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Controlling water pollution in developing and transition countries—lessons from three successful cases

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Abstract

The policy prescription for solving environmental problems of developing countries and countries-in-transition (CIT) is slowly getting polarized into two viewpoints. One group of researchers and policy advocates including multilateral organizations upholds extensive use of market based instruments (MBIs) in these countries. The other group argues that institutions need to be built first or the policy makers should select the incremental or tiered approach taking into account the existing capabilities. The group also insists that the financial, institutional and political constraints make environmental regulation in these countries more problematic than in industrialized countries. In the short-run, the immediate needs of the developing countries can be addressed effectively by learning lessons from the difficulties encountered by a few successful cases and accordingly evolving an appropriate policy instrument. In this paper an attempt has been made to highlight three such cases from three different parts of the world—Malaysia (Asia-pacific), Poland (Eastern Europe) and Colombia (Latin America). The paper looks into what policy instruments led to a fall in water pollution levels in these countries and what role did MBIs play in this pollution mitigation? The case studies suggest that it is a combination of instruments—license fee, standards, charge and subsidies—reinforced by active enforcement that led to an overall improvement in environment compliance.

1. Introduction

The policy prescription for solving environmental problems of developing countries and countries-in-transition (CIT) is slowly getting polarized into two viewpoints. One group of researchers and policy advocates including multilateral organizations like the World Bank upholds extensive use of market based (MBIs)/economic instruments (EIs)[2] in these countries. The other group insists on the use of a tiered or piecemeal approach. The proponents argue that developing countries and CIT should use MBIs to tackle their pollution problems because application of MBIs generates 'win-win' situations. More specifically, they benefit the *treasury* (by raising revenue in a cost-efficient manner), the *environment* (by encouraging polluters to alter their behavior so as to become less polluting and/or using the revenue generated to support environmental protection efforts), and the *economy* (by creating incentives for private sector investment in the development of cost-effective environment-benign technologies (see for example, Rietbergen-McCracekn and Abaza, 2000; Panayoutou, 1994; Pearce, 1989; Baumol and Oates, 1988 among others). However, the recent period has witnessed stiff opposition to the idea of blindly promoting MBIs. Bell (2003), Anderson (2001), Soderholm (2001), Cole and Grossman (1999), and O'Connor (2004) among others, argue that either institutions need to be built first or

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[2] The paper uses a number of abbreviations. The full forms are given as and when these abbreviations are used, besides the Appendix also gives the list of these abbreviations.

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that policy makers should select the incremental or tiered approach taking into account the existing capabilities.

Blackman and Harrington (2000) contend that financial, institutional and political constraints make environmental regulation in developing countries far more problematic than in industrialized countries. In a similar vein, Bell (2003) argues that besides valuing efficiency, the chosen environmental policy instrument must be politically acceptable to various stakeholders[3] and supported by existing institutions (mainly the legal system), levels of human capital and infrastructure. He further argues that the four ingredients for success of MBIs, namely transparency, accurate monitoring, realistic incentive to trade, and trust, are scarce in CIT and virtually non-existent in developing countries (Bell, 2003: 12). In this context, Rietbergen--McCracekn and Abaza (2000) argue that in comparison with developed countries, many developing countries and CIT face: (a) more severe environmental degradation; (b) a greater reliance on environmental resources for economic development; (c) weak institutional base to implement environmental policy; (d) a greater risk of resistance to the introduction of MBIs; (e) important issues of equity and social justice; (f) and a weaker environmental research and development (R&D) capacity.

In spite of all these limitations, the potential (theoretical) benefits of using MBIs may clearly outweigh the costs involved in correcting these deficiencies. However, any such endeavor may involve considerable time and resources. In the short-run, the immediate needs of the developing countries can be addressed effectively by learning lessons from the difficulties encountered by a few successful cases and evolving an appropriate policy instrument accordingly. In this paper an attempt has been made to highlight three such cases from three different parts of the world—Malaysia (Asia-pacific), Poland (Eastern Europe) and Colombia (Latin America). The paper looks into what policy instruments led to a fall in water pollution levels in these countries and what role did MBIs play in this pollution mitigation?

The case of Malaysia is very interesting. The increasingly stringent regulations on the Palm oil processing industry did not stifle the growth of the industry and instead complemented the industry's efforts to innovate and remain competitive. On the other hand, despite having one of the highest pollution charges (mainly air), Poland experienced the highest economic growth in the Eastern European (CEE) Region from 1990–1997. The case of Colombia provides another interesting example of an environmental charge that is working in spite of a difficult policy environment. The success of the scheme, given a high GDP growth (averaging 4.6% from 1985 to 1995) with much of the growth being resource intensive (agricultural or mining), makes it all the more appealing.

Since the measures adopted by these countries have resulted in reduced water pollution, other countries can benefit from the positive aspects of these measures. For a firm, a pollution charge is a financial sacrifice and in every likelihood, may be opposed, indicating implementation difficulties. The Polish and Colombian case studies show how these difficulties were circumvented during the course of implementation. Thus, the cases have important lessons for other developing countries. The organization of this paper is as follows: Section 2 gives the Malaysian example along with the lessons to be learnt; the Polish example with lessons is detailed in Section 3; Section 4 gives the Colombian example and concluding remarks are made in Section 5.

It needs to be mentioned at the outset that the focus of the present paper is on water pollution and as such does not endeavor to check the merits and demerits of different possible instruments that can be employed in controlling water pollution. For a discussion on these issues, please refer to Kathuria and Haripriya (2003, 2002, 2000); Markandya et al. (2002); Rietbergen-McCracekn and Abaza (2000) among others. Lastly, the paper is more applicable to medium and large-scale units rather than small units (SSIs).

2. Mitigating the palm oil effluent problem in malaysia[4]

2.1. The Malaysian palm oil industry—origin, growth and extent of pollution[5]

The expansion of the Malaysian palm oil industry (POI) can be traced back to 1960s when (a) the prices of the competing crop—rubber—began to fall; and (b) the Malaysian government embarked on a massive program of agricultural diversification. By the early 1970s, to cater to the processing needs of the plantations, a large number of moderately sized mills scattered around the plantations were established. Between 1965 and 1975, the output of Crude Palm Oil (CPO) grew six times leading to more water use for processing and eventually more discharge of (untreated) wastewater into water bodies (Ma et al., 1980). The estimates suggest that for every ton of CPO produced, the mills generate 2.5 tons of effluent (Ma et al., 1982 as referred in Vincent et al., 1997: 328).

The extent of pollution is reflected in the fact that by mid-1977, 42 rivers in Malaysia were so critically polluted that freshwater fish could not survive in them (Aiken et al.,

[3] To cite an example, the design of SO_2 trading program in USA had to satisfy a wide range of stakeholders (Bell, 2003).

[4] This is an abridged version of the case study co-authored by Kathuria and Khan (2002).

[5] The next two subsections draw mainly from http:/www.unescap.org/drpad/publication/integra/volume3/Malaysia/3my04c02.htm accessed in April 2002, Vincent et al. (1997), and Israngkura (2000).

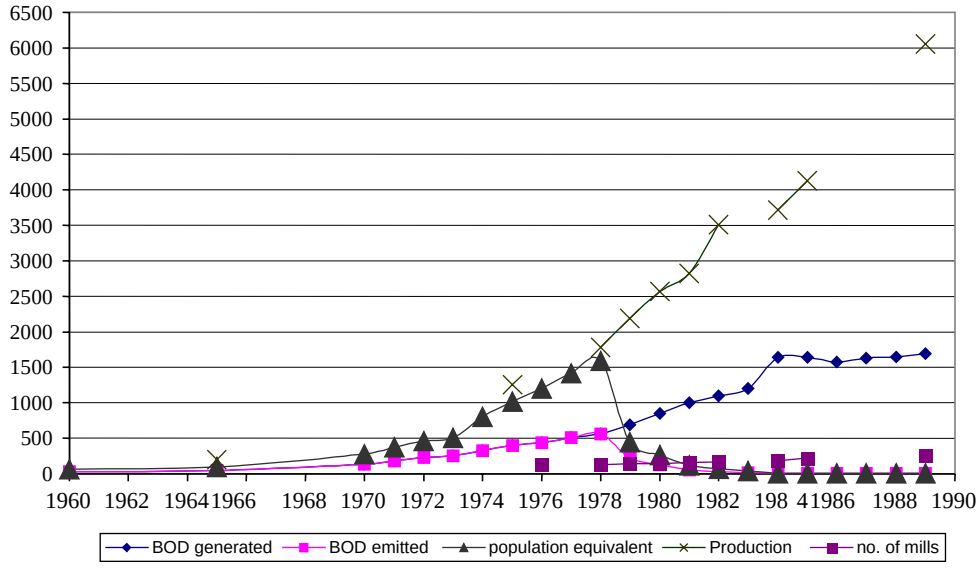

Fig. 1. Trend in CPO Mill's production, number of Mills, BOD generated, discharged and population equivalent of BOD. Source: Kathuria and Khan (2002)

1982). This had wide ramifications because freshwater fish were a major source of protein for rural Malays. Unfortunately, the palm oil mill effluent (POME) problem was unique to Malaysia and no proven treatment technology existed at that time. The pollution situation, however improved within 6–7 years from 1978 to 1985 due to the adoption of different policies. The trend in BOD (biological oxygen demand) generated and discharged along with the CPO production and population equivalent of BOD is shown in Fig. 1. The data shows that in 1975, the BOD load discharged by 131 CPO mills was equivalent to the BOD load in the raw sewage of 12 million people, which corresponded to Malaysia's entire population during that time (Vincent et al., 1997: 320).

By 1985, however, the population-equivalent BOD load declined by 99% to only 80,000 people. Correspondingly, the number of polluted rivers fell to 12 and clean rivers rose to 81 in 1992 (Vincent et al., 1997: 320). This suggests that some strong policies were in place during this period. The change occurred despite a significant ($\approx$72%) increase in the number of CPO mills from 131 mills in 1975 to 225 in 1985 along with the tripling of the industry's output (from 1.3 MT in 1975 to 4.1 MT in 1985) (refer Fig. 1). Interestingly, the period also marked the time when POI became the country's largest foreign exchange earner and Malaysia consolidated its position as the world's largest producer of CPO and accounted for 3/4th of world's exports and its contribution to GDP increased from 4.3% in 1980 to 8.4% in 1989.

2.2. Reduction of palm oil related water pollution in Malaysia—measures adopted

Since the POI was a principal engine of Malaysia's growth and diversification, the government used a combination of three instruments to control water pollution: (i) a pollution tax that was referred to as a license fee, (ii) effluent standards and (iii) R&D subsidies in terms of fee exemption (Israngkura, 2000). Though Malaysia has witnessed various command and control (CAC) based pollution control measures since 1974, the first year of regulations did not impose uniform standards. Instead, a charge was levied on the pollutant discharged by CPO mills, and it was left to them to choose their abatement level and means of abatement (Vincent et al., 1997: 320).

The three major policy steps to control pollution were: the passage of the Environmental Quality Act (EQA), the establishment of the Department of Environment (DOE) (both in 1974), and the formation of an expert committee (with representatives from both the government and industry). These measures convinced the POI that the government was keen on reducing pollution levels. The EQA authorized the DOE to 'prescribe' certain industrial premises i.e., necessitating them to procure a license as a precondition to operate besides fulfilling conditions related to pollution control (Vincent et al., 1997: 330).

On July 7, 1977, the EQ (Prescribed premises) Regulations were announced by the DOE imposing standards on eight parameters of POME (Maheswaran, 1984). The regulations were designed to serve two purposes: (a) raising revenue through licensing; and (b) ensuring a guaranteed reduction in BOD discharge by a minimum amount through standards. The DOE also announced that it would make the standards increasingly stringent over the next four years. The warning was intended to induce the mills make an early investment in treatment facilities.

However, the development of the appropriate standards was an outcome of two years of preparatory work by

Table 1
Regulatory standard for palm oil mill effluent (POME)

Parameter effective date: 1st July of relevant year	A 1978	B 1979	C 1980	D 1981	E 1982	F 1984
BOD[a]	5000	2000	1000	500	250	100
COD	10000	4000	2000	1000	–	–
TS	4000	2500	2000	1500	–	–
SS	1200	800	600	400	400	400
Oil and Grease	150	100	75	50	50	50
Ammonical Nitrogen	25	15	15	10	150[b]	100[b]
Organic Nitrogen	200	100	75	50	–	–
Total Nitrogen	–	–	–	–	300[b]	200[b]
pH	5.0–9.0	5.0–9.0	5.0–9.0	5.0–9.0	5.0–9.0	5.0–9.0
Temperature, °C	45	45	45	45	45	45

Source: Department of Environment (DOE), 1983. Notes: all parameters are in mg/l except pH and temperature.
[a] Sample for BOD analysis incubated at 30 °C for three days.
[b] Value of filtered sample.

the expert committee (Maheswaran and Singam, 1977 as referred in Vincent et al., 1997: 330). Since BOD is the key parameter of the palm oil mills (POMs),[6] it attracted the maximum attention of the authorities. The firms were asked to reduce BOD concentration from 5,000 ppm (parts per million)[7] to 500 ppm in four years—1978 to 1981. These limits were further reduced to 250 ppm in 1982 and to 100 ppm in 1984 (Table 1). The regulators gave a grace period of one year to the mills to install treatment facilities enabling them to comply with the regulations. The regulations also required CPO mills to apply for an operating license every year for a particular fee. The fee consisted of two parts—a flat processing fee of M$ 100[8] and a variable effluent-related fee. The variable component varied according to: (a) the class of premises; (b) the location of premises; (c) the quantity of wastes discharged; (d) the pollutants discharged; and (e) the existing level of pollution so as to induce mills reduce pollution levels.

The first generation standards however did not differentiate between watercourse discharge and on land disposal, as effluent-related fees computed for both the mediums were equivalent. The mills were required to pay M$ 0.05/ton of BOD for discharges onto land. For any watercourse discharge, the fee was M$ 10/ton of BOD for concentrations up to the standard, and beyond that an excess charge was levied equivalent to 10 times the license fee.[9] The mills, thus, had a choice as they could either dispose of their pollution and pay the fee or invest in a treatment facility and save on the license fee.

The later generations of standards, however, created an incentive for watercourse discharge as the effluent related fees were substantially lower than those for land disposal.[10] For example, 100,000 tons of BOD load with a concentration of 100 mg/l discharged into a watercourse would require the mill to pay effluent-related fees of M$ 100 (0.0001×100,000×M$ 10) subject to a minimum of M$ 150 specified in the regulation, compared with M$ 5,000 (100,000×M$ 0.05) for land disposal. The DOE calculated the fees on the basis of information provided by the mills in their license application on projected effluent volume and BOD levels for the forthcoming year. To check the veracity and accuracy of reports, the DOE compared them with quarterly returns and made sudden undeclared visits. In addition to applying for an operating license, the POMs were required to report the total effluent discharge, its composition and the method of disposal every three months.

2.3. Impact of regulations on effluent generation and effluent treatment

The results of policy implementation appear to be quite encouraging, yet below the expectations. The DOE had expected that the average daily discharge of BOD per CPO mill would reduce from 220 to 25 tons. However, it fell to only 125 and many mills opted to pay the excess fee. Of 130 mills, 46% paid a fee of more than M$ 10,000; 7% paid more than M$ 100,000 and a total of M$ 3.5 million was collected (Ong et al., 1987). Table 2 gives the extent of license fee collection from 1978 to 1991. The revenue from

[6] The other seven parameters were—chemical oxygen demand (COD), total solids, suspended solids, oil and grease, ammoniac nitrogen, organic nitrogen, and pH.
[7] 1 ppm = 1 mg /l.
[8] 1US $ = 3.8 RM (Malaysian Ringgit) or 3.8 M$ in 2001.
[9] For example, a 100,000 ton BOD load with a concentration of 5000 mg/l standard of the first generation discharged into a watercourse would require the mill to pay M$ 5000 (0.005×100,000×M$ 10) effluent-related fees. For the same disposal onto land the effluent-related fees were also M$ 5000 (100,000×M$ 0.05) regardless of the BOD concentration.
[10] Since dilution is possible when effluent is discharged in watercourse, whereas the land discharge could have affected the fertility of the land, besides affecting ground water quality. Under the circumstance inducing palm oil producers to discharge on watercourse appears to be the right strategy.

Table 2
License fee collection by DOE from 1978 to 1991 (In M$ 1,000)

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
License fees	2768	714	714	40	219	271	254	258	281	310	335	362	391	376

Source: DOE (different years).

the palm-oil license fee was used to finance the waiver scheme.

The DOE had two alternatives—either to increase the license fee or to make the standards more stringent and binding. The DOE opted for the latter and made it abundantly clear to the mills that any violation of the BOD standard would be dealt with by closure. The threat worked as it yielded immediate results. The average daily discharge fell to 60 tons the next year with a total reduction in load discharged of 84.7%, whereas in terms of the effluent-related fee none of the mills paid more than M$ 10,000 after the 1980s.

2.4. Innovations in treatment technology and development of by-products

In addition to inducing a reduction in the average discharge, the enforcement of the fee also prompted cost effective innovations in treatment technology.[11] Mills having access to land used the pond system, while mills with limited land used a system of agitated tanks (Vincent et al., 1997). The industry's efforts to develop better treatment technologies received further impetus in 1980 when the government established the Palm Oil Research Institute of Malaysia (PORIM). Endeavors got a further boost by the development of various commercial by-products such as animal-feed, fertilizers and methane gas from POME (Vincent et al., 1997: 335).

The efforts of the industry and the impact of regulations are amply reflected in a survey conducted by PORIM in 1980–81. The survey found that the effluent of 90% of the 40 mills surveyed had a BOD concentration below the fourth-generation standard of 500 mg/l. It is worth noting that 40% of the mills were discharging POME with a BOD concentration even below 100 mg/l (Ma et al., 1982). These findings and other evidence of ongoing improvements in treatment technology encouraged the DOE to announce the fifth and sixth generation BOD standards further lowering BOD levels (refer Table 1). In compensation, the DOE eliminated standards on COD, total solids and organic nitrogen, which the survey revealed, proved rather difficult for the industry to meet (Vincent et al., 1997). By the end of 1982, 80% of 185 POMs complied with the fifth generation standard of 250 mg/l.

What made the industry comply so fast? There could be a number of possible explanations to this, e.g., the development of a simple and cheap treatment technology, commercialization of by-products, support of PORIM etc. However, none of these could have been possible without stringent enforcement. The DOE suspended the license of 27 mills to enforce the standard strongly during the period 1981 to 1984 (Vincent et al., 1997). This created fear in the minds of mill owners and they started complying with the standards.

2.5. Cost of meeting regulations

The fall in pollution level in such a short period raises an important concern—what was the cost incurred by the industry to meet the regulations? Chooi (1984 as referred in Vincent et al., 1997: 336) found that relative to the industry's total production costs, treatment costs were quite low—only 0.2% in 1983. The regulations, however, created a perverse distribution effect where the burden fell on (small) palm-oil producers and not on palm-oil processors or customers. This is because of the highly competitive world market structure for fats and oils, which made it virtually impossible to shift the costs on to consumers. Two-thirds to three-fourths of the increased costs were shifted upstream and borne by palm-oil growers, who had no outlet for the fruits except the POMs (Khalid, 1991; Khalid and Braden, 1993). By 1984, it was calculated that the mills had spent about M$ 100 million on treatment facilities. This amount could represent the loss incurred by palm oil producers.

2.6. Palm oil mills—current scenario

In recent years also the production of CPO has increased by almost 50% from 7.8 MT in 1995 to 11.8 MT in 2001 (Malaysian Palm Oil Promotion Council News Bulletin, 2001). Currently, Malaysia accounts for 51% of the world palm oil production and 62% of world exports. With respect to environmental compliance, the practice of revoking licenses is still being followed. For instance in 1997, 117 firms were charged with environmental offences for flouting their licensing conditions, out of which 66 (i.e., 56%) were POMs.[12] With respect to the river water pollution, unfortunately, the continued growth of CPO mills has reversed the trend. The number of clean rivers, which was

[11] Such innovations are, in fact, not specific to Malaysia. Any true enforcement—be it of standards (say, technology based, as in US or emission based, as in Malaysia) or MBIs—will induce firms innovate and find cheaper ways of doing. I am thankful to one of the reviewers for pointing this out.

[12] Source: http://www.biotech.com/spillevent8.htm accessed in July 2002.

81 in 1993, fell to 24 in 1997. In the same period, the number of polluted rivers increased from 12 to 25. However, it should be noted there are arguments stating that the fall in water quality could be due to less water in the rivers caused by the El-Nino effect, which could have detrimentally affected their self-cleansing property.

2.7. Lessons from Malaysia's pollution control experience

The Malaysian experience in effluent control in the palm oil industry has shown that a set of well-designed environmental policies can be very effective in controlling industrial pollution in a developing country. The CPO regulations with active enforcement by the regulator in Malaysia represent a mixed system of pollution control instruments. Malaysia's experience in the regulation of the palm oil industry offers several lessons for pollution control efforts in other developing countries:

(a) Pollution reduction and industrial expansion can occur simultaneously. The fact that an industry is economically important is not a justification for not addressing the pollution problems caused by it.
(b) The environment and industry objectives can be merged only if an effective and relatively inexpensive technology is developed along with numerous byproducts from the effluent. But this can be possible only with the active support of the State.
(c) The other lesson that can be learnt is that a proper support to R&D is required if compliance is to be ensured. The inclusion of a clause by DOE that full or partial waiver of the charges/fee is permitted if any firm was believed to undertake R&D on effluent disposal or treatment reflects this support.
(d) The last and the most important lesson that can be learnt is that compliance requires a regulator to fulfill multiple roles—a credible regulator, a facilitator and an enforcer. The credibility of laying down the standards was established when the industry was also made part of the standards fixation process, whereas, the facilitator role of the regulator became apparent when the DOE decided to give some time to the industry to construct a treatment facility and acquire some experience before implementing new regulations. However, the pollution control process could succeed because of proper enforcement in the form of unannounced visits, penalizing the defaulters, closures etc.

3. Tackling the water pollution problem in Poland

3.1. Water pollution problem in Poland

Poland has limited water reserves with a per capita water availability of 1630 cubic meters (cum), which is one of the lowest in Europe. Several natural and anthropogenic factors tend to aggravate this situation. Since the planners were more occupied dealing with the scarcity of water, they virtually neglected the water quality aspect in Poland. In 1991, almost 11% of the country's territory was considered 'severely environmentally threatened'. Of the 118 rivers monitored in 1990, only 6% of the rivers were rated in the Class I category (i.e., of drinkable quality with the use of only disinfectants).[13] Eighty per cent of river length was deemed non-classifiable according to the biological characteristics and 36% according to physio-chemical properties. This increased to over 83% and 40% respectively by 1992. Tables 3 and 4 give the status of Polish rivers from 1974 onwards.

Pollution from untreated sewage was one of the chief problems for both rivers and lakes. It was estimated that in the early nineties 63% of the total population fell under the untreated sewage category leading to excessive BOD concentration and heavy metals. Water quality was also a serious problem along the coastline (OECD, 1995). In 1989, about one-third of the wastewater was discharged without treatment into the surface water, and only about 32% of the discharge was treated at the required level (Nowicki, 1993). Even where the effluent had been treated, the treatment efficiency was rather low, with only 40% of the treated waste achieving 75% BOD removal (OECD, 1995). Industrial discharges were responsible for toxic pollution. Coal mining led to the problem of saline water in Upper Silesia, in the two major rivers of Poland—Vistula and Oder. This ultimately led to pollution problems in the Baltic Sea as the Vistula river empties there (OECD, 1995). Likewise, groundwater resources became progressively polluted as untreated wastewater, drainage from waste dumps and agricultural chemicals seeped into the groundwater table. Thus, it is clear that pollution was a serious problem in Poland, with industry being a major contributor till the early 1990s. Only in the last five years has the situation been improving. It is argued that the efforts of the Polish government and various policy instruments used have made more than a nominal contribution to the improvement.

3.2. Environmental regulations in Poland[14]

Poland developed a system of environmental/resource charges and fines as part of the environmental management system as early as in the 1970s, whereas pollution fees and environmental protection funds were first levied in the early 1980s. However, the charges during the period were toothless. This is because the soft budget constraint for

[13] Poland has classified its rivers into four categories in decreasing order in terms of quality.

[14] This subsection draws mainly on Anderson and Fiedor (1997) and http://www.rri.org/envatlas/europe/poland/pli-nst.html accessed in July 2002.

Table 3
Change in water quality status of polish rivers-physio-chemical parameters

Year	Length of control sections (1000 Km)	Cleanliness Class I	Cleanliness Class II	Cleanliness Class III	Non-classified (overly polluted)
1974–77	17.8	9.6	30.7	26.7	33
1978–83	16.2	6.8	27.8	29	36.4
1984–88	17.6	4.8	30.3	27.8	37.1
1990	10.1	6.0	27.9	30.3	35.8
1995	6.2	2.9	20.3	33.8	43
1996	@	4.2	21.5	42.5	31.8
1997	@	2.1	21.9	44	32
1998	@	2.9	23	34	30.1

Source: CSO (1990); CSO (1996); CSO (1999) as referred in Lehoczki and Sleszynski (2000); Peszko and Lenain (2001). Notes: Physio-chemical parameters comprises of surveying 23 parameters including temperature, turbidity, pH, conductivity, alkalinity, total dissolved solids etc. The figures are in %age terms of total rivers monitored; @—Information not available.

Table 4
Change in water quality status of polish rivers-biological parameters

Year	Length of control sections (1000 Km)	Cleanliness Class I	Cleanliness Class II	Cleanliness Class III	Non-classified (overly polluted)
1984–88	16.5	0.0	3.9	20.3	75.8
1990	10.1	0.0	3.0	16.8	80.2
1995	6.2	0.0	3.1	11.8	85.1
1996	@	0.0	2.5	13.5	84.0
1997	@	0.0	3.1	12.2	84.7
1998	@	0.0	2.5	23.4	74.1

Sources: Same as Table 3. Notes: Biological parameters include BOD, COD, coliform etc; Other notes as above.

State-owned enterprises meant that the extra financial burden of an environmental charge was more or less covered by additional money from the State. The major function of the charges was to raise revenue into 'ear-marked' funds (national and local). However, with the change in the political and economic scenario in 1989, the environmental charges became institutionalized. In the post 1989 era, the costs and profit implications of the charges became real and the charges were re-established with emphasis on their direct incentive impact.[15]

3.2.1. Facility permits

The primary policy instrument used for achieving environmental objectives in Poland is the *facility permit* for point sources of pollution discharges (and emissions). Polish law requires all economic units to apply for permits to the Voivod[16] administration for water intake and wastewater discharges. The permit specifies: (a) the allowable amount of sewage disposal; (b) highest concentration of particular pollutants; and (c) other technical features of sewage (e.g. the radioactivity or temperature). The application procedure requires an environmental impact statement (EIS), furnishing details on: (i) production levels; (ii) types of production processes; (iii) fuels used; (iv) types and volumes of discharges/emissions; and (v) the types of installed pollution controls. Although firms have to self-declare all the details, the veracity is easily ascertained, as the EIS needs to be approved by an independent reviewer. Since charges and fines are doubled for any pollutant not covered by a valid permit, strong incentives exist for obtaining at least a temporary permit. New permits may also be denied if ambient standards are exceeded. Most of the larger facilities in Poland operate under either a valid permit or a temporary permit. In 1992, 17,389 facilities were registered as water polluters and 46, 305 as air polluters. Due to limited resources in processing permit applications, it is estimated that half the facilities operate without valid permits and have only temporary permits (Broniewicz et al., 1994: 5–6).[17]

3.2.2. Environmental charges and fines

The provisions for imposing environmental charges are contained in the Environmental Protection Law (EPL) of 1980, the Water Law of 1974, and amendments to these laws. Both laws restrict the use of revenues from charges to ecological purposes (i.e., earmarking) and require disbursement through environmental funds. Besides these, the other two important legislations are: the Statute on the State

[15] Source: Sofia Initiative: Economic Instruments (http://www.rec.org/REC/Programs/SofiaInitiatives/EcoInstrume-nts/EIReport).

[16] The term 'region' is referred to as 'voivodship' or 'wojewodztwo' in Polish.

[17] Anderson and Zylicz (1996) as referred in Blackman and Harrington (2000: 31) also state that in 1992, 55% of all registered water polluters (and 40% of air polluters) were operating without valid permits. This implies both categories—firms having valid permits and firms operating with temporary permits—were instrumental in the fall in pollution in Poland, as we shall see later.

Table 5
Charges for wastewater in Poland in 1995 ($/ton)

Group	Industry	Parameters					
		BOD_5	COD	SS	C and S	HM	VP
1	Power generation, fuel processing, chemical, metallurgical, machine, and light industries	1722	1206	74	6	8600	3226
2	Pulp and paper	732	434	74	6	8600	3226
3	Food industries	430	290	74	6	8600	3226
4	Municipal sewage, hospitals and social care institutions	172	96	74	6	8600	226
5	Other (except saline coal-mining waters)	861	483	74	6	8600	3226
	Saline coal-mining waters discharged—to an aquifer	–	–	–	48	8600	–
	—from dosing reservoirs	–	–	–	6	8600	–

Source: Anderson and Fiedor (1997). Notes: * For discharges into lakes and retention reservoirs double rates apply. C&S, HM and VP are Chloride and sulfate ions; Heavy metals; Volatile phenols respectively. The total payment is calculated as the maximum charge for BOD_5, COD, SS, and C&S; added to the charge for HM and VP.

Inspectorate for Environmental Protection (1991) that created an environmental inspectorate; and the National Environmental Policy (NEP) (1991) adopting sustainable development as its basis.

The NEP aimed to achieve three main objectives: (i) to encourage polluters to minimize the social costs of meeting environmental goals; (ii) to ensure that charges bear some relation to the marginal damages; and (iii) that charges generate revenues, which could be reused for environmental investments and related purposes (e.g., education, research, monitoring equipment etc.). The procedure for levying charges is formulated by the Ministry of Environmental Protection, Natural Resources, and Forestry (MEPNRF), where a list of pollutants is prepared for charge assessment and decisions about charge rates taken.

The salient features of the water pollution charge are as follows: (i) the charge is based on the total volume of selected pollutants present in the wastewater and is levied on six major classes of pollutants namely, BOD, COD, SS, heavy metals, chlorate and sulphate ions, and volatile phenols; (ii) any enterprise discharging its sewage directly into surface waters or soils, must obtain wastewater discharge permits; (iii) the charge is calculated on the basis of self-reported emissions. Generally, charge rates are revised annually and are adjusted for projected inflation in the next year to avoid any slippages in charge rates. It is to be noted that since the consumption goods prices did not really reflect the production costs in the 1970s and 1980s—the period when charges were first introduced—the households were largely protected from the potential price impact of the charges. Therefore, public negotiations were not part of the original preparation. Similarly, the soft budget constraint for State-owned enterprises precluded any effort to consult the industry before designing the instrument. However, in the post 1990 era in Poland, consultation with industries became one of the important factors in the design of policy instruments.[18]

For assessing charges, factors like damages, abatement costs, and economic characteristics of the polluting sector are taken into consideration, ultimately the rates are set at levels that are politically acceptable and meet revenue requirements (Peszko and Lenain, 2001). The charges were increased and differentiated by geographical regions and by type of industry indicating pollution intensity in 1990 and 1991. For instance, Katowice, a water-scarce region has twice the rates of the rest of the Poland. The wastewater discharges from different industries have been classified in five groups (Table 5). Regular rates are doubled for industries falling in polluter group 1, like chemical, fuel processing etc. The multiplying factor for enterprises in polluter group 2—i.e. the paper and pulp industry—is 0.85 of the regular rate and so on (Table 5).

An interesting feature under the EPL (1990 amendment) is that the enterprises can treat environmental charges as normal production expenses and can deduct the amount paid from taxable income. Another attractive provision allows enterprises to deduct the amount levied in the current year on the taxable income even if the enterprise pays the charges in the next calendar year.

3.2.3. Fines

Fines are levied if the regulated firm discharges pollution in excess of the levels specified in the permit. Generally, the fine is equal to the difference between the actual and permitted pollutant levels multiplied by the fine rate, which is simply a multiple of the charge rate (Anderson and Fiedor, 1997). The wastewater penalties are generally 2–3 times the applicable charge rate, but can be as high as 10 times. Thus, Poland has a hybrid and two-tiered fee/standard instrument. A normal charge/fee is to be paid on all discharges (or emissions) below the standard and a 'penalty fee/fine' is paid on all discharges (and emissions) above the standard.

3.3. Enforcement issues

The State Inspectorate, established in all 49 Voivods, has the main responsibility to enforce permits. The Inspectorate determines the extent of permit violations, levies non-

[18] Source: Status of Public Participation Practices in Environmental Decisionmaking in Central and Eastern Europe (http://www.rec.org/REC/Publications/PPstatus/Poland.html accessed on September 2004).

compliance penalties (for discharges beyond permitted levels), approves requests for deferral of penalties, and monitors the enterprises' progress in addressing violations.

The Inspectorate can ask for the immediate payment of deferred fines if an enterprise fails to take corrective actions. In practice, Regional Inspectorates do not ask for payment of deferred charges until the period ends, even if a polluter makes no effort to correct the violation[19] (Anderson and Fiedor, 1997: 9). The Inspectorate is also empowered to shut down persistent violators or units operating without valid permits. For tax purposes, non-compliance penalties/fines are treated differently from charges. Enterprises are not allowed to deduct them as production expenses, but they can defer them for 3–5 years. The penalties can be waived if investments exceed them. In contrast, if the enterprise fails to comply, a 50% surcharge on the original amount of the penalty is collected.

At the beginning of the transformation process in Poland, the MEPNRF prepared a list of 80 worst polluting units in the country based on the criteria of: (a) frequency of pollution discharges beyond standards; (b) concentration of discharges; (c) location; and (d) range of negative impacts. These units were asked to meet the criteria by April 1993. Another 800 enterprises were then targeted for not meeting the criteria and subjected to special supervision by the Voivod offices. These enterprises were required to prepare environmental audits and develop compliance strategies. The discussion thus indicates that enforcement is the key to pollution control in Poland.

3.4. Impact of the charges on revenue generation

Water pollution (and other) charges are collected once a year by the Voivod administration. The revenue from charges and fines is distributed to the National, 49 Voivod, and approximately 2400 Municipal (Gmina) Environmental Funds in the proportions 36, 54 and 10% respectively for expenditure on water pollution control.[20] It is estimated that nearly 450–500 million US$ are collected annually from (air and water)[21] environmental charges and fines, which account for nearly half of the annual capital costs of environmental investments in Poland (Anderson and Fiedor, 1997: 3). The wastewater charges and fines (except saline mining waters) are earmarked for reducing pollution in general, but not necessarily to address a specific type of wastewater problem.

Table 6
Environmental charges and fines imposed and collected before and after policy changes (in million US$)

Year	Imposed charges	Amount collected	Collection efficiency rate (%)
1990	31.1	30.1	96.8
1991	523.1	385.7	73.7
1992	649.6	446.8	68.8
1993	660.6	428.5	64.9
1994	585.9	431.6	74.0

Source: Kruszewski (1994) till 1993, NFOSiGW (1995) for 1994—referred in Anderson and Fiedor (1997).

Although recent data is not available, the imposition and collection increased substantially immediately after the changes in the charge-regime in 1991 (Table 6). The collection rate for fines is difficult to interpret because of provisions for deferral. Yearly fluctuations in collection rates may be attributed partly to the payment of delinquent and unpaid charges in the current year.

Since the level of charges imposed is based on self-reported emissions and discharges, the ability of Regional Inspectorates to verify these is limited in terms of adequate personnel. The task is compounded due to a large number of facilities and the requirement that individual pollutants must be checked. In addition, there appear to be a number of SMEs that have not been included in the charge system. Similar problems exist for fines too. This suggests that potential charges and fines are probably higher than the levels reported.

3.4.1. Impact of the charges on wastewater effluent

A report by the State Inspectorate in 1993 has listed the following environmental impacts (relative to 1989 levels) after the adoption of water pollution charges: (i) the decrease in sewage discharge by 37%; and (ii) removal of several industries from the 'list of 80'. The policy has also led to technological changes, process modernization and installation of pollution abatement equipment resulting in reduction of water pollution levels. The implication of the water charge is evident from Table 7, which shows a downward trend of wastewater discharge from 12,903 million m^3 in 1985 to 9797 million m^3 in 1994 i.e., a fall of nearly 25%. In the initial years post-1989 (i.e., first half of 1990s), though there was some kind of industry shutdown and sluggish growth, its impact in terms of facilitating improvement was not much. This is because, the decline in industrial wastewater generation was only

[19] This is the personal communication of Anderson and Fiedor with the Warsaw Voivod Inspectorate in 1996.

[20] Not all charges and fines are distributed identically. Charge and fines on NOx and saline mining wastewater discharges are distributed only between National and Gmina funds in the ratio of 9:1. Whereas, charges and fines on solid and hazardous waste disposal are disbursed in the ratio of 2:3:5 among National, Voivod and Gmina funds (Spyrka, 1994 as referred in Anderson and Fiedor, 1997). The variation in distribution is to keep larger objectives in mind. For example, a substantial share going to National fund from saline mining water charges and fines is to ensure flexibility for financing investments in pollution controls at mines, as well as treatment in downstream river basins. Similarly, the distribution scheme for solid and hazardous waste charges and fines reflects the local nature of disposal and impacts (Anderson and Fiedor, 1997: 6).

[21] Of these, nearly 20% are pertaining to water effluent. For the period 1994 to 1996, the yearly revenue from water effluent charges and fines hovered around 100 million US$ with the collection efficiency of averaging 44% (Source: http://www.rec.org/REC/Programs/SofiaInitiatives/EcoInstruments/EIReport).

Table 7
Total wastewater discharge in Poland

Year	Waste water discharge (million m^3)				Waste water intensity	
	Industrial wastewater	Municipal wastewater	Total wastewater	%age Change (annual)	m^3/million PLZ	%age change
1985	12,903	12,903	12,903	–		
1990	9100	2400	11,500	−2.35 (avg.)		
1992	@	@	10,048	−5.88 (avg.)	20.29	10.57
1993	@	@	9738	−3.08	20.31	0.098
1994	@	@	9797	0.6	18.79	−7.48
1995	8050	1900	9950	1.56	17.54	−6.65
1996	8125	1875	10,000	0.5	16.77	−4.4
1997	8100	1850	9950	−0.5	15.97	−4.77
1998	8025	1850	9875	−0.75	15.05	−5.76

Source: Sleszynski (1996); Peszko and Lenain (2001). Note: PLZ, Old Polish Zloty; PLZ 10,000= PLN 1 (new Polish Zloty); In 1996, approx. PLZ 27,000=US $1.

7% compared to 30–40% in many of Eastern European countries.[22] In the second half of 1990s, the Polish GDP growth rate was quite impressive with an average growth of 5.5% per annum[23] indicating it as one of the most successful transition economies. Despite such a high and robust growth, the industrial and wastewater generation has not increased since 1994, as the wastewater generation has remained the same (i.e., approx, 8025 million M^3) (Table 7), thus indicating a significant fall in discharge in real terms.

The indicator that would best reflect the impact of pollution charges is how much of the wastewater discharge requires treatment. Against 32.5% of water requiring treatment in 1990, only 10% required treatment in 1998 (Peszko and Lenain, 2001). Another indicator that reflects on the efficiency of the charge system is wastewater intensity. This is calculated as the amount of wastewater in cum (cubic meter) per million PLZ of GDP. The table reveals that the charge system has resulted in a significant fall in wastewater generation intensity from 20.29% in 1990 to approximately 15% in 1996, i.e., an over 25% decline.

3.5. Reduction in industrial pollution: current scenario

The Baltic Marine Environment Protection Commission, known as the Helsinki Commission (HELCOM), has announced that Poland has made good progress in cleaning up its pollution hotspots, but Polish rivers are still too polluted to use for industrial or agricultural production. Investments in environmental protection in the country have increased five-fold since 1990, with 94% of funding coming from within the country, in many cases from the polluting plants themselves. The National Fund in Poland has reinvested £125 million to restore some of the hotspots. As a consequence, in 1999, of the total daily 5.3 million m^3 wastewater discharge, 86% was being treated.[24] With respect to the list of 80, seven units have been permanently closed and the production at another 22 facilities was interrupted by 1993. By May 1994, the list comprised 74 units after few additions and deletions (Anderson and Fiedor, 1997: 15). The recent data indicates that in the period 1992–1998, the Inspectorate shut down the operations of 136 plants (Wajda, 2000 as referred in Peszko and Lenain, 2001: 5).

3.6. Problems with design and implementation

Despite the successful application, the instrument suffers from some design and implementation problems. The provincial inspectorates lack staff resources and face a huge burden of monitoring pollutants. Sometimes the factories violate the rules by not acquiring a water permit. Self-reporting may also induce them to falsify. It needs to be mentioned here that the self-reported emissions/charges could be one of the weakest factors of implementation in Poland. This is because these self-reported emissions or discharges are checked only as part of monitoring compliance with permitted emissions/-discharges. And such monitoring is rather weak in most of the Eastern European CIT including Poland. This is because the regulator has a limited ability to verify self-reported emissions/discharges as it is understaffed, under financed and many a time lacks public support (Blackman and Harrington, 2000). Further, many enterprises do not pay the charges levied. One of the problems with the Polish environmental charge and fines is that it is difficult to isolate the effect of charges alone on compliance decisions, independent of subsidized

[22] Source: http://www.unep.or.jp/ietc/Publications/TechPublications/TechPub-15/3–7EuropeEast/7–1–1.asp.

[23] Source: http://www.oecd.org/document/37/0,2340,en_2649_201185_1916581_1_1_1_1,00.html.

[24] Source: http://www.edie.net/news/Archive/4723.cfm.

financing. This is because the revenue from charges is re-circulated as grants and soft loans to enable enterprises to finance environmental investments which form almost half of the funds.

Another problem with the fines is that a significant proportion of fine levied is not collected, and gets deferred. Against a non-compliance fee of US$ 101.4 million in 1994, only 13.5 million US$ was collected, indicating a collection ratio of 13% (NFOSiGS, 1995 as referred in Anderson and Fiedor, 1997).[25] A poor collection rate could have a perverse impact on compliance behaviour of other violators.

While Polish charges are differentiated across the regions and nature of the industry, critics argue that no transparent methodology was applied while designing the rates. A closer look indicates some flaws in rates for different users. For example, charges for surface and ground water use and wastewater discharge are 31, 47 and 10 times higher for certain classes of industrial users than for households, municipalities and agricultural interests (Zylicz, 1994 as referred in Anderson and Fiedor, 1997: 12). It is suggested that they need to be differentiated according to the quality of watercourses into which a unit discharges its effluent, not solely on the basis of industrial use. For instance, Vistula river may not have uniform quality of water through its watercourse. A higher charge for discharge into watercourse having less carrying capacity can be more effective.

As charges and fines serve mainly two purposes—raising revenue and sending price signals on the true cost of using the environment, critics argue that the second function is fulfilled less effectively. Polish pollution fees are high as compared to countries using them for revenue raising purposes (France, United States, Japan, Netherlands), but they are still lower than effluent fees and taxes designed for incentive purposes as in the case of Germany, Slovenia and Czech Republic (Peszko and Lenain, 2001: 21). Furthermore, the current scheme involves cross-subsidization of municipalities by industry, which runs counter to the 'Polluter Pays' principle.

3.7. Lessons to be learnt

The objective of a pollution charge system anywhere in the world is to contain pollution levels by forcing polluters pay a price for their excesses. The charges are implemented by the governmental organizations and revised annually to adjust for inflation and non-compliance. The same has been practiced in the case of Poland. The case of Poland is all the more interesting for despite having one of the highest pollution charges, it experienced the highest economic growth in the CEE region from 1990–97. The policy encouraged polluters to invest in environmental protection equipment. The environmental protection investments compared to 1991 increased by 1.8 times in real terms in 1998 (CSO, 1999 as referred in Peszko and Lenain, 2001: 5).

It is true that one of the important factors for improvement in water quality in Poland was public investment in wastewater treatment plants. However, it has to be looked at from the angle of overall environmental policy being pursued in Poland. The major rationale for the construction of water treatment plants was the stringent effluent standards introduced with the directive of the MEPNRF on November 5, 1991. The directive introduced new water protection strategy where for the first time effluent standards were tied to wastewater treatment scope and required efficiency.[26] Since till that time river water quality used to be the base for designing wastewater treatment plants, the change in directive induced municipalities to invest in highly effective technologies for treating water. Besides this, additional factors that contributed to a decline in wastewater generation, were the use of more efficient technology, introduction of water pricing etc., which reduced the need for water.[27] However, despite all these, it is the environmental policy of 1991 that led to improvement in water quality. Two factors drive Poland's environmental policies: the need to correct the damage from the Cold War and the desire to integrate with other free-market democracies. The success of Polish water pollution charges can be considered for the following lessons:

(a) The most important lesson learned from the Polish example is that it did not rely exclusively on charges; rather it is the combined use of discharge permits based on environmental quality standards with fees and fines, public environmental subsidy schemes and widely publicized list of the worst polluters that brought the pollution problem in control; and these were complemented by long-term time consistency, gradual tightening of enforcement and limited administrative discretion.
(b) An important feature of the Polish charge system is its flexibility. The system allows the enterprises to treat their charge amounts as normal business expenses. It also permits them to deduct the amount of charges levied in the current year from the current year taxable income even if the unit actually defers the payment until next year. But the State Inspectorate needs to keep a vigil on such enterprises so that the practice does not culminate into a widespread problem. In such a situation, there would be a squeeze of funds in

[25] It is to be noted that figures in subsection 3.4 are for both —environmental charges and fines and for both mediums —air and water. But these figures are only for 'fines' collected for water pollution.

[26] Source: http://www.lwr.kth.se/Forskningsprojekt/Polishproject/JPS3s11.pdf.

[27] Source: http://www.unep.or.jp/ietc/Publications/TechPublications/TechPub-15/3–7EuropeEast/7–1–1.asp.

the medium to long-term and many subsidy and assistance schemes would be adversely affected.

(c) The Polish water pollution charge has been successful in solving the problem of inflation, as it is automatically revised annually to adjust with the inflation.

(d) The earmarking of revenue from pollution charges for ecological purposes and various subsidy and assistance schemes for enterprises is definitely an example of a strong political will and an efficient institutional set-up. Since charge is a financial sacrifice, which an enterprise has to incur for the common good, the earmarking ensures support of the enterprises for the charge.

(e) A noteworthy feature of the implementation of Polish environmental charges and fines is that continuous monitoring of discharges (or emissions) is not required. The extent of violations is estimated *ex post*, on the basis of frequency of violations and calculations based on discharge (or emission) factors, level of production and use of inputs (e.g., amount of dyes used by the enterprise etc.). Under Polish law, the penalty rate is fixed and cannot be reduced even through negotiations. However, the degree of violation may be subject to negotiation.

(f) Another lesson that can be learnt from the Polish example is using the resources more efficiently by targeting heavy polluters first. In that connection, the government has first made a list of 80 heavy polluters followed by another list of 800 organizations presumed to be more polluting in nature. The preparation of the list has helped central and local administrations focus their attention on the environmental hot-spots and also stimulated communities in the neighbourhood of listed enterprises in solving environmental problems.

(g) Though the deferral policy most often leads to elimination of violations, it has some disadvantages. First of all, it increases the workload of inspectorates, as the inspectorate has to undertake the monitoring of a polluter's plan to correct a permit violation. Secondly, the added penalty for failing to comply after requesting deferral is only a one-time charge of 50%. For a 3–5 year deferral this is insignificant given recent annual inflation rates ($\approx$25%) in Poland. However, if the penalty is also adjusted for the rising inflation rate, it will correct this problem and may lead to more compliance.

4. Water pollution taxes in Colombia

Colombia introduced water user charges as early as 1942, but the real introduction of water charges took place only in 1993, with the passage of Law 99. The scheme was implemented initially in 1997 in seven regions of the country, with each region allowed to vary the rate until the target reduction had been achieved. At that point the charge was frozen in real terms. The scheme resulted in significant reductions in emissions across the country. For instance in the Rio Negro, BOD discharges fell by 68% and overall organic discharges in the areas covered fell by 87% by 2001 (ACEE, 2001c: 2). Even the collection rate was very high-reflecting the success of the charge system. This section analyses under what circumstances the water tax was introduced and how it led to the fall in organic pollution load over time.

Table 8
Pollutant load contributed by three tributaries to river Bogota

Tributaries	Pollution load (in tons)		Other pollutants
	SS	Organic Matter	
Juan Amarillo	135	105	NA
Fucha	650	300	Heavy metals (such as Cd, Cr, Pb, Hg)* and Toxic substances like detergents, fats and oils
Tunjuelo	571	80	Do

Source: Serroa da Motta et al. (2000: 168). Note: NA, not available, * The source of these heavy metals is galvanizing and anodizing units.

4.1. Water pollution problem in colombia—background[28]

Colombia, which is divided into 34 departments and 1082 municipalities, has abundant renewable water resources with more than 1000 river systems and 720,000 micro-watersheds. Rainfall level exceeds 2000 mm per year for over 88% of the country, with a national average of 3000 mm per year. The total volume of rainfall is 3425 km^3 and the evaporation volume is 1313 km^3, giving an overall water availability of little over 2000 km^3 per year.

Despite a high reserve of water sources, water bodies are highly contaminated due to discharge from industries. For instance, the contamination of the Bogota river starts very close to its source, with discharges from the tanning industry. Further downstream, a stretch of 150 km receives sewage and wastes from municipalities, slaughterhouses, horticultural enterprises, coal yards, foundries, thermal plants, and other industries. By the time the river reaches Bogota, it is already carrying 35% of its contamination. In Bogota, the city sewerage system through three tributaries runs into the river with no purification. Table 8 gives the pollutant load contributed by each of these tributaries.

Similarly, in one of the most industrialized regions of Colombia, i.e. the Oriente Antioqueño covering an area of 8100 km^2 and a population of nearly 600,000 inhabitants, the water pollution problem was severe until 1997. Pollution of rivers in the 8 most important basins of the region was caused by both municipal and industrial load. The municipalities in the region did not have wastewater

[28] Unless otherwise stated, the next two subsections are based on Seroa da Motta et al. (2000) and Uribe and Meléndez (2003).

treatment plants and around 500 industries were discharging effluents without treatment.[29]

Until the first half of 1997, 95% of municipal wastewater, 70% of industrial wastewaters and 90% of agro-industrial wastewaters flowed into Colombia's watershed ecosystems untreated (ACEE, 2001c: 2). The health costs associated with this water pollution have been estimated at around US $17 million per year (Seroa da Motta et al., 2000: 168).

4.2. History of water pollution charges in Colombia[30]

The history of water use charges in Colombia dates back to 1942 when 'vigilance' service rates were introduced by the Ministry of Agriculture to finance the monitoring of water use. Since 1974, water user charges were introduced by INDERENA (the Institute of Renewable Natural Resource) and the regional Environmental Protection Agencies (EPAs). In 1982 INDERENA established eight types of charge rates according to water usage, from hydro-power generation (at US$ 0.012 l/sec/month) to the use for shipping (charged at US$20/vehicle/ semester). Rodriguez--Becerra and Uribe (1995 as referred in Seroa da Motta et al., 2000) find that due to low levels, these charges had no significant impact on the cost of water to users. Moreover, they were not systematically collected too. Available data indicates that till 1989 only US$ 0.116 million was collected against potential revenue of almost US$ 90 million.

As part of the National Development Plan for 1991–94, the government developed a strategy to improve the environmental regulatory framework and resolve environmental issues in a coherent way. This led to Law 99 in December 1993, with the creation of the Ministry of Environment (MoE), the National Environment Council (NEC), and the National Environmental System and closure of INDERENA. MoE took complete charge of environmental responsibilities, and was made responsible for the National Environmental Fund. NEC was created as a mechanism to secure agreements among diverse social groups on matters of National Environmental Policy.

Law 99 also redefined and strengthened the role of the Corporaciones Autonomas Regionales (CAR's) by decentralizing power, as 16 new CARs were created, and making them solely responsible for environmental management in their jurisdictions. The Law also emphasized the use of EIs and in particular the use of 'compensatory' and 'retributive' pollution charges. The 'compensatory' tax relates to the compensation to CARs required to ensure a given level of quality for a given water resource, whereas, 'retributive' tax relates to the retribution or recompense to the water body for acting as a deposit for waste. The new legislation redefined the retributive rates so the tax: (i) must reflect the social costs of pollution; (ii) is levied for using the resource as a receiver of the discharge; and (iii) will encompass all activities-public or private.

The MoE defines the tax level and collection system on a yearly basis, by formulating a tax structure and listing the variables to be taken into account in its determination. The Ministry also establishes a minimum tax level applicable nation-wide. The local environmental authorities can adjust the rate levels—only upward—to reflect the carrying capacity of the location.[31] The retributive tax finally got implemented in 1997 following decree 901. The main issues defined by this decree were as follows:

(a) Initially the tax will be charged only on emissions of organic waste i.e., BOD and TSS. The minimum tax rate will be US$ 0.03 and US$ 0.013 per kilo respectively.
(b) Each regional EPA will establish an environmental target that will be revised quinquennialy. The target will be determined through a consensus and participatory-based process involving different stakeholders associated with the water resource in question.
(c) Polluters must present an emission report regularly every six months. EPAs will organize random emission tests to verify the accuracy of the information.
(d) Tax rates will be adjusted every six months on a regional basis until the predetermined goal is achieved.
(e) Tax levels will be adjusted by increasing the regional factor (a multiplier) by 0.5. This implies that for those regions adopting the minimum level set by the Ministry, the tax will double the first year, and increase by 50, 33, 25 and 20% between the second and fifth years.

The first phase of implementation covered seven highly populated, developed and polluted regions. The program was called Watershed Cap and Charge program (WCC). An analysis of abatement costs indicated that a charge of US$ 100 per ton would reduce the industry's organic emissions to waterways by 80% (Wheeler, 2000). However, the program began by charging only US$ 28 per ton for BOD and US$ 12 per ton for TSS. It was assumed that these charges would be high enough to impinge on the pollution level, but not too high to provoke any hostility from the industry.

Most of the remaining regions would participate subsequently. The plan to implement compensatory tax was, however, put on hold, because strong political

[29] Source: Decontamination Costs, Polluter Pays… in Latin America and The Caribbean (http://www.inbo-news.org/pdf/inbo8_11_a_16.pdf) accessed on December 30, 2002.

[30] For a detailed history of pollution charges and other institutional changes for pollution management in Colombia, please refer Uribe and Meléndez (2003).

[31] This is similar to the 'subsidiarity principle' of the European Union (EU) policy making or the one followed in India, where the States can tighten the pollution norms depending upon region's carrying capacity (Kathuria, 2004).

Table 9
Industrial sector effluent discharge in three regions before and after the WCC program

Region	BOD (kg/semester)			TSS (kg/semester)		
	Before	After WCC	% Change	Before	After WCC	% Change
CVC	5,200,000	3,700,000	28.85	4,000,000	2,750,000	31.25
CORNARE	1,250,000	450,000	64.00	900,000	100,000	88.89
DADIMA	6,150,000	3,750,000	39.02	7,800,000	3,600,000	54.13

Source: Adapted from ACEE (2001c: 2). Note: Before WCC means the baseline level for BOD and TSS, which is determined by the environmental authority and is included in the negotiation process with each regulated sector.

opposition was anticipated. The use of environmental charges has been well supported by a number of other instruments. Notable among these are 'People's Action Law' and 'Transfer Payments for Environmental Services' and tax incentives.

4.2.1. People's Action Law and Environmental Information Systems and Industry participation

The Judicial system has also played an important role in the implementation and orientation of environmental policies, as the constitutional reform of 1991 laid the foundation of legal instruments, such as—the 'Citizens' Rights Action' (Acción de Tutela), the 'Compliance Action, ' and the 'People's Action'. The latter specifies that anyone who files a People's Action has the right to a compensation between 10–15% of the total value of the work necessary to correct the environmental damage caused. This provided a strong incentive for citizens to sue non-compliant firms, and also represented a potentially powerful substitute for an ineffective administrative enforcement. The effectiveness of these instruments has been proven in a short time: in three years there have been almost 300 'tutelas' related to environmental disputes.

Environmental Information system is another important tool being used to influence the firms' behaviour. The Environmental Department of Bogota (DAMA) has designed an advanced environmental information system to inform the public about industrial environmental performance. Through the website, one can observe the industrial discharges in the city. This information is important for the public as it serves as a strong tool to demand that the firms should improve their environmental performance. In a study underway at the University of the Andes in Bogota, it has been found that the publication of the environmental monitoring data on the internet constitutes a significant incentive for environmental investment (Uribe and Melendez, 2003).

Lastly, in a number of CARs agreement on cleaner production has been signed with the industrial sector since 1995. In CORNARE 65% of the goals in agreement have already been reached due to a fall in BOD from 122,483 ton/sem to 42,687 ton/sem and in TSS from 25, 288 ton/sem to 8,545 ton/sem respectively (Uribe and Melendez, 2003: 51). Similarly in Cartagena 85% of the firms participating in the Agreement have already given their respective Environmental Management Plans to achieve the target.

4.3. Impact of charges

4.3.1. Environmental impact of WCC since 1997[32]

After four years of implementation of the WCC program, ECLAC evaluated the effectiveness and economic efficiency of the charge system in three major watersheds with serious pollution problems: the Rio Negro, Cauca and Magdalena river basins under the jurisdiction of CORNARE, CVC and DADIMA respectively.

When WCC was implemented, firms were categorized into two groups—Group 1—firms in CVC and CORNARE region, where some firms were in compliance, and Group 2—industrial sector in DADIMA, where most firms were not. The compliance of Group 1 was an outcome of previous wastewater treatment plant (WWT) regimes, when the regulated sector had carried out significant investments in WWT, but they all had high abatement costs. Imposition of charges affected the pollution load in both the groups, but in Group 1, the reduction was much more than what was achieved with WWT, thus, facilitating the environmental authority to rapidly achieve a reduction in total pollution levels as shown in Table 9.

4.3.1.1. Environmental impact under the jurisdiction of CORNARE. In CORNARE's jurisdiction, while pollution was reduced by 10% only during 15 years of administrative control, in a few months, since its launch, the WCC program reduced the BOD by 20% and TSS by 34%. Such a drastic reduction in such a short period raises suspicion about figures. However, as we shall see later, the way the program was implemented and enforced, it dispels any suspicion. Moreover, though the impact was imminent and quite drastic, responses differed widely across the plants. Of the 55 regulated plants, only 7 cut their BOD emissions, and 8 TSS emissions (Wheeler, 2000). Two explanations can be given for the divergent response: (i) MAC for many of the plants might be higher than the charge levied; and/or (ii) the managers might not have sufficient time to adjust their

[32] The Economic Commission (ECLAC)'s executive summary (as referred in ACEE, 2001c) of evaluation of WCC program and Uribe and Melendez (2003) form the basis of this subsection.

Table 10
Fall in effluent discharge in CORNARE region before and after the WCC program

	Industry	% Fall in BOD load	% Fall in TSS load
1	Industrial Cluster	68	87
2	Aquaculture	57	47
3	Poultry Industry	87	81
4	Cut-flower industry	51	55

Source: ACEE (2001a: 2). Note: All these industries are in Rio Negro area.

Table 11
Fall in effluent discharge in CVC region before and after the WCC program

	Sector	% Fall in BOD load	% Fall in TSS load
1	Sugar refining industry	55	65
2	Pulp and paper industry	14	64
3	Rest of the industry	14	41
	Total industry	33	60

Source: ACEE (2001a: 2).

pollution control practices. The situation improved even further, as by the end of 2000, BOD and TSS loadings fell by 56% and 67% respectively. Table 10 gives the fall in different sectors from the baseline.

4.3.1.2. Environmental impact under the jurisdiction of CVC. CVC was the second agency to implement the WCC program in the first semester of 1998. Table 11 gives the fall in pollution loadings in different sectors in the region. It was primarily in the sugar refining industry, where pollution loading fell drastically, mostly with the adoption of cleaner production processes. Till the end of 2000, polluters had already paid to CVC a total of US $1.37 million (ACEE, 2001a: 2). The funds were managed under the new Regional Environmental Fund, and were to be used for financing public decontamination projects, demonstration of new technologies, research in cleaner production and environmental education programs.

4.3.1.3. Environmental impact under the jurisdiction of DADIMA. DADIMA implemented the WCC program in the second semester of 1999. As shown in Table 9, the total flows from the industrial sector fell in Barranquilla discharging into the Magdalena river by 39% and 54% for BOD and TSS respectively. During the period, DADIMA billed industries for a total of US$ 359,000 and received US$ 330,000 indicating a collection of nearly 92% (ACEE, 2001a: 2).[33]

[33] Since the overall budget outlay from the Ministry has fallen due to recession, the revenue has been used to fund operating costs and environmental projects, which otherwise would not have been carried out (ACEE, 2001a: 2).

An important reason for a drastic fall in different parameters was the sustained progress towards environmental quality goals, which were agreed upon by industrialists and different CARs (Uribe and Meléndez, 2003).

4.3.1.4. Compliance costs of pollution charges—case studies. The ECLAC study also looked into compliance costs of pollution charges in three specific cases: two private companies—Monomeros Colombo Venezolanos S.A. and Canteras Yarumal and one sector—the Association of Sugar Cane Growers—ASOCANA. The case studies yielded three important findings: (a) after the firms started paying for their effluents, their discharges reduced even more than previously achieved with the CAC system; (b) the flexibility introduced by the WCC program led firms to seek cleaner production alternatives upstream in production process; and (c) while searching for greater efficiency in the production process, firms not only managed to reduce their pollution loads but also increased their productivity levels (ACEE, 2001c: 3).

4.3.2. Impact on revenue collection—strengthening of regional regulatory programs

Historically, regional environmental authorities in Colombia have depended on the national budget for financial support. During recession or a fiscal crisis, the outlay dwindles. The WCC program has provided stability and strengthened the environmental management by generating a continuous flow of financial resources. As more and more regional authorities started implementing the program, it led to a sharp increase in total revenue. The revenue from the program in relation to the national budget allocations rose sharply from 10.1% in 1998 to 227% in 2000. For instance, since implementation, WCC has generated US $9.7 million in total revenues, which is nearly 2.36 times higher than the national budget allocations in the same period for the 14 environmental authorities, which are billing the pollution charges (ACEE, 2001b: 2). Two additional impacts of increased financial flow are: (a) better financing of the personnel, activities and supervision of water resources by the regulator; and (b) support to new investments and co-financing of municipal WWT projects (ACEE, 2001c: 3).

In some of the regions like Rio Negro the administration of charges has been quite efficient as not only the charges assessed in 1999 were high, but the collection also was close to 99%. In the recent past, the collection rate in CORNARE has fallen, though it is still very high. Until the end of year 2000, the collection rate was nearly 85% (a total of $ 1.14 million billed) (ACEE, 2001a: 2). Table 12 gives the charges assessed and collected in Rio Negro for the year 1999.

Such a high success rate in collection also warrants an in-depth analysis. This is because the previous experience of Colombia was quite disastrous in terms of collection.

Table 12
Pollution charge administration in Rio Negro in 1999

	Sector	Total pollution sources	Sources charged (%)	Total charges assessed (Million Pesos)	Total charges collected (Million Pesos)
1	Urban sewage	8	8 (100)	57.3	57.3 (100)
2	Urban industry	55	43 (78.2)	65.6	64.4 (98.2)
3	Agro-industry	46	41 (89.1)	0.2	0.2 (100)
Total		109	100	123.1	121.9 (99)

Source: CORNARE as referred in Wheeler et al. (2000). Note: 2573.3 pesos = 1 US $ (as on October 2004). Figure in parenthesis are percentage of the total in that category.

Learning from its own failure, the MoE followed an innovative scheme, as it enlisted one of Colombia's top commercial banks to collect the pollution charges (for a percentage fee). The administration and disbursement of funds was also entrusted to the bank. This ingenuous solution acted as a two-pronged strategy for the program's effectiveness. First, it reduced the burden on the local agencies, which had little expertise in billing, collecting and disbursing and they could concentrate more on monitoring. Secondly, it encouraged private sector polluters to pay to preserve their credit ratings[34] (Wheeler, 2000; and Coronado, 2001 as referred in Sterner, 2002: 324).

4.4. Impact on institutional cost-effectiveness

The WCC program has proved to be more cost-effective for authorities than the WWT program. For example, though the total cost of the two programs is similar in CORNARE, the pollution loadings decline has been greater under WCC program. The regulatory cost per kg of BOD reduced fell by 79% from US $0.07 (165 pesos) in the previous system to US $0.02 (35 pesos) with the WCC program (ACEE, 2001: 3). Fig. 2 gives the change in the regulatory cost in the two regimes.

The survey of firms by ECLAC also yielded several important findings. These include a clear preference to cleaner production investments over WWT due to price pressure and both kinds of firms (in compliance and non-compliant) make rational investments when faced with pollution charges (ACEE, 2001c: 3). Furthermore, as the economic incentives also give flexibility to the firm, the fall in pollution may go much beyond the standards. The following cases illustrate this. In the case of Sugar industry located in the Cauca basin, despite the fact that WWT were in operation when the WCC system was implemented, additional pollution reductions were achieved through cleaner production, as the BOD load fell by another 24% and TSS by an additional 65%. Before implementation of WCC, the fines as well as plant closures imposed on Monomeros Colombo Venezolanos S.A. and Canteras Yarumal did not yield desired pollution levels. However, both firms reduced effluents by over 90%, when billed by the EPA (ACEE, 2001c: 3). The abatement led to savings of more than 400 million pesos (US $171,233) and 22.6 million pesos (US $9,674) a year respectively in the payment of charges.

An interesting aspect of WCC is that the firms reduced their pollution loadings even when production levels rose by introducing efficiency in the production system, especially in water use. For instance, despite an annual increase of 5.6% in the production of the sugar industry during 1998 to 2000, the total sectoral pollution load fell by more than 22% over the period.

4.4.1. Environmental expenditure/investments

Environmental investments by manufacturers are one of the ways to see the level of implementation of environmental policies. Between 1995 and 2000, the environmental expenditures of the manufacturing industry increased steadily while public environmental spending fell. In 2000, the environmental investments of the manufacturing sector and the government were similar, in each case close to 0.25% of the GDP (i.e., ≈US$ 240 million) (CEDE, 2001 as referred in Uribe and Meléndez, 2003). One of the causes for increased environmental investments is tax incentives. Between 1997 and 2000 tax exemptions rose nearly to US$

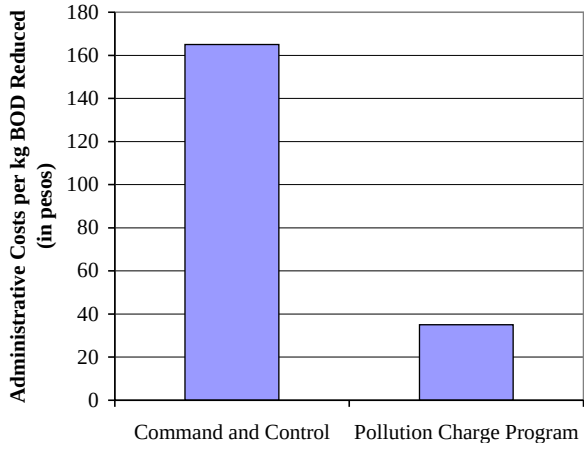

Fig. 2. Regulatory cost per ton of BOD reduced in two regimes. Source: ACEE, 2001c

[34] The impact of this is akin to informal regulation of pollution widely used in some countries like Indonesia, Philippines etc. Refer Kathuria (2004) for a discussion on formal and informal channels of informal regulation.

80 million against environmental investments of nearly US$ 500 million.

4.5. Implementation issues

The implementation issues in the case of Colombia can easily be divided into two phases—phase 1 when the charge was being designed and phase 2 after the WCC program started functioning.

4.5.1. Implementation issues before introduction of charge

As already stated, the Law 99/93 eliminated the cost-recovery limitations of charges and specified that pollution charges should be based on the criteria of full environmental costs. The new rules necessitated a demanding and sophisticated institutional capacity. In particular, 90% of the CARs declared that the technical requirements were too rigorous for them to implement. Uncertainty in economic and social impacts also generated strong opposition from polluters and users. Realizing that the complexity of the proposed MBIs was exceeding domestic institutional capacity,[35] the Colombian EPA streamlined the program by implementing it in stages. Moreover, attention was paid to a careful analysis of economic and social impacts on future negotiations with polluters and users.

Before the WCC program began, CORNARE forged a good relationship with local businesses and communities as they worked closely with several large factories to develop plans for installing cleaner technologies. CORNARE also collected good information about local water pollution and can now successfully pinpoint the major sources of discharges into the Rio Negro and other rivers. After consulting with factory managers and communities, CORNARE set a reduction target of 50% for organic discharges within six months. Though the industry leaders protested that such an ambitious target would prove too costly, BOD discharges from industry into the Rio Negro fell by 52% in the first six months and TSS discharges fell by 16% under the plan.

Once the appropriate charges (having significant impact on pollution without bankrupting polluters) were decided, the MoE team sensed that the political issues were eclipsing the technical issues. Polluters themselves started showing concern about who would get the money paid by them. The regional agencies laid claim to some of the funds, as it would give them insularity from political interference. The idea that the remainder would go to the central treasury did not find acceptance with the industrialists and public works managers (Wheeler, 2000). They viewed the charges as a 'financial sacrifice', which they would bear provided the revenues were 'earmarked' to fund local environmental investments.

This resulted in protracted negotiations with the regional EPAs enlisting community-based organizations as their allies. The negotiations yielded that the charge program would support 'regional decontamination funds'. A part of the revenue would also be diverted to fund agency budgets. These funds were to be shared between various activities including end-of-pipe treatment, cleaner production, creating awareness etc. Column 2 of Table 13 gives the breakdown of the revenue shared for these activities. Column 3 gives the actual allocation for the year 1999 against that proposed by the CORNARE.

Table 13
Proposed sharing and actual allocation of revenues in CORNARE collected from environmental charges for 1999

	Activity	Proposed allocation (%)	Actual allocation (%)
1	Co-financing municipal wastewater treatment	70	50
2	Co-financing cleaner production in industry and farming (R&D projects)	20	30
3	Feasibility studies for new approaches	5	
4	Environmental Education Projects (School, Universities)	5	5
5	Research		10
6	Administration		5
Total		100	100

Source: Colombian Environment Ministry as referred in Wheeler et al. (2000: 135) and CORNARE, 2001 as referred in Sterner (2002: 324).

4.5.2. Implementation issues after the introduction of charges

Two implementation issues—extending the coverage of polluting sources; and appropriate tax level determination—are yet to be effectively tackled. To work as incentives, these taxes must be applied in proportion to the volume of polluting substance discharges. Otherwise, the rates would become a simple revenue-raising mechanism. At present, the coverage of the system is only restricted to those industries and residential locations operating as 'point' sources of pollution and sanitation companies handling discharges from these sources. In fact, the National Association of Industrialists (ANDI) in a public hearing openly expressed its concerns stating that it would create inequities and competitive disadvantages for companies that do pay and reduce charges (ACEE, 2001c: 4).

Besides these, some degree of conflict has also arisen among the polluters (Sterner, 2002: 323). Industrial polluters are claiming that the rising charges are unfair because the industrial sources have already reduced their effluents, while the municipalities have done nothing. Meanwhile, municipalities, which were contributing to

[35] The situation of weak institutional capacity is not specific to Colombia. There is increasing evidence that even in developed countries MBIs are facing constraints because of limited institutional capacity (OECD, 1994a and 1994b as referred in Seroa da Motta et al., 1999: 178).

the tune of 44% of effluent have refused to pay their fees, alleging they have no money (Sterner, 2002: 324).

On October 12, 2001 a special public hearing discussed contamination levels associated with municipalities, which despite representing 70% of pollution loadings, had no plans to either decontaminate or pay charges. The ANDI argued that where both industries and municipalities coexisted, the non-compliance from the latter made it harder to reach the decontamination target, resulting in a gradual increase in the charge (ACEE, 2001c: 5). The Association of Public Utility Companies (ANDESCO), representing municipalities, however, argued that even though Law 142/94 allowed the incorporation of environmental charges in the operation costs and the transfer of these to users, many companies had not paid for the charge due to lack of a clarifying resolution from the National Regulatory Commission (ACEE, 2001c: 5). It is argued that the Association is apparently following a strategy to legally entangle the program, instead of paying the charge or proceeding with WWT.[36]

Despite these implementation problems, recently in September 2001, in DADIMA, the major municipals agreed to pay pollution charges. The Aqueduct, Sewage and Hygiene Company of Barranquilla—Triple A—which had vehemently opposed the program since its implementation, finally agreed to pay its pollution charges beginning October 2001 and the debt totaling US$ 1.08 million (approx. 2.5 billion pesos) in monthly installments (ACEE, 2001a: 5). The agreement could be secured only with a vigorous action by DADIMA when they imposed an embargo on Triple A's assets. Previously in 2000, Public Enterprises of Medellin (EPM) initiated its payments of US $ 2.5 million debt under the WCC program and is currently advancing in the implementation of WWT (ACEE, 2001a: 2).

4.6. Lessons to be learnt

The case of Colombia provides an interesting example of an environmental charge, which is working despite a difficult policy environment. The CORNARE success is also instrumental in the gradual spreading of the charge system throughout the 33 regional environmental agencies in Colombia. Of the country's 37 regional environmental authorities, 26 have officially established programs with 5 year decontamination goals, and 14 are now charging for pollution as well as collecting revenues (ACEE, 2001b: 2). Table 14 gives the amount charged and collected for a few CARs. The success has also diverted attention to expand the system by introducing charges for air pollutants; solid waste; and highly polluting segments of the agricultural sector (e.g., large-scale plantation crops such as banana and coffee) (Sterner, 2002: 324). An important favourable development seems to be the attitudinal change, which becomes evident from the statements given by the environment ministry in different forums.[37]

Table 14
Amounts charged and collected from retributive taxes (2001 dollars)

Sr. No.	Environmental Authority	US $ Charged	US $ Paid	% collected
1	CRC	467,623	232,394	49.70
2	Corpoaruba	310,317	47,624	15.35
3	CDMB	1,389,031	817,737	58.87
4	Cortolima	403,970	154,117	38.15
5	Cornare	950,629	436,523	45.92
6	Cardinare	487,200	49,118	10.08
7	Carolina	63,990	11,521	18.00
8	Cas	946,709	66,391	7.01
9	DAMA	452,137	–	–
10	Area Metropolitana	294,015	13,876	4.72
11	Dagma	4,873,860	–	–
Total		10,639,482	1,829,301	17.19

Source: Oficina de Analisis Economico, Ministry of Environment as referred in Uribe and Melendez (2003). Note: '-' not available.

Table 15
Index of regulatory control for six environmental authorities in Colombia

Sr. No.	Environmental Authority	Control Index	No. of Firms	Control Index/ No. of firms
1	DAMA	3824	149	25.7
2	CAR	88	10	8.8
3	Cornare	468	24	19.5
4	Area Metrop.	77	7	11.0
5	CVC	403	11	36.6
6	Dagma	198	12	16.5

Source: Uribe and Melendez (2003). Note: Control Index is equal to number of equivalent letters, where 1 visit = 2 letters and 1 fine = 5 visits.

Though the WCC program has proved to be a success, there are still some implementation problems. First of all, the level of implementation is uneven due to varied institutional capacity as found by a recent survey of 250 industries in different parts of the country (Uribe and Meléndez, 2003). Table 15 giving the extent of regulatory control for six environmental authorities in Colombia, testifies to this.

Another problem is that despite changes in technological factors, scientific information about impact of pollution, social preference for environmental quality, and legal and constitutional framework, the discharge standards have not changed since 1984 except in Bogota. Besides, the pollution reduction occurred during the most severe economic recession Columbia has faced in decades. The country, of late, has come out of the recession. It will be interesting to see if the declining trend in pollution reduction continues.

[36] Some observers believe that the strategy is designed to wrest control of the revenue stream away from the environmental authorities (ACEE, 2001b: 2).

[37] Two such statements have been quoted by Sterner (2002: 325).

A recent study by The ACEE estimated that with proper operation and administration, the pollution load can be reduced further and there is a potential to collect up to US$ 17.3 million per year (ACEE, 2001b: 2). The potential is because: various environmental authorities including DAMA and CAR in Bogota with a very high pollution load, are not collecting the pollution charges; and several public utility companies, the country's greatest polluters have procrastinated paying the charge. Despite these problems, the success of the program has a number of lessons for other developing countries:

(a) Widespread political support is essential for the successful implementation of any instrument be it MBI or CAC. In the case of Colombia despite a change in the National administration twice, and three different environment ministers since 1997, the support for the program has continued. This is because the program's local constituencies remain politically potent (Wheeler, 2000).
(b) Another important lesson is the proper definition of competency between regional and national agencies. According to ECLAC—this solved one of the main problems in Colombia's public environmental management (ACEE, 2001c).
(c) The success of a program also requires a close co-operation between the industry and the regulatory agency. This implies that the regulator should act as a facilitator. Industry usually needs credible evidence that pollution control will not bankrupt them. The Colombian case illustrates that industry support was gathered after numerous meetings in which regulators and international experts presented credible information about abatement costs (Wheeler, 2000).
(d) The charge should not prick the firms financially. This is another important message from the Colombian case. The charges were kept high enough to affect the manager's cost calculations significantly. And it became more profitable to treat than to pay charges.
(e) Another lesson, which is very vital is that an initial support from the industry can only be garnered if the amount collected is *earmarked* for environmental management in the region. This may sound a little bizarre from a public finance theory point of view, but initial acceptance is more important than some welfare loss due to earmarking.
(f) The ingenuous scheme of charge collection—where a market mechanism was also made use of—also has some lessons for other countries. Successful collection was possible with the involvement of an outside agency. Although the agency was an outsider, it had inside information about the firms. This is because the firms were dependent on it for loans, etc. The agency used an 'informal' channel of pollution control implicitly. Separation of collection from the monitoring facilitated EPA to concentrate on monitoring only.
(g) Lastly, as in the case of Malaysia and Poland too, it is a combination or joint working of a number of instruments—CAC, MBI and Suasive along with an active complementary role of a number of actors and active enforcement, that has finally led to the desired change in Columbia.

5. Concluding remarks

The present paper gives three cases from three different parts of the world where the efforts of the State led to control of water pollution. The case studies show that the application of policy instruments has never been an instant phenomenon. Rather in most of these countries it was an organic process where several reversals were effectively tackled as and when a crisis occurred. The case study of palm oil mills in Malaysia, water pollution charges in Poland, and the pollution charges program of Colombia suggest that it is a combination of instruments—license fee, standards, charge and subsidies—reinforced by steady enforcement that leads to an overall improvement in environment compliance.[38] In fact, it is interesting to note that a recent study by Jordon et al. (2003) on the use of new environmental policy instruments (NEPI)[39] in eight developed countries[40] also finds similar results. Despite the fact that all these countries moved towards NEPI, the evidence suggests that regulation is still the dominant instrument for pollution control (Jordon et al., 2003: 209).

The combined use of several instruments has an important lesson for other countries that adequate attention should be paid in ensuring that the instruments neither overlap nor come into conflict with one another (Jordon et al., 2003a: 222). Use of a plethora of instruments also indicates that the State's task of tackling the pollution problem is now much more involved than was the case earlier, when it was resorting to only CAC regulations.[41] Since many instruments have simultaneously applied to tackle the problem, an important issue emerges is that 'what is the relative effectiveness of each instrument?' A proper understanding of the relative effectiveness of different instruments can help developing countries in a better way,

[38] It needs to be mentioned that in most of the successful examples from developed countries, enforcement proved to be the key. For example, in the case of SO2 trading program in USA, the non-compliance is promptly punished (Bell, 2003).
[39] The instruments selected are ecotaxes, tradable permits, voluntary agreements, eco-labels and regulation.
[40] The countries selected are Austria, Australia, Finland, France, Germany, Ireland, the Netherlands, and the U.K.
[41] For example, Jordon et al. (2003b) in their study of use of NEPIs for UK find that to negotiate 42 climate change voluntary agreements (VAs), the environment ministry devoted 17 person years.

as they can prioritize the implementation of instruments and save the scarce financial and other resources.

Two of the case studies indicate that there is a shift from environmental government to environmental governance, as regulation has given way to innovative instruments like charges, their collection, targeting etc. The case studies also illustrate that the choice and implementation of specific policy instruments depends to a considerable degree on the national context, the country's political profile, and the relations between the government and industry (Anderson, 2001). The examples reinforce the fact that the barriers to use of MBIs are fundamentally different in developing countries from those in transition economies and even between developing countries. Not only the barriers, but also the institutions are different across countries. In fact, the study by Jordon et al. (2003a) clearly validates this in the context of eight OECD countries that despite each country adopting the MBIs, 'the use is anything but homogenous' due to different political and institutional set-ups (Jordon et al., 2003a: 209).

An important barrier in many of the developing countries to the use of MBIs is the lack of strong support even from the respective environmental ministries and regulatory bodies.[42] In fact, the antipathy was strong in the case of developed countries too when they started implementing MBIs. However, the 1990s has seen a steady decline towards this aversion (Jordon et al., 2003a: 206). The hostility to MBIs is primarily a reflection of the legal, technical and/or scientific background of the policy makers. Another important barrier, which no longer exists for developed countries, is the opposition from environmental pressure groups especially for environmental taxes. The 1990s has seen its steady demise for eco-taxes in most developed countries including CITs. However, in most of the developing countries this opposition and suspicion about the use of instruments like eco-taxes, charges or voluntary agreements persist.

However, there are barriers, which exist in almost all the countries irrespective of their level of development. Some of the important ones are opposition from vested interests, public opposition, fears about competitiveness etc. Energy intensive industries irrespective of the nationality often oppose adoption of eco-taxes and tradable permits. As a consequence, most of the developed countries adopting eco-taxes have given generous exemptions to high-energy users, in gross violation of the efficiency criterion. In fact, there has been considerable industry resistance to tradable permits in Austria, Finland, France, Germany and Ireland (Jordon et al., 2003a: 207). Similarly, public opposition to any new tax is a major emerging constraint in many countries irrespective of the development status. The protests in France, UK, Austria, Germany, etc., against rising fuel prices reflect the same institutional barrier as prevalent in many developing countries including India, Bangladesh etc.

Lastly, fear about loss of competitiveness as raised in Germany, France, Ireland etc., is no different from the concern often brought up in many developing countries. However, the Malaysian example shows that pollution reduction and industrial expansion can occur simultaneously. The fact that an industry is economically important does not provide grounds for not addressing the pollution problems caused by it. The earmarking of revenue from pollution charges for ecological purposes and various subsidy and assistance schemes for enterprises in Poland is definitely an example of a strong political will and an efficient institutional set-up. Since the charge is a financial sacrifice, the earmarking ensures support of the enterprises for the charge. In both Colombia and Poland, this earmarking can be one of the reasons for the success of the charge system.

To conclude, despite each country having different political and institutional structure—the examples in the paper illustrate that pollution control is possible with enforcement proving to be the key. Furthermore, with growing internationalization, the case studies indicate that efforts are on to move towards more cost-effective policy instruments.

Appendix A. Abbreviations used in the text

ANDESCO	Association of Public Utilities Companies.
ANDI	National Association of Industrialists.
BOD	Biological Oxygen Demand.
CAC	Command and Control.
CARs	Corporaciones Autonomas Regionales.
CEE	Eastern European Region.
CIT	Countries-in-transition.
COD	Chemical Oxygen Demand.
CPO	Crude Palm Oil.
cum	Cubic Meters.
DOE	Department of Environment.
ECLAC	Economic Commission for Latin America and the Caribbean.
EIS	Environmental Impact Statement.
EIs	Economic Instruments.
EPA	Environmental Protection Agencies.
EPL	Environmental Protection Law.
EQA	Environmental Quality Act.
GDP	Gross Domestic Product.
INDERENA	The Institute of Renewable Natural Resource.
MBIs	Market Based Instruments.
MEPNRF	Ministry of Environmental Protection, Natural Resources and Forestry.

[42] Evidence from India suggests that despite setting up of a Working Group (with World Bank backing) to look into the feasibility of MBIs like tradable permits etc., there is hardly any progress. This is because even after 4 years of its set-up, the working group could not identify industrial estates for test purpose. A major cause for this lack of progress is the antipathy of regulators.

MoE Ministry of Environment.
NEP National Environmental Policy.
NEPI New Environmental Policy Instruments.
POI Palm Oil Industry.
POME Palm Oil Mill Effluent.
PORIM Palm Oil Research Institute of Malaysia.
ppm parts per million.
R & D Research & Development.
SSIs Small Scale Units.
TSS Total Suspended Solids.
WCC Watershed Caps and Charge program.
WWT Wastewater Treatment Plants.

References

ACEE, 2001a. Economic instruments and environment: can economic instruments work in developing countries. The Andean center for economics in the environment. Newsletter 1 (1) (May).

ACEE, 2001b. Economic instruments and environment: can economic instruments work in developing countries. The Andean center for economics in the environment. Newsletter 1 (2) (July).

ACEE, 2001c. Economic instruments and environment: can economic instruments work in developing countries. The Andean center for economics in the environment. Newsletter 1 (4) (October).

Aiken, R.S., Leigh, C.H., Leinbach, T.R., Moss, M.R., 1982. Development and Environment in Peninsular Malaysia. McGraw-Hill International Book Company, Singapore.

Anderson, M., 2001. Economic Instruments and Clean Water: Why Institutions and Policy Design Matter. OECD, Paris accessed from http://www1.oecd.org/puma/regref/pubs/CleanWater.pdf on September 22, 2004.

Anderson, G.D., Fiedor, B., 1997. Environmental Charges in Poland, C4EP Project, Environment Discussion Paper No. 16. Harvard Institute for International Development (HIID), Harvard.

Baumol, W.J., Oates, W.E., 1988. The Theory of Environmental Policy. Cambridge University Press, Cambridge.

Bell, R.G., 2003. Choosing Environmental Policy Instruments in the Real World OCED Global Forum on Sustainable Development: Emissions Trading. OECD Headquarters, Paris.

Blackman, A., Harrington, W., 2000. The use of economic incentives in developing countries: lessons from international experience with industrial air pollution. Journal of Environment and Development 9 (1), 5–44.

Broniewicz, E., Poskrobko, B., Zylicz, T., 1994. Internalising Environmental Impacts of Industry in Poland: Preliminary Empirical Evidence Paper presented at the 5th Annual Conference of the European Association of Environmental and Resources Economists, Dublin, Ireland 1994.

Centro de Estudios sobre Desarrollo Económico-CEDE, 2001.Anon., 2001. Harvard Institute of International Development-CIDAnon., 2001. Proyecto Andino de Competitividad 'La Gestión Ambiental Pública y privada y la Competitividad de la Industria en Colombia,' Bogota 2001.

Chooi, C.F., 1984. Ponding system for palm oil mill effluent treatment. In: Proceedings of the Workshop on Review of Palm Oil Mill Effluent Technology vis-à-vis Department of Environment Standard (PORIM Workshop Proceedings No. 9). Palm Oil Research Institute of Malaysia, Bandar Baru Bangi, Malaysia.

Cole, D., Grossman, P., 1999. When is Command and Control Efficient? Institutions, Technology, and the comparative efficiency of alternative regulatory regimes for environmental protection. Wisconsin Law Review 5, 887.

CORNARE (Corporacion Autonoma Regional del Rionegro-Nare), 2001. Tasa redistributivas: Informe de avance de la meta regional, Noveno Semestre (Abril-Septiembre 2001), El Santuario, Colombia, http://www.cornare.gov.co/tasar.htm (accessed September 2002).

Coronado, H., 2001. Determinantes del Desempeno y la Inversion Ambiental en la Industria Master's Thesis in Environmental Economics. Universidad de los Andes, Bogota, Colombia.

CSO, 1990. Report on the State, Endangerment and Protection of the Environment. Central Statistical Office, Warsaw.

CSO, 1996. Environmental Protection. Central Statistical Office, Warsaw.

CSO, 1999. Environmental Protection in Poland Quarterly Statistics, VII(3) . Central Statistical Office, Warsaw (December).

Department of Environment (DOE) (various years). Environmental Quality Reports. Government of Malaysia, Malaysia.

http://www.edie.net/news/Archive/4723.cfm accessed in July 2002.

http://www.lwr.kth.se/Forskningsprojekt/Polishproject/JPS3s11.pdf accessed on September 23, 2004.

http://www.oecd.org/document/37/0,2340,en_2649_201185_1916581_1_1_1_1,00.html as retrieved on September 15, 2004.

http://www.rec.org/REC/Programs/SofiaInitiatives/EcoInstruments/EIReport accessed on September 28, 2004.

http://www.unep.or.jp/ietc/Publications/TechPublications/TechPub-15/3-7EuropeEast/7-1-1.asp accessed on September 22, 2004.

Israngkura, A., 2000. Malaysian palm oil pollution tax. In: Rietbergen-McCracekn, J., Abaza, H. (Eds.), Economic Instruments for Environmental Management. Earthscan Publication, London.

Jordon, A., Wurzel, R.K.W., Zito, A.R. (Eds.), 2003. New Instruments of Environmental Governance? National Experiences and Prospects—Special Issue Environmental Politics, Vol. 12(1).

Jordon, A., Wurzel, R.K.W., Zito, A.R., 2003a. New environmental policy instruments: an evolution or a revolution in environmental policy? Environmental Politics 12 (1), 201–224.

Jordon, A., Wurzel, R.K.W., Zito, A.R., Bruckner, L., 2003b. Policy innovation or muddling through? New environmental policy instruments in UK. Environmental Politics 12 (1), 179–198.

Kathuria, V., 2004. Informal Regulation of Pollution: Empirical Evidence from India. Madras School of Economics, Chennai (Working Paper 2).

Kathuria, V., Haripriya, G.S., 2000. Industrial pollution control: choosing the right option. Economic and Political Weekly 35 (43–44), 3870–3878.

Kathuria, V., Haripriya, G.S., 2002. Industrial pollution control: need for flexibility. In: Parikh, K.S., Radhakrishna, R. (Eds.), India Development Report—2002. Oxford University Press, Delhi, pp. 140–156.

Kathuria, V., Haripriya, G.S., 2003 Industrial Pollution Control: Choosing the Right Option. Draft Report submitted to SANDEE, Nepal.

Kathuria, V, Khan, N., 2003. Environmental compliance Vs Growth: Lessons from Malaysia's Regulation of Palm Oil Mills. Economic and Political Weekly 39, 3393–99.

Khalid, A.R., 1991. Internalisation of externalities: Who bears the cost of pollution control? The Environmentalist 11 (1), 19–25.

Khalid, A.R., Braden, J.B., 1993. Welfare effects of environmental regulation in an open economy: the case of Malaysian palm oil. Journal of Agricultural Economics 44 (1), 25–37.

O'Connor, D., 1996. Applying Economic Instruments in Developing Countries: From Theory to Implementation. http://203.116.43.77/publications/specialp2/ACF2AE.html (accessed on September 22, 2004). OECD Development Centre, Paris.

Kruszewski, J., 1994. Poland. In: Francis, P. (Ed.), National environmental protection funds in central and eastern Europe: case studies of Bulgaria, the Czech republic, Hungary, Poland and the Slovak republic. Regional Environmental Center for Central and Eastern Europe, Budapest.

Lehoczki, Z., Sleszynski, J., 2000. In: Rietbergen-McCracekn, J., Abaza, H. (Eds.), Water pollution charge in Poland Economic Instruments for Environmental Management. Earthscan Publication, London, pp. 135–144.

Ma AN, Basiron Y, Amiruddin MN, The interdependence of economic development and environmental quality in South East Asia: Malaysia as a case study. Unpublished manuscript. Bandar Bangi, Malaysia: Palm Oil Research Institute of Malaysia; 1980.

Ma, AN, John CS, Ahmad I, Isa Z. Palm oil mill effluent treatment—a survey. In: PORIM Workshop Proceedings No. 4. Bandar Baru Bangi, Malaysia: Palm Oil Research Institute of Malaysia; 1982.

Maheswaran, A., 1984. Legislative measures in the control of palm oil mill effluent discharge. Department of environment, Malaysia.

Maheswaran, A., Singam, G., 1977. Pollution control in the palm oil industry-promulgation of regulations. Planter 53, 470–476.

Malaysian Palm Oil Promotion Council News Bulletin, 2001.Anon., 2001. Palm oil link, vol. 12(1/6). Malaysian Palm Oil Promotion Council, Malaysia.

Markandya, A., Harou, P., Bellu, L.G., Cistulli, V., 2002. Environmental economics for sustainable growth: a handbook for practitioners. Edward Elgar, Cheltenham UK.

National Fund for Environmental Protection and Water Management (NFOSiGW) (1995) The Report of the National Fund for the Year 1994. Warsaw.

Nowicki, M., 1993. Environment in Poland-issues and solutions. Kluwer Academic Publishers, Kluwer.

OECD, 1995. Environmental Performance Review of Poland Center for Cooperation with Economies in Transition. OECD, Paris.

Ong, A.S.H., Maheswaran, A., Ma, A.N., 1987. Malaysia. In: Chia, L.S. (Ed.), Environmental management in Southeast Asia. National University of Singapore Press, Singapore.

Panayoutou, T., 1994. Economic Instruments for Environment and Sustainable Development, Prepared for the United Nations Environment Programme (UNEP), Nairobi 1994.

Pearce, D., et al., 1989. Blueprint for a Green Economy. Earthscan, London.

Peszko, G., Lenain, P., 2001. Encouraging Environmentally Sustainable Growth in Poland Economics Department Working Paper No. 299. OECD, Paris.

Rietbergen-McCracekn, J., Abaza, H. (Eds.), 2000. Economic Instruments for Environmental Management. Earthscan Publication, London.

Rodriguez-Becerra, M., Uribe, E., 1995. Instrumentos economicos para la gestion ambiental en Colombia, CEPAL, mimeo, Bogota 1995.

Seroa da Motta, R., Huber, R., Ruitenbeek, H.J., 1999. Market based instruments for environmental policymaking in Latin America and the Caribbean: lessons from eleven countries. Environment and Development Economics 4 (2), 177–202.

Seroa da Motta, R., Rudas, G., Ramirez, J.M., 2000. Water pollution taxes in Colombia. In: Rietbergen-McCracekn, J., Abaza, H. (Eds.), Economic instruments for environmental management. Earthscan Publication, London, pp. 167–177.

Sleszynski, J., 1996. Two case studies on implementation of selected economic instruments in Poland Paper submitted in the UNEP project on Economic Instruments, Warsaw 1996.

Soderholm, P., 2001. Environmental policy in transition economics: will pollution charges work? Journal of Environment & Development 10 (4), 365–390.

Spyrka, J., 1994. Poland-part B. In: Klarer, J. (Ed.), Use of Economic Instruments in Environmental Protection in Central and Eastern Europe: Case Studies of Bulgaria, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, and Slovenia. Regional Environmental Center for Central and Eastern Europe, Budapest.

Sterner, T., 2002. Policy Instruments for Environmental and Natural Resource Management. Resources for the Future Press, Washington DC.

Uribe, E., Meléndez, M., 2003. The internalization of environmental management in sectoral policies in Colombia, April. Centro de Estudios Económicos (CEDE), Universidad de los Andes. [mimeo].

Vincent, JR, Ali RM, Associates. Water pollution control. In: Environment and development in a resource-rich economy: Malaysia under the new economic policy. Harvard Institute for International Development and Institute of Strategic and International Studies. Malaysia: Harvard University Press; 1997.

Wajda, S., 2000. Harmonisation—the commitment to change, paper presented at the conference in Budapest, 12–13 June 2000. [mimeo].

Wheeler, et al., 2000. Greening industry: new roles for communities, markets and governments World bank policy research report. Published for the World Bank by OUP, New York.

Zylicz T. Taxation and environment in Poland. In: Taxation and environment in European economies in transition. OECD: Paris; 1994.