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Firm Compliance to Regulatory Enforcement of Industrial Wastewater Standards in Kenya

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Abstract[1]

Regulatory enforcement and industrial non-compliance are very familiar issues in environmental protection and water resource management. Current thinking recognizes the insufficiency of the traditional regulatory enforcement structures that are based orthodox deterrence theory. There are, therefore increasing shifts among some industrialized countries towards "new regulatory regimes" that focus on management styles, and forms of self-regulation, based on innovative and incentive device. However, the orthodox instruments remain the principle means for regulatory enforcement among many developing countries.

Our goal in this paper is to examine the effects of these (traditional) regulatory enforcement instruments on firm' compliance to wastewater standards in Kenya. We (i) examine the state of wastewater regulatory compliance and infractions; (ii) construct and estimate a model of enforcement incidence based on monitoring, inspections, warning letters, and court prosecutions; and (iii) discuss the linkages in the enforcement framework, and behaviour of firms). We use primary and secondary data from 53 industrial plants across 5 urban areas. The results of our model help us to identify flaws In the existing regulatory and enforcement "regime".

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[1]This paper is based on chapter 8 of my Ph. D. dissertation. While claiming responsibility for errors, I would like to acknowledge the comments of Prof. Ole Jess Olsen, Prof. Soren Lund, Dr, Dr. Claes Brundanius, who were members of my dissertation committee and Dr. Poul Ove Pedersen. The study was conducted as part of the DANIDA/ENRECA activity organised jointly between Institute for Development Studies (University of Nairobi) and the Centre for Development Research, Copenhagen.

1.0 Introduction

Issues pertaining to monitoring and enforcement of industrial wastewater standards remain the object of many empirical analyses. This is because industrial wastewater management is a persistent problem for which policy prescriptions, in many countries are still ineffective. The traditional (orthodox) instruments, applied for industrial wastewater regulation, include monitoring, inspections, warning letters and court prosecutions. Even though regulatory enforcement has induced limited success in the developed countries (Magat & Viscussi, 1990; Laplante & Rilstone 1996), they remain completely defective in developing countries. Because of the rapidly growing problem of water resource degradation through industrial wastewater pollution, in Kenya, it is of great interest to examine how different enforcement activities affect the wastewater performance.

The main instruments, applied for regulating industrial wastewater standards in Kenya, include monitoring, inspections, warning letters and court prosecutions. Our purpose in this paper is to evaluate firm responses to these enforcement instruments, by providing explanations to existing practices. The paper is organized as follows: section 2 discusses the conceptual framework and institutional issues in firm response to wastewater regulation. Section 3 discusses the scope of the study, the enforcement process and model construction. In section 4, we discuss the supply of violations: wastewater treatment technologies, and display the results of our model on firm response to regulatory instruments. In section 5, we provide an overview of firm reactions and limitations of various enforcement activities. We conclude in section 6.

2.0 Conceptual and Institutional Issues in Industrial Wastewater Management

2.1 Conceptual Framework

The guiding assumption, in the analysis of compliance behaviour by firms, is that individual firms are economic, rational decision-making units, responding to the costs and benefits of participation in legal and illegal activities. Firms are assumed to subjectively weigh the potential gains and losses of committing regulatory infractions. A firm's "gain" function can be represented by $\Pi_{PC} = (C_{\Pi} + V_{\Pi})$ where C_{Π} (current compliance gain levels) and V_{Π} (current violation gain levels) are, respectively, assumed to be known, with certainty, and that, based on convexity assumption for analytical convenience, each is increasing at a decreasing rate in the amount of abatement effort. Given that firms select an optimal level of wastewater treatment x, if we let a firms' net profits, Π^R, be written as

$$\Pi^R = \Pi^r - z(x)$$

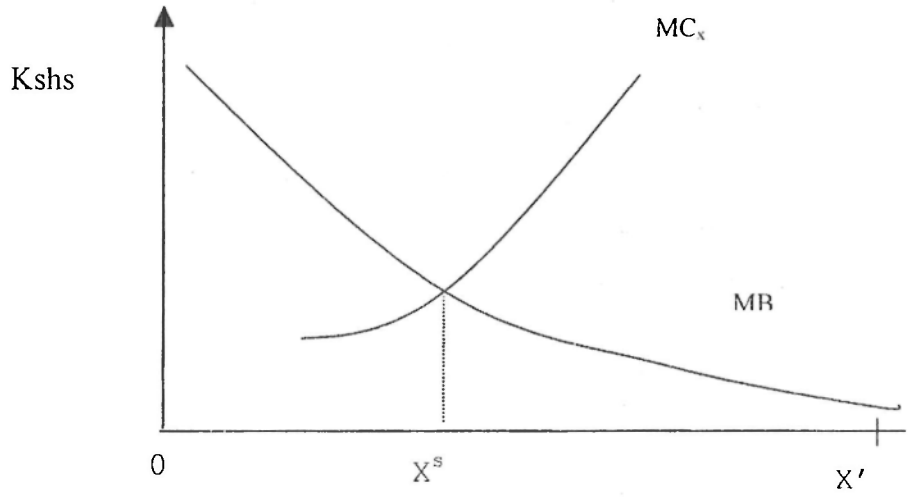
Where Π^r is the profit before wastewater abatement, and $z(x) \geq 0$ is the cost of abatement, such that costs decrease with increased infractions (wastewater pollution), $z'(x) \equiv dz/dx < 0$, where marginal costs equal zero, $z'(x')=0$, at a threshold level of wastewater pollution, X'. Therefore, the firm's marginal benefit, from increased wastewater pollution, equals $-z'(x)$. Let society's net gains, Π^s, given the damage by firms' wastewater pollution, be written as

$$\Pi^s = \Pi^R - M(x)$$

Where, Π^s, is the gain, given no wastewater pollution, and M(x) is the monetary equivalent of the damage suffered, where damages increase with increased wastewater pollution, $M'(x) \equiv dM/dx > 0$. The society's marginal cost of increased pollution is, therefore, equal to M' (x) (Hanley, et al., 1997:30).

From figure 1, the firm's optimum is x', and the society's optimum is x^s, level of wastewater infractions (pollution). The social optimal level of wastewater infractions is determined by taking account of the firms' impact on society. The social optimum requires that firms' marginal benefit be balanced against the society's marginal costs, -z(x)=M'(x), represented by X^s in figure 1 below. If firms ignore the negative impacts on society, they will continue to pollute until their marginal benefits from wastewater pollution are zero, -z'(x)=0.

Fig. 1: Illustrative social (society's) and private (firms') optimal level of wastewater abatement



The basis of our analysis is that, wastewater standards are not self-enforcing and that securing of compliance by firms involve efforts, by the regulatory agencies, to discourage firms from operating at x'. Enforcement involves (substantial) resources, while perfect compliance is neither possible nor desirable. Therefore, the goal of the system should be optimal compliance. That is, the point at which

the marginal social benefits, accruing from compliance, are equivalent to the marginal costs incurred in securing that level of compliance (x^s). The return to non-compliance (x') is, however, made uncertain because the violator could be detected and punished.

2.2 Institutional Issues

If we identify the social benefits of compliance as the reduction of unprevented damage costs, the preventable losses were there compliance, and the costs, comprising mainly those incurred in administrating the system of enforcement, then the principal economic goal of enforcement policy is to minimise such costs. To understand the relationship between these two costs, and, therefore, explore the institutional means of achleving the minimisation goal, we adopt a simplified version of the familiar Becker deterrence model, assuming that individuals and firms comply with regulatory obligations if the expected benefits, derived from contravention, are exceeded by the costs. Different probabilities and associated costs attach to these possibilities, whether they are sequential or alternatives. This condition can be expressed as:

$$E(\Pi_{nc}) < p_1D_1 + p_2D_2 + p_3D_3 + p_4D_4 + \ldots + p_nD_n \quad \ldots\ldots\ldots (1)$$

Where: $E(\Pi_{nc})$ is the expected profit, to the offender, from a regulatory infraction; p_i is the probability of apprehension by a public agency; and,

D_i is the direct and immediate costs, to the firm, resulting from sequential apprehension. Thus, each element in the right-hand side of the inequality represents the probability, and associated costs, of a different predictable event in the enforcement process.

There are other aspects that require clarification before we proceed further. First, the p_i and D_i variables reflect the potential offender's subjective perception of the probability of apprehension and of the associated level of costs, respectively, rather than their objective values. The accuracy of such perceptions will be a function of the offender's information costs (Ogus and Abbot, 2001). It follows, too, that pD should be weighted to reflect the degree of risk aversion (if any) towards the consequences (Polinsky and Shavell, 1979). Secondly, since p refers to apprehension by the public agency and not, more narrowly, to a formal determination of liability (or guilt), by the court or agency with power to impose a penalty, D covers a far wider range of costs than any formal sanction. It, thus, includes the "hassle" costs of pressure, by an agency, to comply, legal and other defence expenditures, and any stigma (or loss) of reputation, resulting from the apprehension and subsequent events.

2.3 Comparative Statics

In our empirical case, the violator faces four sources of uncertainly, corresponding to the four stages in the judicial process: (i) detection with a warning (verbal or written), (ii) prosecution, (iii) conviction, and (iv) punishment. Even with a conviction, the ensuing penalty is not known with certainty. It may take the form of an indefinite closure, a fine, forfeiture of water permit, or, indeed, the violator may get away with simple warning. It is assumed that, although a potential violator does not know *ex ante* the form of punishment, he does know its magnitude and assigns a *subjective probability* that it may be awarded upon conviction. In addition to punishment costs, there is a cost to the defendant, at each prior stage of the judicial process. The direct and immediate cost of detection D could include

any immediate exchanges (written, verbal), water permit suspension, or temporary closure (depending on the level of attention attracted by the violation). There are also direct prosecution costs (*A)* that would include attorney and /or court costs.

Institutionally, if the level of monitoring and inspections is high and the threat of facing a penalty is real, then compliance by firms is likely. If the direct and immediate cost of detection is high, the aggregate expected gains, at non-compliance, are low. Thus, $=>\partial E(\Pi nc)/\partial D \leq 0$. If the level of monitoring and inspections are high while the threat of a penalty is low, then regulation is not a real constraint to the firm, which might prefer to face the penalty. Thus $=>\partial E(\Pi nc)/\partial D \geq 0$. If the level of monitoring and inspections are low, and the penalty is high, then the firms know that the probability of being caught is very low and they will be less obliged to comply. Thus $=>\partial E(\Pi nc)/\partial D > 0$. When the probability of detection is high, the aggregate expected gains at infraction (non-compliance) are low. Thus $\partial E(\Pi nc)/\partial P_d \leq 0$.

All the other parameters behave as follows: $\partial E(\Pi nc)/\partial P_{p|d} \leq 0$; $\partial E(\Pi nc)/\partial P_{c|p} \leq 0$; $\partial E(\Pi nc)/\partial P_{f|c} \leq 0$; and $\partial E(\Pi nc)/\partial f \leq 0$.

Where: A = prosecution costs;

D = direct and immediate cost of detection;

P_d = the subjective probability of detection;

$P_{p|d}$ = the subjective probability of prosecution;

$P_{c|p}$ = the subjective probability of conviction given prosecution; and

$P_{f|c}$ = the subjective probability of being fined upon conviction.

2.4 The Scope of the Study

Urban Areas and Types of Firms Covered

The firms covered, in our study, belong to the following industrial categories: food processing, beverage, textile, pulp and paper, leather and tanning, wood products, and chemical products (see table 1). Our primary criterion, for selecting the 53 industrial firms, was based on the dominant water-consuming industrial sub-sectors in Kenya (i.e. falling into 5 broad classes. The justification was to capture water-using firms wlth different intensities and characteristics. Our second sampling frame entailed identifying the towns from where the firms would be surveyed. The selection of urban areas was based on the considerations of water tariffs and regulatory implementation. In principle, we chose urban areas whose water departments were active in billing of firms and who had departments for the enforcement of wastewater quality. The urban areas selected included Nairobi and Kisumu cities, Eldoret, Thlka and Nakuru towns.

Table 1: Industry Sampling by Sub-Sector

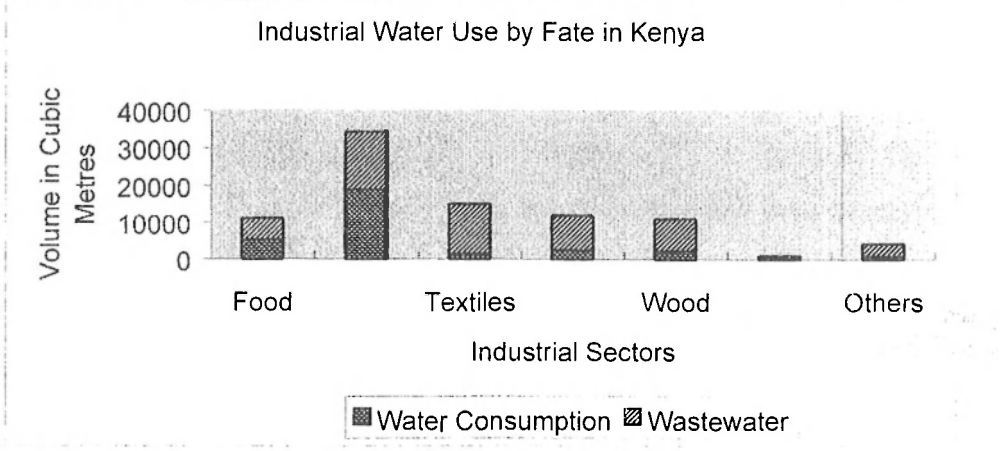
3 DIGIT ISIC CODE	SECTOR	THIKA	NAIROBI	NAKURU	KISUMU	ELDORET	TOTAL NUMBER
311	Food Processing	4	1		2	3	10
		(1)	(1)		(0)	(0)	(2)
313	Beverage	1	2	1	2	1	7
	Industries	(0)	(2)	(1)	(2)	(0)	(5)
321	Textiles	5	4	3		4	16
		(4)	(3)	(2)		(0)	(9)
323	Leather Products	2	3				5
		(2)	(2)				(4)
331	Wood Products					1	1
						(1)	(1)
341	Pulp and Paper	1	3			1	5
		(1)	(1)			(0)	(2)
352/35	Chemical	2	1	4			7
1	Products/Others	(2)	(1)	(1)			(4)
TOTAL		15	14	8	4	10	51
		(13)	(8)	(4)	(2)	(1)	(27)
Surface and Groundwater usage (%)		87	57	50	50	10	53

Source: Survey data. Figures in parenthesis show the number of firms using boreholes/river. Other figures show the total number of firms using public sources.

In the survey, water intensities vary across firms and sectors. The Beverage Industries (food processing) sector is the most water intensive, followed by Leather and Textiles. Our aggregation also shows that the volume of water discharged, by firms surveyed, is very high, constituting over 60% of the water consumed. These figures imply that, there is low wastewater recycling rate among firms. The figures also suggest that there are great potentials, for water resource conservation, among the surveyed industries.

A graphical illustration of the water consumption magnitudes involved is given in figure 2. From a policy perspective, the figure gives some indication of where the potential for industrial water savings lie. For example, in the pulp and paper industries, the bulk of the water is used in "process" with only a very small fraction going to wastewater. This suggests that the potential for recycling is nearly exhausted and, further savings can be attained through change of production technology. The situation in the other industries is radically different with the bulk of the water discharged as wastewater. The implications for water pricing can also be radically different. Firms that generate large volumes of wastewater might have easy technical options for wastewater reduction that may not be cost sensitive. Hence, pricing and regulation, on the input side, in these industries could lead to large water savings at relatively low costs.

Figure 2: Average Monthly Water Consumption and Wastewater Discharged



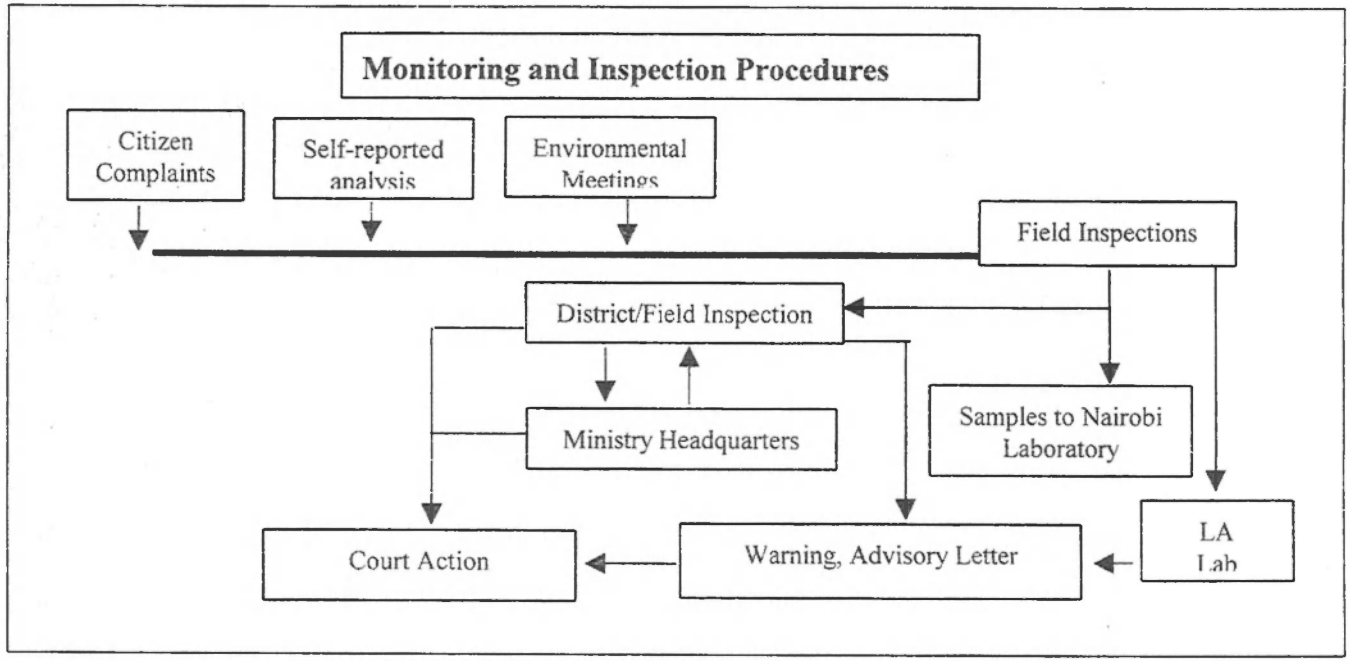
Source: Own Survey Data
Notes: Water consumption = recycling + consumptive + losses. (2) Wastewater=discharges. (3) Total consumption = Water consumption + wastewater.

3.0 Regulatory Approaches for the Enforcement of Wastewater Standards in Kenya

There are three (3) judicial steps in the enforcement of industrial wastewater standards in Kenya. We have summarised the orgnizational arrangements covering the steps in Figure 3. The first step involves monitoring and inspection of the firms. The inspection could be triggered by citizens' complaints, environmental meetings, self-reported samples, or own field inspection by enforcement officers in the Ministry of Environment and Natural Resources (MENR) or Local authorities (LA). In the case of Local Authorities (LA), samples are delivered to own laboratory (lab) within the town and further action (i.e warning letters or even court action) may follow after the analysis. In the case of MENR's enforcement, the samples collected are taken to Nairobi for analysis. The MENR's enforcement officers, on the ground, can issue

warning letters, but they have to consult with the parent ministry in Nairobi, before taking any court action. The second and third judicial steps are warning or advisory letters and court action, respectively.

Figure 3: Monitoring and inspection Procedures in Kenya



3.1 Step 1: Monitoring and Field Inspections

Monitoring activities (field inspections and waste water sampling) are undertaken in all the urban areas. Sometimes, complaints made by citizens, or highlighted in newspapers, regarding environmental incidents, also give rise to enforcement. However, there are widespread variations in the enforcement strategies for different urban areas.

Self-Reporting as a way of Monitoring

Thika and Nakuru by-laws require firms to self-report their wastewater compliance status. The apex of enforcement activities in Thika is the District Environmental Committee/meetings, where all industries are challenged to justify, or defend, their compliance status, on various environmental parameters (wastewater quality being one of them). Nakuru town has an organized Inter-Ministerial Working Group (IWG) for the coordination and supervision of various institutions that are geared towards environmental protection and management of Lake Nakuru, in collaboration with the local Agenda 21 initiative – Pollutant Release Transfer Register (PRTR)[1].

3.2 Step 2: Warning and Advisory Letters

Warning and Advisory letters were a major tool of enforcement in Thika, Nakuru and Eldoret and, to a smaller extent, Kisumu. Nairobi city had the lowest number of such letters. We have provided samples of a warning letter's [2] and advisory letter[3], elsewhere, to avoid ambiguity in definition. Overall, the number of warning and advisory letters, sent to firms, is very large. These letters varied a great deal, in content, and we could categorise them into the following: (i) those advising firms on what steps to take in order improve their wastewater quality, (ii)

reminders to firms to meet their obligations, as earlier agreed (iii) threats of action, if measures are not taken (iv) statutory notices that court action is imminent unless remedial measures are undertaken within a stipulated period.

3.3 Step 3: Court Prosecutions and Penalties for Violations

Court prosecutions represent the ultimate step in the enforcement process for wastewater regulation. Procedurally, when firms fail to comply with advisory, warning, and statutory notices, they should be eligible for court action. If the polluting agency has obtained a water permit for abstraction of water from a river or ground source, the WAB may withdraw the water permit untll the situation is rectified.

3.4 Other Regulatory Approaches/Instruments

3.4.1 Suspension and Revocation of Water use Permit

One of the enforcement tools currently available to the Ministry of Water Development, for the enforcement of standards, is the suspension of firms' water use licence whenever violations are "sufficiently of concern". For firms whose main source of water are rivers and boreholes, revocation and suspension of a water permit (or licence) could be a much more effective tool than court action because (i) it poses a credible threat to production as firms can stop production altogether when access to water is denied, (ii) suspension of a permit does not require any court decision and it can be handled administratively within MENR. (iii) Furthermore, it does not require skilled or technical personnel, such as court prosecutors, to enforce. Ironically, the power of revocation is used extremely sparingly even though the enforcement agency has absolute control over this. It remains the most difficult instrument to enforce in Kenya due to economic, social, and political factors.

Over the last 10 years, it appears that only 6-8 threats have been made by the enforcement agencies over the use of this instrument. We found out that only two instances were carried out during the last ten years (revocation and suspension). From a deterrence perspective, it might seem to make sense to proceed with permit revocation/suspension only when the court system does not appear to achieve compliance. But, there is no compelling evidence that this is the enforcement agency policy in Kenya; all we know is that the two cases were not pursued through the courts before the action was taken.

3.4.2 Sewer Charges

One of the most distinctive features of the Urban Water Provision in Kenya is the sewer charge, which accompanies all water consumption within the municipalities. The sewer charge is meant to finance nearly 100 per cent of expenditures, including the construction and operation and maintenance of Wastewater Treatment Plants. In most of the urban areas, the sewer charge is volumetric and is as high as 50-100 per cent the cost of water itself. Ideally, the charge should follow the rule that the polluter pays, particularly for industrial firms, but this is not the case. In any case, very little of the money collected is injected back into the Sewer Treatment Works. One argument that the industries have presented to the Local Authorities, over the years, is that they (the industries) pay a sewer charge commensurate with the volume of water consumed, yet, they have to comply with wastewater standards.

3.4.3 Violation Charges

All the Local Authorities by-laws stipulate financial penalties that violating firms should pay. For example, in Thika and Eldoret, a firm which contravenes, or fails to comply with the wastewater by-laws, or any of the conditions imposed by the council on water, is guilty of an offence and is liable to[4]: (i) in the case of a first offence, a fine not exceeding two thousand shillings (US$30), or imprisonment for a term not exceeding six months, or both such fine and imprisonment; (ii) in the case of a second offence...one thousand shillings or an imprisonment sentence for a term not exceeding nine months, or both such fine and imprisonment; and (iii) where an offence is of a continuous nature, the offender shall in addition to the penalties prescribed ...pay an addltional fine or five thousand shillings per day, for the period in which the offence continues. In Eldoret, the penalties stipulate that (a) an extra five shillings (Kshs) will be added on to the rates for effluents exceeding any of the following limits, based on grab sample analysis done by the Council, once every six months; (b) while a penalty of Kshs 100,000 (one hundred thousand) per month will be charged on effluent exceeding any of the limits given for various toxic chemicals. In Thika and Eldoret, towns suggest that these "economic instruments" are prone to serious difficulties, especially, because they demand credible and scientific procedures to implement[5]. In both towns, the penalties have remalned "paper tigers" in the bye-laws that have not been implemented.

3.4.4 Trade Effluent Charges

The "trade effluent" charges are "the extra sewerage (wastewater) charges paid to the service provider (WSP) in order to reflect the additional costs created by the

treatment of highly polluted or difficult to treat sewage (wastewater)." Since 1970s, there have been joint efforts, by Sewerage Division of the Ministry of Water Development and the Ministry of Local Government, to develop a system of enforcing wastewater standards in Local Authorities, by charging the industries, on the basis of treatability, for their wastewater i.e. by possibly using the modified Mogden formula for charging purposes. Crude forms of the application of this charge are found in the by-Laws of Thika and Eldoret towns. However, the development of this trade effluent charge is still inhibited by many factors including resistance by industries and politicians.

4.0 The Supply of Wastewater Violation Compliance

4.1 Wastewater Treatment Facilities/ Technologies by Firms

The level of sophistication of wastewater treatment plants required varies with the type of industrial activity and scale of production. It should be remembered that, even within the same sub-sector, there can be dramatic differences in the type of goods produced, hence the toxicity of wastewater and thus the requisite wastewater pre-treatment facilities. This variation was more pronounced among the food processing industries surveyed. Most firms have installed wastewater abatement gadgets that are summarized in Table 2.

Table 2: Wastewater Treatment Facilities/ Technologies

Wastewater Treatment	*Number Visited*	Number with wastewater treatment	Number of wastewater treatment facilities working during survey	Type of Treatment
Food Processing	10	7	4	[a], [b], [d], [c], [f]
Beverage Industries	7	6	4	[a], [d]
Textiles	16	12	6	[a], [c], [g],[d]
Leather Products	5	5	4	[a], [b], [d], [c]
Wood Products	1	1	0	[c], [a]
Pulp and Paper	5	4	4	[c], [a]
Chemical Products and Others	7	4	2	[c], [d], [a], [e], [f]
Total	**53**	**38**	**24**	
Percentage of Total	**100**	**72**	**45**	

Source: Own Survey Data

Note: Types of Treatment include:- Physical: [a] =settlement; [b]=floatation; [c]=screening:- Biological: [d]=aerobic[1]; [e]=Anaerobic [2] :- Other: [f]=deep well injection; [g]=precipitation with chemicals; [*]=municipal sewer.

4.2 Status of Wastewater Treatment Facilities

Even though 72 percent of the firms surveyed had facilities, only 45 percent of the facilities were operating at the time of the survey. Most firms had seepage pits, as alternative buffers to oxidation ponds. The proportion of firms with wastewater treatment facilities is highest in Thika and lowest in Kisumu while all firms in Thika had facilities, only 73 percent of these were working during the survey. In Kisumu, only one (1) plant at the Kisumu brewery (25 percent of the facilities) was operating. Several factors explain the variations in the status of wastewater treatment facilities. We observed a general tendency for the larger firms to own treatment equipments probably, because of the visibility of the actions. This scenario was true across all sectors.

4.3 Disposal Patterns of Industrial Wastewater

All firms in urban areas had the option of discharging wastewater into three points: (i) the open streams, (ii) municipal sewer, or (iii) both. However, wastewater disposal patterns varied, a great deal, across the urban areas. In Thika, 40 percent of the firms were discharging their wastewater into the municipal sewer, 7 percent were discharging into a nearby river or stream, while the remaining 33 percent were discharging into both the river and municipal sewer. In Nairobi, 73 percent were discharging into the municipal sewer, 7 percent into rivers/ nearby streams, and 20 percent into both municipal sewer and open streams. In Nakuru, 78 percent were discharging into municipal sewer and the other 22 percent into both municipal sewer and open streams. In Kisumu, 50 percent were disposing their wastewater into municipal sewer and the other 50 percent into rivers and municipal sewers. In Eldoret, 60 percent and 40 percent were discharging into municipal sewer and both streams and sewers, respectively. A summary of the modes of disposal has been provided in Table 3. In general, 60 percent of the firms were discharging into municipal sewers alone, 13 percent into streams alone, while 27 percent were discharging ther wastewater into both sewers and streams. Firms using the public sewer have to pay sewer charges and make minimum investments to comply with the stipulated standards and by-laws. In view of these differences:

i) Firms with large volumes of wastewater to dispose might find it advantageous to dispose off the effluents in a way that minimizes their costs i.e. into rivers.

ii) Dirty firms (pollution-intensive firms) should find it less costly to discharge into municipal sewers, since the wastewater standards are lower.

In relation to the first case (i), there was a pattern, in Thika town, for firms with self – supplied water, to avoid paying sewer charges, by preferring to discharge into streams and rivers. On the other hand, sewer charges are based on quantities of water consumed and the municipal authorities attempt to monitor these quantities of water. Such firms prefer own disposal to avoid paying the sewer charges. In the process, the firms find that they have large volumes of wastewater to dispose in rivers and open streams. The main problem with this choice is that the firm has to contend with the Ministry of Water's wastewater standards, which are much stringent than for the firms discharging into municipality sewers. For this reason, violation of standards was more likely for firms discharging into streams. Another reason for preferring streams is that, it proves, somehow, tricky for the enforcement officers to detect a violation, once the discharge had entered the streams/rivers. What the firms needed to do is optimize on the timing of the discharge, to avoid detection (i.e. by discharging at night or during weekends). In relation to the second case (ii), we have not observed a systematic pattern of dirty industries preferring to discharge into municipal sewers. Disposal patterns, among the dirty firms, (mainly leather, chemical, wood and paper) were much more dependent on their location, with the firms located ciose to rivers having the tendency to discharge into rivers, rather than into sewers.

4.4 Model Construction

To examine the effect of enforcement activities, and the effectiveness of regulatory instruments, we need to model (i) the linkage between the violation rates (supply of violations) and the enforcement instruments (i.e. the sanction variables) with respect to the risks such as probability of detection (P_d),

prosecution ($P_{p|d}$), conviction ($P_{c|p}$), and fines ($P_{f|c}$). Previous studies have used empirical information on observed violations, (ii) number of prosecutions, and (iii) the proportion of prosecutions that result in conviction, as indicators of probabilities for various enforcement variables (Furlong, 1991; Polinsky and Shavel, 1979; Laplante and Rilstone, 1996; and Lanoi and Fearnley, 1998).

A number of other factors also appeared to determine the compliance status of industrial firms in our survey. First, because of their activities, firms in certain sectors such as the leather and tannery (dirty industries) appeared susceptible to infractions than others (e.g. food and beverage). Secondly, water consumption levels also appeared to be an important factor, since the large water consumers also had problems with installing elaborate abatement facilities sufficient to avoid infractions. Their wastewater problem was much more visible, and posed greater concerns for the authorities.

In view of the above factors, the basic equation tested in this paper follows the work of Furlong (1991), Polinsky & Shavel (1979), Laplante & Rilstone (1996), and Lanoi & Fearnley (1998). In which:

$$VIORATE_{it} = \alpha_0 + \alpha_1 WAT_t + \alpha_2 INSP_{it} + \alpha_3 INSP_{i\,t-1} + \alpha_4 P_{d\,t-1} + \alpha_5 P_{p|di,t-1} + \alpha_6 P_{c|pi,t-1} + \alpha_7 P_{f|c,t} + \alpha_8 ds_{it} + \varepsilon_{it} \quad (2)$$

Where:

i=1,2,3, ...N stands for plants; t=1,2,3,....T stands for time;

$VIORATE_{it}$ represents the sum of regulatory infractions (BOD, TSS, COD) divided by number of inspections; $INSP_{it}$ represents the number of inspections performed at plant *i* at time t;

$INSP_{i,t-1}$ represent the cumulative inspections performed at piant *i* up to time t-1;

P_d	Probability of detection
$P_{p\|d}$	Probability of prosecution
P_c	Probability of conviction (not appearing in the equation)
$P_{c\|p}$	Probability of conviction given prosecution
$P_{f\|c}$	Probability of fines
WAT	Volume of water used
ds_i	Firm specific effects and;
μ_{it}	are the usual error terms

Definition: $P_{f|c} = P_{c|p}(P_{p|d})$ and $P_c = (P_d)P_{c|p}(P_{p|d})$

The most obvious question that arises in the context of the above equation concerns the possible *endogeneity of sanctions,* and the consequent impact on the least squares estimates. For example, while we are generally interested in estimating the response of firms (violation rates) to enforcement (sanction variables etc), difficulties arise in that "enforcement or level of sanctions" at any given time *t* may itself be a function of violation or compliance at time *t* (that is the enforcement authority may observe non-compliance at time *t*, and then decide whether or not to inspect at time *t*). In other words, inspections may themselves be *endogenous* and correlated with the same variables that determine current pollution levels. If this is the case, least-square estimates will be biased in general.

In fact, both Magat & Viscussi (1990), and Laplante & Rilstone (1996) have rejected the hypothesis that inspections were exogenous. As a result, Magut and Viscussi (1990) have included, in their analysis, a vector of only past enforcement

effort (inspections). Laplante & Rilstone (1996) on the other hand have preferred to estimate an inspection equation and use it to re-estimate their basic inspection model by instrumental variables using expected inspected as instruments. Interestingly, these last authors have found out that the probability of an inspection, in any given period, is a decreasing function of past inspections – the regulator's monitoring strategy thus being akin to one of sampling without replacement. To control this (and to identify the resulting parameters), it is necessary to model the sanctions, using some variables that do not enter the basic model.

Interviews with the Ministry of Water and Local Authority enforcement officers indicate that inspections are motivated by several considerations. First, the volume of wastewater discharged seems to be a factor: small water consumers are less likely to be inspected than larger consumers. Secondly, there seems to be an effort to visit as many plants as possible. Thus, an obvious implication of this "sampling without replacement" strategy is that a plant knows that, all things being equal, the probability of an inspection, even when a firm is a major water consumer, is inversely related to the number of previous visits.

In response to wastewater regulation (VIORATE), in this study, we look at the control of three main measures of water pollution. The first, biological oxygen demand (BOD), is not a direct measure of water pollutant, but measures the effects on the environment of a number of pollutants. The second, total suspended solids (TSS), is a direct measure of the presence of solid waste emissions in the water supply. The two measures are often correlated, but constitute separate policy goals,

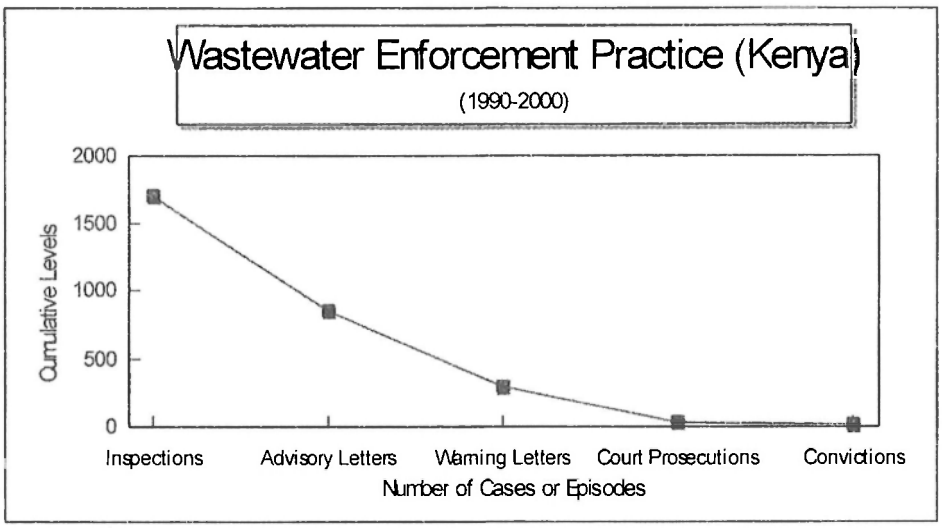
and require, to some extent, different abatement technologies. In particular, elimination of TSS requires a primary treatment, based on gravity, while the elimination of BOD requires both a primary and secondary treatment, based on biological processes. The third measure is chemical oxygen demand (COD).

For the purpose of estimation, we have assumed that: (1) the firm-specific effects are random; (2) the error term is uncorrelated with the variables and well behaved; (3) all the right-hand side variables in the sanction equation are doubly exogenous – that is, uncorrelated with the firm-specific effects as well as with the error term. This is a very drastic assumption, given our awareness that the beverage sub-sector has the highest levels of water consumption and waste generation. (4) Also assumed away are the lock-in-failures or threshold effects where firms are "locked in" to complex systems of current technology and where the associated infrastructure, skills, knowledge, and capabilities are dominant. Water management systems face lock-in failures. Most of the urban water supply, storm water and "wastewater" management systems are based on technologies, or systems, of the past. (5) There are several other implicit assumptions in our model, for example one or more of the following contingencies must occur, if the compliance condition is to be met: Firms are highly risk-averse; The potential firms' subjective perception of the formal sanction likely to be imposed is very high; The potential firms significantly over-estimate the probability of a conviction and formal sanction.

4.4.1 Computing Subjective Probabilities

Figure 4 shows cumulative enforcement activities, for the firms covered in five urban areas. The figure also shows that convictions for wastewater infractions were much lower than episodes of court prosecutions, while inspections were also much higher than all the other judicial measures.

Figure: 4



On the basis of primary and secondary information on inspections, advisory letters and court action, we have computed various probabilities for the sectors studied. These are summarised in Table 3.

The probability of detection (P_d) is defined here as the sum of advisory letters and warning or statutory letters divided by inspections. The probability of prosecutions leading to detection ($P_{p|d}$) is defined as court prosecutions divided by the sum of

advisory letters and warning or statutory letters. The probability of conviction arising from prosecution (P_{cjp}) is defined as convictions divided by court prosecutions.

Table 3: Comparison of Enforcement by Sector/Industry

Sector	Number of Firms surveyed	Inspections (approx)	Advisory Letters	Warning Letters/ Statutory notice	Court Prosecutions	Convictions	P_d	$P_{p\,d}$	$P_{c\,p}$
Food	10	574	244	97	6	6	0.594	0.018	1.000
Beverage	7	87	53	21	4	3	0.851	0.054	0.750
Textile	16	466	215	91	10	7	0.657	0.033	0.700
Leather	6	271	174	59	6	6	0.860	0.026	1.000
Wood & Products	1	41	11	9	1	0	0.488	0.050	0.000
Pulp and Paper	5	105	73	20	2	2	0.886	0.022	1.000
Chemicals & Others	8	158	77	30	4	3	0.677	0.037	0.750
Total	53	1702	847	327	33	27	0.689	0.028	0.818

Source: Own Survey Data

The above (Table 3) estimates suggest that, given the levels of inspection across sectors: (i) Detection was much more likely in the pulp and paper, followed by leather industries. This observation seems to indicate that there is concentration of enforcement activities in these sectors. (ii) Prospects for prosecution, upon detection, were, however highest among wood and chemicals, suggesting that regulatory authorities are much more efficient in monitoring certain discharge points. Even though the results suggest that, *ceteris paribus*, plants whose emissions are most likely to impose high environmental damages are facing a higher probability

of being inspected and warned, the probability of an inspection appears to be an increasing function of the final discharge point for the plant i.e. either a stream or municipal sewer. Moreover, we suspect that these outcomes are heavily influenced by the primary motivation of the enforcement agencies. (iii) Conviction, upon prosecution, is much more likely among the leather tanneries than any other industry.

4.4.2 Enforcement by Towns

Table 4: Comparison of Enforcement by Towns

Sector	Number of Firms surveyed	Inspections (Approx. No.)	Advisory Letters	Warning Letters/ Statutory notice	Court Prosecutions	Convictions	P_d	$P_{p,d}$	$P_{c,p}$
Thika	15	634	316	114	13	8	0.678	0.030	0.846
Nairobi	15	509	221	64	10	6	0.559	0.035	0.800
Nakuru	9	155	61	28	--	--	0.574	0.000	0.000
Kisumu	4	203	146	26	4	3	0.847	0.023	0.750
Eldoret	10	201	103	95	6	4	0.985	0.030	0.833
Total	53	1702	847	327	33	27	0.689	0.028	0.818

Source: Own Survey Data

Notes: Probability of detection (P_d) is defined here as the sum of advisory letters and warning or statutory letters divided by inspections. Probability of prosecution given detection ($P_{p,d}$) is defined as court prosecutions divided by the sum of advisory letters and warning or statutory letters. Probability of conviction given prosecution ($P_{c,p}$) is defined as convictions divided by court prosecutions.

The above estimates (Table 4) suggest that (i) Given the levels of inspections, detection of violation was much more likely in Eldoret followed by Kisumu, Nakuru, Thika and finally Nairobi. (ii) A detected violation is much more likely to be

prosecuted in Nairobi, followed by Thika, Kisumu. (ii) A prosecuted firm is much more likely to be convicted in Kisumu, followed by Nairobi, Eldoret, Thika and finally Nakuru.

4.4.3 Model Results: The effect of Regulatory Instruments

A summary of wastewater violations is displayed in table 5. The results are displayed in two columns (1), and (2). In the first column, (1) we display the model results when all the sanction variables (P_d, $P_{p|d}$, and $P_{c|p}$) are used in our estimation equation. In the second column (2), we replace $P_{p|d}$, and $P_{c|p}$ by $P_{c|d}$, since the latter results from the former. Our results show the test for the response to enforcement on the violation rates for absolute discharges of BOD standards.

Table 5 Tobit Estimates of Supply of Wastewater Violations by Sector

	(1)	(2)
Constant	0.1193	0.1079
$INSPECTION_{it}$	- 0.1713	- 0.1149
$INSPECTION_{i,t\ 1}$	- 0.2080	- 0.1965
P_d	- 0.1141	- 0.0181
$P_{p|d}$	- 0.0911	--
$P_{c|p}$	- 0.0042	--
$P_{c|d}$	--	- 0.0041
Textile	0.1421	0 0119
Leather	0.3643	0.2006
Food	0.1152	0.1616
Beverage	0.0411	0.0321
Pulp	0.1461	0.0133
Wood	0.3316	0.4756
Other	0.0521	0.2355
WATER	0.6144*	0.4414*
Log Likelihood Function	19.334	17.284
Number of Observations	53	53

Source: Own Survey Data

Note: Significant at 95 percent level. Probability of detection (P_d) is defined here as inspections divided by the sum of advisory letters and warning or statutory letters. Probability of prosecution given detection ($P_{p|d}$) is defined as court prosecutions divided by the sum of advisory letters and warning or statutory letters. Probability of conviction given prosecution ($P_{c|p}$) is defined as convictions divided by court prosecutions.

From the model estimates, the perceived magnitude of the expected inspections, and prosecution fines are, each, estimated to reduce infractions, as indicated by the negative coefficients associated with in all the three columns. However, a given increase in the expected inspections, detections, prosecutions, and fines do not have an increasing or larger effect along the progression. This does not make any intuitive sense. Furthermore, none of the estimates of the deterrent effect of penalties on violation rates is statistically significant. The violation rates are strongly correlated with the water consumption levels and suggest that higher water consuming firms in Kenya are much more likely to violate wastewater standards than otherwise. Sector-specific dummies have a positive coefficient, but none of these are significant. This implies that we could not use industrial sectors in Kenya as a basis for predicting wastewater standards' infractions.

4.4.4 Elasticities of Wastewater Violations

A comparison of the relative impacts of different explanatory variables on the violation rates is provided in Table 6, where elasticities for selected variables are presented. From among the policy variables, inspections induce the largest violations response (in terms of elasticities). For example, a one percent increase in inspections is predicted to deter 0.061 percent of violations.

Table 6 Elasticities of the Supply of Violations with Respect to Sanction Variables (Absolute Values)

	(1)	(2)	Mean
$INSP_{it}$	0.061	0.077	0.0205
$INSP_{i,t-1}$	0.017	0.022	0.0194
P_d	0.002	0.003	0.0118
$P_{p\|d}$	0.010	--	0.0931
$P_{c\|p}$	0.003	--	0.0124
$P_{c\|d}$	--	0.006	0.0910

Source: Own Survey Data

Notes: Significant at 95 percent level. Probability of detection (P_d) is defined here as inspections divided by the sum of advisory letters and warning or statutory letters. Probability of prosecution given detection ($P_{p|d}$) is defined as court prosecutions divided by the sum of advisory letters and warning or statutory letters. Probability of conviction given prosecution ($P_{c|p}$) is defined as convictions divided by court prosecutions. $INSP_{it}$ represents the number of inspections performed at plant *i* at time t; $INSP_{i,t-1}$ is cumulative inspections performed at plant *i* up to time t-1;

Elasticities for detection, prosecution and fines are considerably smaller than those for inspections. The ranking of elasticties in Table 6 does not, generally, conform to the theoretical predictions at the beginning of the paper.

5.0 Reactions to Various Enforcement Activities

5.1 Reactions to Warning Letters and Statutory Notices

Most firms surveyed seemed to respond to inpections and warning letters by announcing investments, but these investments did not seem to have much effect on effluents. Another common behavior noted among the firms was for them to declare that they had engaged consultants for the design of their wastewater treatment works. In most cases, it took several years for the consultants to come up with the requisite designs. A number of firms had shoddy waste treatment plants, for which they heaped blame on design engineers, and bad advice from

the enforcement officers. Some firms remained completely defiant and sought protection through political patronage whenever faced with the threat of punishment.

5.2 Reactions to Court Prosecutions

From tables 3 and 4, we observe that, the *probability of prosecution given detection* is very low Kenya. The decision to prosecute is also lengthy, given that many cases are repeatedly referred to the headquarters before such a decision can be made. However, in instances where public outcry instigates the process, evidence is collected hurriedly and prosecution can be sure to follow. This is despite the fact that firms should have received multiple warning letters before the decision to prosecute can be reached. To most firms, *the prosecution costs* comprise, mainly of the legal (lawyers) fees and the costs for attending court hearings i.e. transport, and other manpower costs.

Some firms engage lawyers to put up a strong defence, while others encourage their lawyers to take a cost-minimization approach. For example, convictions are always likely since most firms prefer to enter "a guilty" plea, probably, to cut down on the prosecution costs. This practice raises *the probability of conviction given prosecution.* Often, the *probability of being fined upon conviction* is also very low. For example, of the 33 firms who had faced some court prosecution before, there were 27 convictions (80 percent). Of these 27, only about half of them had been fined. Others had been acquitted, or ordered to take remedial measures within a given duration. Often, the firms got away with a simple warning. In any case, the fines have been very low, as they are limited by Law, and are not in excess of Kshs

3000. Experience, with court prosecutions, violates our initial assumption that court action is the apex of regulatory enforcement sanctions.

We can, however, make several observations in regard to the court prosecutions:

1. One general observation about court cases is that, there was a common trend for firms to enter a "guilty" plea, when they expected that the case was going to take long (with higher legal charges), hence, they preferred to face the penalties which, in all cases, could not exceed Kshs.3000.
2. Several firms indicated that, even if they thought they were not guilty of the offence, they still found it appropriate to enter a guilty plea to the save company's resources (time, financial).
3. In a majority of firms' violation that led to court prosecutions, the firms "relaxed" once a court verdict had been announced, not expecting further regulatory activity for a while, while they continued with violations. Some of the firms even resorted to more covert activities to conceal their actions.

5.3 Other Institutional Weaknesses in the Enforcement Process

We consider that most of the problems encountered, during regulatory enforcement, emanate from a low level of implementation rather than any serious deficiencies in the legal provisions. We mainly attribute the low level of enforcement to the following factors:

(i) The multiple agencies with different mandates, each agency trying to define the laws and activities on the basis of its narrow mandates. No agency expressed interest in correlating their tasks with the others;

The multiplicity of enforcement agencies on wastewater regulation in Kenya present numerous difficulties and raise questions on the appropriateness of the institutional arrangement. The fact that there are many acts, rules, regulations and by-laws, with regard to the multiplicity of agencies involved in the regulation of industrial wastewater, means that there are widespread variations in interest and focus across the country. We have summarized the distribution of these multiple agencies and levels of enforcement in Table 7.

Table 7: Levels of Enforcement Activities of Different Agencies

Parameter	Thika	Nairobi	Nakuru	Kisumu	Eldoret
LA –Water & Sanitation Department		√ (2)			
LA – Public Health Department	√ (2)		√ (3)		√ (3)
MENR – District Water Office	√ (1)	√ (4)	√ (4)	√ (3)	√ (2)
Environment Sanitation				√ (4)	
Labour/ Industry Inspectorate			√ (1)		
NGOs – WWF for Nature			√ (2)		
Other Departments Involved					
LVEMP				√ (2)	
KEMFRI					

Extent of involvement (1) very high (2) high (3) medium (4) low: LVEMP =Lake Victoria Environmental Management Project; KEMFRI=Kenya Marine Fisheries Research Institute; WWF= World Wide Fund.

Some urban areas have a high number of agencies interested in wastewater regulation and high levels of activities by the agencies involved:

(ii) The division of responsibilities among multiple agencies, with little coordination, made it procedurally difficult to harmonize operations, thus leading to lack of interest among some departments that felt disadvantaged.

(iii) There was a notable absence of what can best be described as the "philosophy of enforcement" (or internal policies and principies) by the various government departments – a shortfall that we attribute to apathy emanating from multiplicity of agencies. This apathy was greater at senior levels - to some extent. This was reflected by the comparatively junior grade officers responsible for enforcement while the senior officers engaged in non-enforcement activities.

(iv) While the legal enforcement process is very limiting in terms of burden of proof, the *value* of the process is further diminished when the penalties meted out to the guilty firms is very low.

(v) Due to a multiplicity of enforcement agencies, most firms also expressed frustration with the criss-crossing of their premises by multiple government enforcement agencies from different departments as they conducted inspections. This problem was more severe in towns with multiple enforcement agencies for different aspects of industrial regulation.

(vi) Enforcement styles differed across different agencies. For example, Table 8 shows that:

1) There is emphasis on the use of economic instruments by the local authorities, and some have attempted to impose trade effluent charges. Thus, they have stipulated violation charges in their by-laws, mostly based on revenue requirements, which has become a source of rent seeking;

2) The MENR puts emphasis on regulatory compliance with the standards, but is limited in effectiveness due to logistical problems, especially on court prosecutors;

3) Some local authorities have adopted instruments without considering implementation capacity e.g. the emphasis on self–reporting, without a proper incentive framework; and

4) There is too much discretion left on the part of enforcement officers.

Table 9: Summary of Enforcement Instruments

		Ministry of Water (MENR)				Local Authorities		
		Main strategies	Extent of Usage	Implementability	Effectiveness	Extent of Usage	Implementability	Effectiveness
Command and Control	Monitoring and Inspections	Self-reporting (a) Sampling (b)	Moderate (b) Low (a)	Moderate (b) Low (a)	Low	Low	Moderate (b)	Poor
	Warning Letters	Selective	High	High	Low	High	Low	Low
	Court Action	Fines (a) Closures (b)	Moderate(a) Poor (b)	Low	Moderate	Poor	Poor	Poor
	Water Permit	Cancellations	Low	Poor	High			
Economic Instruments	Financial Penalties	Violation penalties				Proposal in 2 towns	Poor	Could be effective
	Sewer Charge	% of water consumed				All towns	High	Moderate
	Trade Effluent Charge	Water volume &				Proposal in 2 towns	Poor	Could be effective

Source: Own Field Data

Notes: (1) High (2) Moderate (3) Low (4) Poor

6.0 Conclusions

The decentralized nature of polluting activity, some of which is clandestine, and the institutional requirements mentioned earlier make violation levels more difficult to monitor. Assessments on wastewater regulations indicate that regulations are ineffective in promoting their objectives for two general reasons: First, there are ineffectively designed regulatory policies, such that, although there is compliance with the regulatory requirements, with each intervention, little or no beneficial effect has been observed. For example, there is a mismatch in the hierarchical steps of the judicial process, since penalties are not graduated, thus making industrial firms indifferent to threats of the most severe penalties. In all circumstances, the *expected gains from violation* are quite high. Therefore, some firms violate, these regulations, expecting the most severe penalty at some point, and will continue polluting after facing the penalties.

One other defect is the misplaced focus on the requirement that firms install pre-treatment gadgets. Since many firms have managed to install "some form" of these facilities, enforcement efforts, by the regulatory agencies, have been shifted to monitoring the appropriateness and the working conditions of these facilities. Most firms, observed, had changed their behavioral game plan upon installation of such facilities. The installations, although perceived as the first step towards compliance, do not lead to automatic compliance, as most of them remain ineffective due to (a) poor design, (b) high cost of operation and maintenance that firms avoid to incur. The overall implication is that, installation of pre-treatment facilities has not produced any reductions in violations.

The second problem with regulatory enforcement is the lack of clear procedure for enforcement. For example, even though there exists extensive regulatory requirements, they are, as a tradition, enforced unsystematically and laxly. That is, – i.e. while in some cases a negotiated approach is adopted, in yet another scenario convicted firms get away with simple warning. Indeed, inspection rates are very high but the penalties are very small, such that there are very few incentives for compliance.

A related question, for example, is that of how many warning letters should lead to an automatic statutory notice or court action. For a number of firms, which have received such letters, it is still unknown as to whether a court action will ever come. Since the enforcement effort is so extensive, it does appear to affect the firms' behavior positively, while the morale of the authorities is impaired. Firms know that prosecution and meting out the penalties on them will be very difficult. On the other hand, regulators know that moving beyond the administration of warning letters to violating firms will pose a daunting task on them in courts.

Policy Recommendations

(a) Targeting of Enforcement Effort

One of our findings is that, much more attention, by the enforcement officers, was devoted to ensuring that the firms got pollution equipment in place, rather than ensuring that it is operated correctly. In most countries, where regulatory enforcement has been effective, controls relating to wastewater pollution are predominantly confined to regulation at the point of production, not discharge. The standards, or regulations, at the point of discharge do not generate financial

incentives to improve the overall production technology by firms (i.e. adoption of water-saving technology) since they encourage window dressing activities, aimed at appeasing the enforcement officers.

(b) Graduated Penalties

The use of monitoring, warning letters, and court prosecutions, in the enforcement of industrial wastewater standards, is common to many countries, both developing and developed. However, these judicial steps should be embodied in graduated penalties. Currently, there are no differences in the punitive effects of these actions. For instance, a court action does not carry any bigger threat than that of monitoring.

c) Institutional Arrangements

Current theoretical models of regulatory enforcement suggest that, a broad-based enforcement agency is likely to be able to achieve higher rates of compliance, than a group of smaller ones. An agency that covers a wide geography and/ or a variety of media is more likely to be able to identify and exploit *synergies* e.g. by implementing compliance-enhancing deals than one with a narrower range of jurisdiction (Heyes & Rickman, 1999:373). Some of the existing problems in regulatory enforcement could be eliminated via a centralised and broad-based enforcement authority for wastewater management in Kenya.

Although some effort has already gone into the establishement of the National Environmental Management Authority (NEMA), the role of Local Authorities has not been redefined to exclude regulatory enforcement of wastewater standards.

Furthermore, many other government organizations, with duplicating roles, still remain in operation while modalities for exploiting synergies (between government departments) have not been established.

Notes

[1] Lake Nakuru National Park contains a wetland of international importance, including the lake itself, which was designated a Ramsar site in 1990. Lake Nakuru is an important feeding ground for one or two million lesser flamingo (*Phoenicoterus minor*) and more than 450 other bird species. The park also supports large mammal populations, including the threatened Black Rhinocerous (*Diceros bicornis*), and over 400 species of flowering plants. Each year, Lake Nakuru National Park receives over 200,000 visitors, making it the second most visited park in Kenya.

[2] "Please refer to a letter Ref. no. MWD/.../DCON/186/4 of 7th April, 19.. which was addressed to you by the District Water Engineer, ... District and copied to this office, among others on the above subject and note that the design plans referred to by the District Water Engineer must be submitted urgently and that no activity, likely to generate polluting effluent, should be started without the necessary anti-pollution measures having been taken to the satisfaction of this Ministry. In this connection, you should further note that lack of co-operation and compliance on your part may lead to the Ministry taking legal action against you. Please take the necessary action accordingly."

[3] "On 2nd July 1998, your industry was visited by our Pollution Control Officers for the inspection of your effluent treatment system and the manner of storage of raw material that your industry recycles to produce drums and containers. During the inspection, it was ascertained that the effluent treatment system has been converted into a septic tank for human waste disposal in addition to serving the raw material before processing. This office recommended the system solely for taking away the said wastewater. At no time did we ever recommend the utilisation of the system for treatment of human waste or any other related purpose..... Besides the improper utilisation of the effluent treatment system, it was also ascertained that contrary to our advice, that you use proper containers preferably high tensile polythene bags for storage of your raw material, you continue to store the material haphazardly all over the place, outside the factory, making the place look like a refuse dump. The raw material, as we know it, is actually very dirty as the containers mostly come from refuse dumps where all manner of filth is likely to be present. During the rains the filth is washed off the containers down into Ruiru river which is only about 20 metres away from the factory."

[4] These effluent By-laws became effective from 25th March 1995, when they were first signed by the Minister for Local Government.

[5] Especially because there is a serious mismatch between these charges and the maximum penalties payable under the law.

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