31	51	38	51	36	60	34	52

Notes: I = total invoiced million of 2002 pesos; *R* = % of total recovered; NR= does not report information; NC = has not charged; NF = has not invoiced; * = data internally inconsistent.

Source: Contraloría 2003.

Table 6. Increments in Fee Rates Mandated by Decree 901 of 1997 due to Failure to Meet Annual Targets for Reducing Total Pollution Loads ($ = pesos)

Semester	*Fee ($/kg)*	
	BOD	*TSS*
1	74.24	31.75
2	111.36	47.625
3	148.48	63.50
4	185.60	79.375
5	222.72	95.25
6	259.84	111.125
7	296.96	127.00
8	334.08	142.875
9	371.20	158.75

Source: Own calculations.

Table 7. Effect of Discharge Fees on Average Sewage Bill by Size of Municipality as of 1999

Population	*No. municips. with tariff*	*No. municips. with discharge fee*	*Mean sewage bill ($/user/ mo.)*	*Discharge fee total cost ($/user/ mo.)*	*Effect of fee on the avg. sewage bill (%)*
<2,500	82	15	1,528	483	31.6
2,500–12,000	138	53	2,871	614	21.4
12,000–30,000	26	17	3,856	640	16.6
30,000–70,000	21	14	4,861	602	12.4
>70,000	17	5	8,672	843	9.7
Department Capitals	22	10	10,235	610	6.0
Total	306	114	9,645	619	6.4

Source: Ministerio de Desarrollo 2002.

Table 8. Contribution of 2002 Revenue from Discharge Fee to 2002 Revenue by CAR and Type ('000 pesos)

Entity	*Fee revenue*		*Other revenue*		*Total*	*Fee rev. as % total*	
	Invoiced	*Recovered*	*Nat. contrib.*	*Self-generated*		*Recovered*	*Invoiced*
CAM	401.3	23.5	1,482	6,352	7,834	0	5
CAR	175.9	NR	0	94,394	94,394	NR	0
Carder	427.5	37	1,563	10,745	12,308	0	3
Cardique	195.8	0	1,097	8,654	9,752	0	2
Carsucre	108.3	1.1	1,932	1,963	3,896	0	3
CAS	1224.8	234.5	1,097	7,168	8,265	3	15
CDA	0	0	2,027	197	2,224	0	0
CDMB	2875.3	2555.4	0	34,782	34,782	7	8
Codechocó	0	NR	1,724	2,014	3,738	NR	0
Coralina	208.1	19	2,025	1,643	3,667	1	6
Corantioquía	22.7	NR	3,452	41,949	45,401	NR	0
Cormacarena	NR	NR	261	317	578	NR	NR
Cornare	363.8		0	15,339	15,339	0	2
Corpamag	521.1	0	2,872	3,743	6,615	0	8
Corpoamazonía	58.9	0.3	1,696	5,118	6,814	0	1
Corpoboyacá	874.5	331.3	1,012	7,388	8,400	4	10
Corpocaldas	0	6.1	1,735	7,801	9,536	0	0
Corpocesar	NR	1.5	1,526	1,830	3,356	0	NR
Corpochivor	NR	NR	1,378	5,174	6,552	NR	NR
Corpoguajira			0	12,661	12,661	0	0
Corpoguavio			0	8,958	8,958	0	0
Corpomojana	0	0	1,993	152	2,145	0	0
Corponariño			1,828	5,841	7,669	0	0
Corponor	NR	NR	1,351	7,685	9,036	NR	NR
Corporinoquía			1,108	6,058	7,166	0	0
Corpourabá	1428.8	202.3	2,276	2,525	4,800	4	30
Cortolima	1454.1	532.3	1,031	16,850	17,881	3	8
CRA			896	15,999	16,895	0	0
CRC	NR	162.7	2,663	17,240	19,903	1	NR
CRQ	NR	143	2,785	4,061	6,847	2	NR
CSB			2,292	5,289	7,581	0	0
CVC	NR	1167	0	82,503	82,503	1	NR
CVS	NR	0	105	13,267	13,371	0	NR
Total	10,340.9	5,417.0	45,207.0	455,660.0	500,867.0	27	101.8
Average	544.3	270.9	1,369.9	13,807.9	15,177.8	1	3.9

Sources: MMA 2002 and Contraloría 2003.

Table 9. Discharge Fee Program Performance for the Year 2002 by CAR (data self-reported to MMA)

Entity	*Base-load BOD (ton/yr)*	*5-year BOD reduction goal (ton/yr)*	*Reduction BOD loads (ton/yr)*	*% BOD goal achieved*	*Base load SST (ton/yr)*	*5-year TSS reduction goal (ton/yr)*	*Reduction TSS loads (ton/yr)*	*% TSS goal achieved*
CAM	8,460	0	212	0	7,084	0	158	0
CAR	110,495	108,794	14,170	768	596,582	10,697	48,191	22
Carder	48,676	4,212	32,245	13	46,794	11,231	24,975	45
Cardique	24,198	272	0	0	25,470	80	0	0
Carsucre	1,528	229	0	0	1,278	192	0	0
CAS	5,308	1,372	740	185	6,320	1,504	886	170
CDA	0	0	0	0	0	0	0	0
CDMB	9,592	724	486	149	110,156	3,635	86,578	4
Codechocó	778	388	0	0	1,612	806	0	0
Coralina	774	346	18	1922	858	472	100	472
Corantioquia	6,661	0	5,508	0	6,600	0	5,918	--
Cormacarena	408	133	0	0	486	112	0	0
Cornare	2,595	95	422	23	4,910	112	150	75
Corpamag	2,586	10	733	1	3,857	10	2,290	0
Corpoamazonía	1,735	1,735	0	0	2,210	2,210	0	0
Corpoboyacá	11,258	940	0	0	7,138	589	0	0
Corpocaldas	111,282	10,238	1,698	603	105,324	9,372	2,636	356
Corpocesar	0	0	0	0	0	0	0	0
Corpochivor	1,080	52	76	68	1,043	54	94	57
Corpoguajira	3,550	0	2,840	0	3,522	0	2,817	0
Corpoguavio	0	323	0	0	0	353	0	0
Corpomojana	1,011	131	0	0	1,243	161	0	0
Corponariño	174	97	0	0	376	74	0	0
Corponor	17,806	0	0	0	11,102	0	0	0
Corporinoquía	6,332	126	0	0	6,384	128	0	0
Corpourabá	6,814	545	58	940	6,636	398	74	538
Cortolima	17,598	1,530	4,668	33	20,163	2,234	5,621	40
CRA	19,360	580	0	0	19,028	570	0	0
CRC	8,157	10,108	6,563	154	6,974	8,910	5,698	156
CRQ	17,816	1,953	1,038	188	12,650	2,219	1,027	216
CSB	0	0	0	0	0	0	0	0
CVC	66,598	45,360	5,064	896	53,458	26,122	4,274	611
CVS	4,943	344	0	0	6,895	247	0	0
Average	15,684	5,777	2,319	180	32,611	2,500	5,803	84

Source: MMA 2002.