# Charges and other policy strategies in Dutch water quality management

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# 1 Introduction

## 1.1 Introduction

The controversy between advocates and opponents of replacing command and control by economic incentive strategies has always been rather heated, though carried on more in terms of theory than of empirical evidence drawn from experience with charges in actual operation (compare Mitnick, 1980: 373-383). In this chapter some evidence on the actual effectiveness of the Dutch effluent charges in the period 1986-1995 is presented and confronted with earlier findings on the period 1975-1980, focusing on industrial wastewater.

By this we touch upon one of the rare examples of far-reaching and well-known financial incentives in Dutch environmental policy. The abstract aim of the Dutch policy on surface water is to obtain a quality that enables as much diversity of organisms and aquatic life-communities as nature can possibly give. Besides this ecological goal the surface water must be appropriate for serving human ends as well, the production of drinking water, agricultural use, recreational use, industrial use are referred to.

The charges on water pollution came into existence as a side effect of the 1970 Surface Water Pollution Act that aimed at improving the strongly deteriorated quality of surface water. The law delegated the task of water quality management to the provincial authorities and often, through these authorities, to established district water boards. An important aspect of the task in hand was the need to clean up sewage water from households and industry. This called for a great deal of money to invest in sewage water treatment. So the law permitted water boards to introduce charges in order to cover their annual costs. The charges were meant as a mechanism to raise resources to finance sewage water treatment, not so much to influence households and businesses. Degradable organic pollution, for instance, was taxed with a hefty charge per unit of pollution, the charges were for instance more than twice as large as the comparable German program (Brown and Johnson, 1983).

Within a few years almost every water board had raised the rates to a level that it paid businesses, emitting their wastewater into the sewage system, to reduce pollution. Meanwhile almost all district water boards also established a charge on heavy metals in the wastewater. Due to the fact that the charges are earmarked, collecting levies is related to the actual costs made to purify, the chargers on heavy metals are relatively low because abatement costs are relatively low.

## 1.2 Dutch effluent charges

Formally like in the US the quality of the industrial water discharges is regulated by licenses. The implementation of the licensing system under the Surface later Pollution Act of 1970 was far from perfect in the seventies and eighties. Like in other environmental sectors (substantial) backlogs of applications for licenses and inadequate enforcement (Audit Office, 1987) were familiar phenomena. This even holds true for heavy metal pollution, one of the water management boards' top priorities.

Since 1984 regional water quality managers have been empowered to issue licenses directly in order to enable them to impose restrictions on firms that discharge the so-called gray and black list substances - in particular heavy metals - into the municipal sewage systems. A survey conducted by DHV among water quality managers from 1984 to 1987 showed that just over half of these firms were issued with licenses. Moreover, the requirements contained in these licenses were more moderate than initially envisaged. The business's economic position was often the overriding concern, even to the extent that the "best existing techniques" criterion was often interpreted as "the best practicable/affordable techniques", a formulation that central government had expressly avoided in relation to these substances.

The most far-reaching and best-known financial incentive in Dutch environmental policy consists of the charges on water pollution. In 1970 the Surface Water Pollution Act came into force, delegating the task of water quality management to the provincial authorities and often, through these authorities, to the water management boards. An important aspect of the task in hand was the need to clean up sewage water. This called for a great deal of money. So the water boards were permitted to introduce charges in order to cover their annual costs. Degradable organic pollution, for instance, was taxed with a hefty charge per unit of pollution. Each water board applies different rates, according to their costs and the number of units of pollution these costs have to cover in their district. Within a few years almost every water board had raised the rates to such a level that it paid businesses to start significantly reducing pollution levels. From 1970 to 1980 organic pollution from industrial effluents fell by two-thirds.

The charge levels are by far the highest in the world. By 1995 the average charge level is some 36 Euro per “population equivalent”, a household paying more than one hundred Euro per year. The total revenue increased from 155 million Euro in 1975, to 355 million Euro in 1980, to 490 million Euro in 1985, 608 million Euro in 1990, 842 million Euro in 1995 and almost a billion Euro in 2000 (CBS 1998)

Research (Bressers, 1980, 1983, 1988 and Schuurman, 1988 – see also chapter 2 of this report) showed that almost all credit for this reduction went to the charges. The licenses introduced at the same time as the charges had had little effect. This is a striking result, considering that it was the licenses, not the charges that were officially designed to manipulate the environmental behavior of businesses. Bressers (1983) attributed part of the charges' success in the seventies to the drastic change they bring about in the consultative climate between the water manager and industry. The keynote of the contacts is collaboration rather than conflict now that industry is able to achieve significant savings by cleaning up pollution. In practice, therefore, environmental charges do not function as a purely economic mechanism. They do not replace consultation between authorities and industry, but actually increase its beneficial effects on environmental conservation.

In view of the damage that heavy metal pollution causes to the sewage water treatment process and to the quality of the resulting purification sludge, most water boards also introduced a charge on the presence of heavy metals in effluents. But as the charge was relatively low, the water boards felt it had little to do with the 50% reduction of heavy metals in industrial effluents achieved between 1975 and 1980. Without negotiations and licensing regulations, so they thought, industry would be unwilling to budge. Statistical analysis (Bressers, 1988) showed, however, that negotiations in districts that had substantially raised the charges were much more successful than in other districts. So the regression analysis revealed that the charges, far from being insignificant, were in fact the most powerful policy instrument!

Generally speaking, the effluent charges have given good *results* compared with the other instruments. One of the main strengths of financial incentives is that they do not simply operate as economic mechanisms, but also help to enhance the effects of consultation between government and industry.

A look at criteria other than effectiveness shows the following picture. As a rule, *spatial differentiation* within the Netherlands was not an environmental policy aim. However, the example of water quality charges - where higher local rates led to stronger local reductions in pollution - do make it clear that charges are capable of achieving spatial differentiation where required. Naturally, such spatial differentiation could make certain "expensive" areas less attractive to businesses than "cheaper" areas. But the same holds true for differences in land prices, and everyone accepts these without a second thought.

The same example indicates that charges are fairly easy to *adjust to changing circumstances*. Note, however, that in the Netherlands such changes were not prompted by a desire to reduce pollution levels, but rather by the need to meet water treatment costs. Businesses may be less willing to accept increases in rates for financing new policy objectives than increases necessary to meet higher purification costs.

In all cases, there was a great deal of *uncertainty* about the effects of the instruments in all cases. As we have seen, the water quality charges were actually not even intended to change environmental behavior. Strikingly enough, this uncertainty did not in most cases lead to disappointing results and, in a number of cases, even to much-better-than-expected results. After the generally poor performance of licensing systems, this is truly remarkable.

The *political feasibility* of financial instruments is always a difficult point. The charges on water pollution were acceptable because they were introduced as charges for sewage water purification, i.e. as payments for services rendered. The employers' organizations in the Netherlands still maintain that other forms of charges are unacceptable to them. One of the reasons is precisely the effectiveness of the instrument. Another reason for this resistance may be that charges without compensation impose a heavier burden on industry than on government.

Furthermore, in several meta-evaluations it has become clear that no absolute statements can be made about the feasibility and effectiveness of policy instruments. The effectiveness of an instrument or mix depends very much on the given circumstances, and no instrument will be effective in all circumstances. It is therefore essential that theories on the feasibility and effectiveness of instruments take these circumstances into account. Building on our experience with research into the effectiveness of large parts of Dutch environmental policy, a contingency theory has been developed at the University of Twente. This contingency theory assesses the feasibility and implementability of policy instruments, taking into account the circumstances in which the instruments are applied (see appendix 2). It therefore enables us to make global predictions and statements about the feasibility and implementation of the various (combinations of) policy instruments in different situations.

A population equivalent is the amount of organic pollution equivalent to the average organic pollution caused by one person in a normal household; the number of p.e.'s thus being equal to the population. Fort industrial pollution, the number of p.e.'s is calculated predominantly on the basis of BOD and COD figures. The definitions ("formulas") changed during the course of time. This is a main reason that we had our analysis in chapter 3 started in 1986.

## 1.3 This report

In section 2 the organizations, processes and aspects of surface water quality are presented and by that the implementation regime of the Pollution of Surface Waters Act is described. This Act provides water authorities with regulatory instruments to set general rules and grant permits, to develop and set water quality plans and water quality standards, to collect levies, to monitor and enforce. The policy towards industrial wastewater works with a mix of different policy instruments, while in the broader context of Dutch water quality policy additional instruments are involved. For instance as has been referred to, the production of collective goods, the treatment of sewage water in plants owned by district water boards, has been a major component of this policy. Beforehand it should be clear that the performances of charges in this case interact with other instruments and aspects of the setting they are used in. As such they are analyzed.

Section 3 reports the empirical analyses on the effects of policy and especially the charges in the period 1976-1980. Each water board applies different rates, according to their costs and the number of units of pollution these costs had to cover in their district. This opens up possibilities to assess the effectiveness of charges. The analysis on the period 1986-1995 is reported in section 4. This will be followed in section 5 by an assessment of the Peper and Cardboard industry and in section 6 the Dairy industry will be analyzed .

Finally section 7 presents the conclusions and the outlooks.

# 2. Management of surface water in the Netherlands

## 2.1 Introduction

Dutch surface water management is a complex system. The best way to describe it might be to consider it as a multi scale, multi actor system of governance in which both private and public actors play a role. It is a heavily coordinated sector with a strong emphasis on consent and 'voluntary' co-operation. Often this might be negotiated co-operation. There is a history of forty years and for these reasons we cannot limit ourselves to an isolated analysis of levies. Focussing on the used levies and their effects without integrating the other aspects of water management system would be misleading.

Pollution from sources of human activity is seriously regulated since the 1970 Pollution of Surface Waters Act (acronym in Dutch: WVO). This several revised law represents the most relevant legal framework for the management of surface water and for reducing pollution. The Pollution of Surface Waters Act is applicable to all surface waters in the Netherlands. Responsible water authorities are supplied with regulatory instruments to set general rules and grant permits, to develop and set water quality plans and water quality standards, to collect levies, to monitor and enforce and to compensate for efforts beyond reasonable impacts (CIWVO, handboek WVO-vergunning, 1999, p. 47).

The Pollution of Surface Waters Act has been proven successful in reducing the organic pollution of industrial wastewater despite industrial expansion. At forehand, like already expressed in the introduction, the policy theory was that the rules and the permits were going to be effective, the levies were only introduced to finance the implementing costs. However this law is only one element in a complex policy system.

In section 2.2 we will explain about the policy system on pollution of surface water. In section 2.3 we will explain more about the approaches and instruments the involved actors use to manage pollution in the waste-water of industrial companies.

## 2.2 Policy system on water management

The abstract aim of the Duch policy on surface water is to obtain a quality that enables as much diversity of organisms and aquatic life-communities as nature can possibly give. Besides this ecological goal the surface water must be appropriate for serving human ends as well. We are referring for example to the use as a material for preparation of drinking water, agricultural use, recreational use, industrial use, etc. (Handboek milieuvergunningen, samson, 1997, p. 14).

In order to get grip on the characteristics of the quality management of surface-water in the Netherlands we cite and paraphrase work of Bressers, Huitema and Kuks on this (1994: 36-38, 42-45): The 1970 Pollution of Surface Water Act was proposed in 1964 after serious deterioration of surface water quality in large parts of the Netherlands had emerged and after widespread recognition of the problem. However, the Act was not passed until 1969. It took so long because all kinds of government authorities lobbied to become the principal authority in this field: central government agencies, provinces, water boards and municipalities. The law distinguishes between national surface waters that are managed by the national government and other waters that are under the responsibility of other sub-national level governments. The national waters include the main rivers, the 'Waddensea' and the North Sea. The water quality task of the national government consists of giving management directives, planning water management, granting permits to discharges into state waters (including the discharges of effluent from treatment plants of adjacent water boards), collecting charges form the same category of discharges, measuring surface water quality and subsidizing abatement measures, typically the building of treatment plants by water boards. The authorities responsible for regional waters have the same function, with the exception of subsidies, but with the important addition of building and operating water treatment plants (CUWVO, 1990). The law assigns the responsibility for the regional waters to the provinces.

However, the provinces are authorized to delegate these tasks to Water Boards or municipalities. This resulted in a delegation of the task by nine provinces to Water Boards. In 1993, however, one of the three remaining provinces delegated its task to a newly established water board and the other two were expected to follow soon. Nearly all treatment plants are managed by these provinces and water boards. Municipal treatment plants hardly exist and are regarded as an anachronism. The prime responsibility of municipalities in water quality management is the management of sewage systems, and to some extent, as we shall show later, pollution control of discharges into their sewage systems.

Also some new interests are now represented in the councils of the water boards. These include renters of agricultural property, inhabitants of the area in which the water boards operate, domestic polluters, and industrial polluters. This, combined with a new policy planning structure, has led to a situation where Water Boards now have to consult and coordinate with others more intensively than previously. To some extent this form of functional territorial decentralization by the province now is somewhat more democratized. The governors of the waste boards are elected. These changes did not decrease the overall importance of the so-called Union of Water Boards. This is a private association, which unites all Dutch water boards in defense of their common interests and coordinates their policies on a voluntary basis.

There is very little animosity between water quality managers at the national and the de-central water board levels. A further binding mechanism is cultural coordination, provided by a common education and training system. These factors explain why there are coordination mechanisms with a high degree of legitimacy in the eyes of individual water boards, which are consensus oriented, while having a broad array of participants. An example is the Commission on Integral Water-Management (CIW) that formerly was referred to as the 'Commission on the Implementation on the Pollution of Surface waters Act'  (CUWVO).  The conclusion of Bressers, Huitema and Kuks is that the institutional and administrative structure of surface water management in the Netherlands is very complex, but that within the group of agencies directly involved there exist a common belief system and a substantial degree of commitment and inter-relatedness. This concerns only the inner core of the administrative actors, however. To characterize the broader network it should be seen in action. Those actions imply contacts with people and organizations outside the inner water community. The water community meets different groups of organizations under different circumstances when carrying out the mentioned two main tasks: wastewater treatment and reducing industrial emissions.

#### *2.2.1 Discharge of pollutants in industrial wastewater*

One of the main threats to surface water quality, next to the imported pollution in the downstream water of the large rivers that enter the North-sea through the Netherlands, is the discharge of pollutants in industrial wastewater. In the case of state waters, the national government is the responsible actor. This responsibility is mandated tot the Public Works Agency. This agency act in a decentralized structure. It consists of a central directorate, an important research institution (RIZA), some service departments and regional directorates. When granting and enforcing permits the Public Works Agency and its sub-agencies deal with the industries that discharge into their waters, as do the required water boards. There are some differences, however. One difference is that generally the direct discharges into state waters are much larger companies than the discharges into regional waters. Many of the country’s largest industries are direct discharges into state waters, especially the river Rhine and its various estuaries. The second difference is that the sub-agencies lose the responsibility for indirect discharges (into sewage systems that discharge into state waters) once a public treatment plant has been built. That is because only the regional boards are entitled to build sewage water treatment plants. Consequently these regional water boards themselves become discharges into state waters with the effluent of their treatment plants, and are subject to permit granting from the Public Works Agency. Another consequence is that the permitting of some categories of indirect discharge becomes the responsibility of the regional water boards instead of the Public Works Agency.

#### *2.2.2 Co-ordination*

This complex constellation of actors call for strong coordination. By 1973 the Committee on the Implementation of the Pollution of Surface Waters Act (in Dutch: CUWVO) was established by the Minister of Traffic and Public Works, which has the responsibility for water polices and whose ministry includes the Public works agency (RWS). This committee developed into ‘the common consultation organ of all parties involved in water quality management’ (CIW, formerly CUWVO, 1990). The CIW currently has three functions: coordination, guiding research and giving advice on subjects such as administrative and juridical matters, implementation aspects of collecting effluent charges, the measurement of water quality and emission standards. It no longer confines itself to the water quality aspects, which are regulated by the Pollution of Surface Water Act. Other topics such as riverbeds and the finance of water quality management, unrelated to abstraction point sources, are now viewed as issues the CIW may address. Within this commission, Working Group VI and its subgroups are one of the most important sources of new emission-oriented water quality policies. The working group has prepared by far the largest recommendations. They are named reports, but are referred to by many water quality members and others as policies, even in written documents or guidelines, and even sometimes by the CIW itself. Next to governmental organizations also of representatives of the target groups such as representatives of branches of industry and chambers of commerce are involved. These reports are accepted by the water quality managers and the latter hardly ever deviate from them. This is one of the reasons why firms of a branch of industry all over the country generally face the same demands, regardless of the water quality manager involved. Furthermore it is difficult for these firms to reject those demands as unreasonable, simply because their representatives in the subgroup agreed to them. From an administrative justice point of view one has to be aware that the possibilities for a water manager to deviate are limited. The principle of equity is part of the principles of decent government in use. A reason to deviate has to be linked immediately to the quality of the surface water or the proper operation of a Public Waste Water Treatment Plant. In practice, the CIW provides a very important arena for the Dutch surface water quality network in which almost all network organizations participate in consensus building. The consensus building orientation in the formulation of policies reflects a pre-existing orientation in daily implementation. An important background for this is the Dutch effluent charge system. Here, we limit ourselves to some implications of the charge system for inter-organizational relationships. A very important aspect of the charge system is that it directs the nature of the interactions into a much more constructive form of consultation because it lets pollution prevention pay. Furthermore, it provided the water boards with an entrée to the firms, even when permit-granting responsibilities did not provide that in the numerous cases of firms discharging to a municipal sewage system.

From early on it was decided that the effluent charge, which has this type of pollution as its main basis, could be levied directly by the water managers in the firms (and households) where oxygen-demanding pollutants are at stake. That not only implied that these firms had a strong incentive to decrease their discharge of organic pollutants, but also that water board officials had an entrée into those companies with indirect discharges. They could legitimately discuss with these firms the organic pollution of their wastewater and the possibilities of decreasing it. Because this also offered firms the possibility of reducing their charges (through reducing their discharges), this facilitated the consultation process. On that basis, water board officials also often tried to discuss pollution form heavy metals and other pollutants. Indeed, they often claimed that certain discharges would not be allowed in the near future. Legally they had no basis for such statements.

The water boards also introduced an effluent charge on heavy metals on the basis of the extra costs of operating treatment plants. Heavy metals polluted the reaming sludge of the plants which often has to be treated as chemical waste instead of being sold as fertilizer. In this the ongoing process of growing environmental awareness, accumulating knowledge which led top a process of gradually increasingly demanding limits. Although the activities, including the assessment of the charge, did success in approximately halving the heavy metal content of industrial wastewater, the situation was still considered unsatisfactory. For this reason the Pollution of Surface Waters Act was changed in 1981 in order to give the water managers direct responsibility over a number of substances or categories of firms that were to be listed in a governmental decree. This was again some sort of victory over the municipalities for the water boards, which had always wanted that responsibility. Apart from the difficulties mentioned above, international agreements and treaties, for instance on grey list and black list substances, made such a change inevitable. For practical reasons it was decides to list not substances, but categories of firms, as the new responsibility of the regional water boards. The CIW played an important role in selecting the branches of industry that were to be subject to the new regulations.

Finishing the citation and paraphrasing, figure 2.2.2.1 gives an overview of the actors in groundwater management and surface water management in the Netherlands.

<table>
<tr><td></td><td>Ground water management</td><td>Surface water management</td></tr>
<tr><td>Management at the national level</td><td colspan="2">Ministry for Public works<br>Public Works Agency<br>Ministry for Environmental Protection</td></tr>
<tr><td>Consultation at the National level</td><td>Main participants:<br>-association of Dutch water supply companies<br>- Agricultural Board<br>- Ministry for Environmental Protection<br>- Ministry for Agriculture<br>- Interprovincial Consultation</td><td>Main participants (by representation in the CIW, formerly CUWVO):<br>- Union of Waterboards<br>- Interprovincial Consultation<br>- Association of Dutch Municipalities<br>- Public Works organisation<br>- Ministry for Environmental Protection<br>- Associations of Industries</td></tr>
<tr><td rowspan="2">Management at the Regional level</td><td colspan="2">Provinces<br>(nationally represented by the Interprovincial Consultation)</td></tr>
<tr><td>Water Supply Companies<br>(private companies, nationally represented by the Association of Dutch Water Supply Companies)</td><td>Water Boards<br>(public agencies, nationally represented by the Union of Water Boards)</td></tr>
<tr><td>Management at the Local level</td><td></td><td>Municipalities<br>(responsible for sewerage system)</td></tr>
<tr><td>Production at the Local level</td><td>Drinking Water Production Units<br>(managed by the Water Supply companies)</td><td>Waster Water Treatment Works<br>(managed by the Water Boards)</td></tr>
</table>

Figure 2.2.2.1**:** Actors involved in ground water management and surface water management at the national, regional and local level

*Source: J.Th.A. Bressers, D. Huitema and S.M.M. Kuks, Policy Networks in Dutch Water Policy, in: Environmental politics, vol. 3, nr. 4, 1994, p. 28*

Figure 2.2.2.1 indicates that water quantity management (to avoid floods) and ground water management (both levels of groundwater and quality of groundwater) in the Netherlands is as important as management of surface water quality. Drinking water is produced from surface water and from groundwater. Water quality and quantity is the primary responsibility of the Ministry for Public Works and the Public Works Agency and not of the Ministry for Environmental Protection, although co-ordination procedures are quite strong. The Ministry for Public Works has created a policy system that is well known for its good organization, and early and large performances, starting in the early 1970s. Industry reduced its organic emissions by circa 80%. In the Netherlands there are ample 30 water boards which operate about 450 wastewater treatment installations.

## 2.3 Policy system on surface water quality

In section 2.2 it became clear that quite a number of actors are involved in water management, being policy on the quality of surface water only one, however an important aspect. An important distinction is made between *water quality policy* and *pollution emission policy*. We start of with the *water quality policy*, the *emission policy* will follow.

### *2.3.1 Water quality policy*

For a number of substances water quality standards are formulated. In most cases these standards express allowed concentrations of harmful substances in surface water. The process of issuing such quality standards is as much as possible based on scientific information and starts with the *determination of scientifically founded risk-limits*. These concern the distracted 'Maximum Allowable Risk-limit' and the 'Negligible Risk-limit'. The Negligible risk-limit is a factor 100 below the Maximum Allowable Risk-limit, by this a security margin is taking into account the toxic effects due to combinations. The Maximum Allowable Risk-limit can only be adjusted if new scientific insights or international co-ordination gives reason for adjustment. If the Maximum Allowable Risk-limit in surface water is exceeded, it implies obligations to act for water-authorities. Within the period of planning, these reductions should lead to a situation of compliance. The Negligible Risk-limit remains the long term goal. This in order to avoid that pollution room present under the 'hard-standard' that integrate Maximum Allowable Risk-limits into quality standards will be filled out. The 'soft standard' might otherwise stimulate transfer of pollution from more polluted surface water to cleaner surface water, be it naturally or superficial.

Secondly, as just has been mentioned implicitly, based on these risk-limits the government issues *environmental quality standards for surface water*. The status of these standards can differ strongly (regulated by law or quasi-legislation). Those by law and 'hard standards' are obligatory, the 'soft

standards' imply an effort obligation. The latter are that are often deduced from established Negligible Risk-limits.
In standards for metals the natural background-levels are taken into account, these differ per region. For nutrients and other natural parameters area-specific standards are in use because of the natural wide regional variation and a large number of water-types.  For nutrients there is only an minimal-quality level, so there is not a more ambitious 'soft standard'. For other polluters there is no geographical differentiation.

*2.3.2 Emission policy*

The relation between *water quality policy* and *emission policy* is as follows: The quality standards, both 'hard standards' and 'soft standard' are considered as 'immission' standards. In principle they determine the amount of emissions into surface water that can be tolerated. It is the duty of the water authorities to manage that the total of emission sources in a region do not exceed the 'immission' limit. This in order not to exceed the quality standards. To a certain extent a 'bubble principle' is implemented, being the water authorities the coordinating actor. This bubble approach is not valid for especially harmful substances. These substances are enumerated in lists of harmful substances. Lists like the black list, priority list and grey list refer to substances that are primarily integrated on the basis of their toxicity, persistence of bio-accumulation. For these substances quality standards do not imply related pollution-room that can be filled up. For these substances the bubble concept is explicitly rejected.

Figure 2.3.2.1 gives a general outline of the general and substance-specific method water authorities use to manage emissions by industry in order to reduce pollution.

<table>
<tr><td colspan="5">REDUCTION OF POLLUTION</td></tr>
<tr><td colspan="5">A. General method</td></tr>
<tr><td>Step 1</td><td>Prevention</td><td colspan="3">Source-focussed, directed at:<br>- Raw material, other materials and design of product<br>- Utilization of clean technology in the production-process, water-management<br>- New production process or ways to manage production<br>- Utilization of process-integrated solutions</td></tr>
<tr><td>Step 2</td><td>Re-use</td><td colspan="3">- Recycling (re-use in the production-process/the management)<br>- Re-use outside the production-process/ the management<br>- Moving up the possible re-use OPWERKING</td></tr>
<tr><td>Step 3</td><td>Removal (end-of-pipe)</td><td colspan="3">Wastewater treatment</td></tr>
<tr><td colspan="5">B. Substance specific treatment of emissions</td></tr>
<tr><td>1.</td><td>Implementation Ésbjerg/OSPAR</td><td colspan="3">Strive for termination of emissions at the latest in 2020</td></tr>
<tr><td colspan="2" rowspan="2"></td><td>Black list substances</td><td colspan="2">Remaining pollution</td></tr>
<tr><td>Organic chlorinated compounds, mercury, cadmium, etc.</td><td>Metals, oxygen demanding substances, P, N, etc.</td><td>'Sulfaat', chloride, heat</td></tr>
<tr><td>2.</td><td>Rehabilitation based on:</td><td>Emission treatment</td><td>Emission treatment</td><td>Water-quality treatment</td></tr>
<tr><td>2a.</td><td>Primal effort obligation</td><td>Best available Technology</td><td>Best employable Technology</td><td rowspan="2">Permission for emissions and requirements that have to be taken into account depend on environmental quality standards</td></tr>
<tr><td>2b</td><td>Further recommendations based on (=Immission test):</td><td>applicable environmental quality standards</td><td>applicable environmental quality standards</td></tr>
<tr><td colspan="5">STANDSTILL PRINCIPLE</td></tr>
<tr><td>C.</td><td>In case of new emissions or increase of actual emissions:</td><td>Emissions in the managed region cannot increase</td><td>The water-quality cannot deteriorate (significantly)</td><td>The water-quality cannot deteriorate (significantly)</td></tr>
</table>

Figure X: Outline of the general and substance specific method water authorities use to manage emissions by industry (CIW, handboek WVO-vergunning, 1999, p. 96).

Figure 2.3.2.1 represents the current approach that developed gradually. More and more the precaution-principle gets shape. This led for instance to a given priority to preventive measurements. Choices of processes and internal management should imply reducing pollution at the source. The *standstill-principle* implies that the discharge of blacklist substances may in no case increase and for other polluters, the resulting water-quality may not get worse. This for instance implies that the good functioning of the water treatment plants of the water boards cannot be disturbed by for example irregular discharge, discharge of strongly thinned or one-sided pre-purified wastewater or obstructing substances. For this reason, categories of companies can no longer vary their pollution load unlimited and cannot pre-purify any way they want. The principle of *connection to the sewage system* is directed at transporting all unpurified, or insufficient purified discharge by a public sewage system to a water treatment plant runned by the water boards (Handboek milieuvergunningen, band 5, Samsom, 1997, p. 17).

## 2.4 Policy system on surface water quality

In order to have some idea on how instruments are used we give below some information, categorized by the often-used distinction between regulation, incentives and negotiated agreements.

### *2.4.1 Regulation and permits*

In operational terms emissions of industry can go two ways: into the surface water or through the sewage system connected to the Public Water Treatment Plants, the effluent going into the surface water. If the emission of a company is over 500 m3 and/or the pollution of oxygen demanding substances is over 5000 population-equivalents, also the emissions at the sewage system have to be licensed on the basis of the Pollution of Surface Water Act. Under these levels, a license to connect to the sewage system, which the municipality mostly owns is necessary and sufficient. The municipality itself also needs a license to connect its sewage system to the Public Water Treatment Plant. Given the requirements of this permit, also the municipality is the coordinating actor of a ‘bubble system’ although at a smaller scale. Requirements can also be deduced from the efficient functioning of the Public waste Water Treatment Plant. Any direct emission into the surface water, also after pre-treatment, has to be licensed in any case. This holds true as much for the companies as for the managers of a Waste Water Treatment Plant. Actors such as the Ministry of Public Works, the Agency of Public Works and the water boards have teams of supervisors and control officials at their disposal. These teams control the compliance to the rules, especially in case of pollution of the surface water.

With regard to regulation, the level of ambition towards the reduction of water-pollution in wastewater was raised considerably in the period 1985-2002. Regulators focussed strongly on hazardous substances like heavy metals, chemicals and on reducing the emissions of fertilizing substances. Practitioners explain that the licenses have become more ambitious during the last 15 years. Nearly always research-obligations are imposed on companies to limit or reduce the discharge of certain substances. In the past these companies almost always only paid attention to substances which determined the levy. In interaction with the company the company has to proof that a discharge his no negative influence, in earlier days this was the task of the permitting organization to proof that something was harmful. However the impact of more ambitious licenses differ per sector of industry. Some sectors are way ahead of the licensers, other are more passive and in those sectors regulation might have substantial impacts (Water board permitter J. Veenstra).

### *2.4.2 Levies and subsidies*

The WVO-levy is earmarked for the finance of public water treatment plants and the costs related to the management of water-quality. Companies pay for the amount of waste they discharge. All actors that discharge on the surface water pay a levy every year which is determined on the basis of emitted loads of polluted oxygen-demanding substances and heavy metals. Practitioners belief that the levy has a strong positive stimulation effect next to the Pollution of Surface Water Act. The most important instrument for the reduction of organic pollution of waste water until the mid 1990s seems to be the levy. This is understandable in the context of the charges that can easily be a million Euros for a company. It can be cheaper for companies to treat the waste-water themselves. In the past there also have been subsidies for the building of some biological purification plants owned by companies, like for Friesland Coberco Diary Foods, that is part of our empirical analysis (Water board permitter J. Veenstra).

How is the levy calculated for individual companies? To determine the levy there is a distinction between two categories: households and companies. In the category companies there is a further distinction (p.e.= population-equivalent):

- Buildings with an discharge smaller than 5 p.e. (the levy fixed at 3 p.e. or 1 p.e.)
- Companies with a discharge smaller than 1000 p.e. and a small number of categories of companies with a discharge smaller than 100 p.e. can determine the dischargement by using a chart for wastewatercoefficients. This chart is produced to have an efficient estimation without the companies having to do actual measurements. These companies are called ‘chartcompanies’.
- Measurement companies. These companies are obliged to determine the discharge by measurement and taking samples.

The water-quality-manager (water boards, public works agency) checks the measurements with own observations. Companies are imposed to measure by means of the license. The levy is determined by the so called public formula:

$$VE = Q\ (CZV + 4.67\ KJ\text{-}N) / 136$$

VE = Discharge (expresses the amount of pollution in p.e.)
Q = Amount of discharged water in twenty-four hours
CZV= Chemical oxygen demand
Kj-N = nitrogen proportion, determined by the Kjedahl-method.
136 = average disposal produced by one person in one day.

The quotient makes clear why the VE is also addressed to as the ‘population-equivalent’ (p.e.).

There is a formula for the discharge of heavy metals as well. There are two categories: black list substances and remaining metals. The next formulas present the quintessence (Handboek wvo-vergunning, CUWVO/CIW, 1999., p. 260):

V.E. black list substances: = (load in kg/year – 0, 0006 x number of discharged i.e.) x 10

VE remaining metals = (load in kg/year – 0,04 x number of discharged i.e.) x 1

Above mentioned formulas are used by the Ministry of Public Tasks. Regional water-boards also collect levies on oxygen demanding pollution and –in most cases- a levy on heavy metals as well, and in some cases on chloride, 'sulfaat' and phosphor (Financiering Zuiveringsbeheer, Commissie Integraal Waterbeheer, 1999, p. 15). Almost always it is calculated very similar, however small deviations are possible. Also the tariff per p.e. differs significantly. A company that discharges unpurified on a public water treatment plant, discharges on average 10.000 to 15.000 p.e. year. So on average these companies pay a water board 10.000 x 50 = 500.000 Euro yearly. That is no trifling matter.

The returns of the levy in 1998 was about 1.9 billion Dutch guilders. The water boards collect nearly 100% of the levy. About 80% of the return is used for purification management and 20% for remaining tasks related to water-quality and water quantity tasks. The levy returns are over 99% based on the discharge of oxygen demanding substances. Heavy metals contribute only tens of percents. Only the presence of heavy metals and not the concentration of it is paid for (Zie Financiering Zuiveringsbeheer, Commissie Integraal Waterbeheer, 1999 Bijlage: p. 28).

Commission III of the earlier mentioned CIW (formerly CUWVO) advises on the issues of the levy and the other financial aspects of water management. In the present implementation of the levy there are some problems perceived with regard to the legitimization of the levy-parameters; some discharges on the sewage system are making costs but do not getting implied a levy (because the discharged substances are not involved within the levy).  We will address this issue later on in the analysis.

*2.4.3 Negotiated agreements*

A new category of instruments became important in the 1990s. The governments reach out for the goals in the National Environmental Policy Plan (NEPP) by working together with so called target groups. Industry is one of the target groups. For sectors of industry that produce substantial environmental effects, Declarations of Intend (DOI) are negotiated. There is some pressure from the government. If a sector of industry is not willing to cooperate or does not perform reasonable well, there is some regulatory threat. In the Dutch context it would be naive to categorize the covenants as purely voluntary agreements. For this reason we speak of negotiated agreements. Industry was only willing to cooperate under the condition that the government promised that any agreements were reached for by willing companies in the end also would be subscribed to possible laggards in the sector that failed to contribute to the performances of the sector. This package of negotiated agreements provides an answer to the problem of the free riders and the government provides legitimacy to the companies' environmental management. These covenants deal with all environmental themes, water pollution being only one of them. The companies are offered some flexibility towards the timing of measures, leaving the solutions to be chosen up to them. This might improve efficiency and the governments promise to deliver a consistent environmental policy. In heterogeneous sectors of industry companies produce an individual environmental plan, the Companies Environmental Plan (CEP). In most cases these CEP's are for four years, if a Declaration of Intend is agreed upon for a longer period, several CEP's are often required. In this plan they explain how they are going to live up tot the collective commitments. The permitting governments have to approve of this plan. The criteria they use are the Declaration of Intend and regulatory requirements.

A Declaration of Intend normally contains the following elements:
- The parties involved.
- The agreed objectives and expected performances.
- The bases of the agreement (like: this DOI will not harm the legal rights and obligations of parties).
- The agreements (like the forming a consultation-group).
- Obligations for the sector of industry (like making a CEP every four years and the expected performances).
- Obligations for authorities (like evaluate, examine and testing).
- Common obligations (like making a communication plan).
- Evaluation.
- Entrance.
- Endurance time, etc.

## 2.5 Trends in water pollution and in treatment 1975-1998

After explaining policy, organization and instruments and before analyzing the effects of levies in particular within this context we present a general overview of the performances of Dutch water quality policy. Table 2.5.1 indicates developments in the total of discharges by target group.

| | *1975* | *1980* | *1985* | *1990* | *1995* | *1997* | *1998* |
|---|---|---|---|---|---|---|---|
| Consumers | 13,7 | 14,1 | 14,5 | 14,9 | 15,5 | 15,6 | 15,7 |
| Industry | 15,3 | 9,7 | 5,9 | 5,6 | 3,3 | 3,8 | 3,8 |
| Remaining category (a.o. agriculture and fruit, energy services, constructing industry, waste disposal as of 1995, remaining target groups) | 4,2 | 4,2 | 3,9 | 4 | 4,1 | 3,8 | 3,8 |
| *Total gross discharge* | 33,2 | 28, 0 | 24,3 | 24,5 | 22,9 | 23,2 | 23,2 |

Table 2.5.1: Discharge of oxygen-demanding substances in the period 1975 – 1998 in million p.e. (one i.e. equals an amount of oxygen demanding substance that uses 136 gram of oxygen)
(Source: www.rivm.nl/milieucompencium/C_milieudruk (uit: CBS))

Table 2.5.1 expresses pollution by polluters on which the involved water quality managers imposed a levy based on the Pollution of Surface Water law. The table illustrates what insiders perceive as common knowledge: A large share of the efforts to improve the quality of wastewater was focussed on industry.
The table clarifies that almost the total reduction of gross discharge has been realized by industry. It also becomes obvious that consumers are nowadays responsible for the bulk of discharge. For individual households there is no incentive for reduction of water pollution. The levy is differentiated, however only by two categories, on the basis of size of the household. If one is willing to accept that pollution by households correlates with the amount of drinking water used, there is some incentive by the price of drinking water. However Dutch drinking water is within the European context relatively cheap.
In the sideline we have to explain that the basis for the levy has been revised in 1986 (in stead of calculation based on 180 g of oxygen-use it has become 136g). The abbreviation p.e. stands for population-equivalent. One p.e. equals oxygen demanding substances that use 180 gram oxygen until 1986, since it has become 136 gram.

Table 2.5.2 shows the difference between emissions and the burden of the surface water.

| *(discharge in million p.e.)* | *1975* | *1980* | *1985* | *1990* | *1995* | *1997* | *1998* |
|---|---|---|---|---|---|---|---|
| *Total gross discharge* | 33,2 | 28, 0 | 24,3 | 24,5 | 22,9 | 23,2 | 23,2 |
| | | | | | | | |
| *Minus Discharge of Public waste Water Treatment Plants* | 12,4 | 16,5 | 18,4 | 20,8 | 21,8 | 22,1 | 22,3 |
| *(Direct discharge)* | (20,8) | (11,5) | (5,9) | (3,7) | (1,1) | (1,1) | (0,9) |
| | | | | | | | |
| *Plus Discharge of effluent* | 3,9 | 4,3 | 4,0 | 5,0 | 3,6 | 3,3 | 3,5 |
| | | | | | | | |
| *(=) Pollution of the surface water* | 24,7 | 15,8 | 9,9 | 8,7 | 4,7 | 4,3 | 4,5 |

Table 2.5.2 shows the difference between emission and the burden of the surface water.
(Bron: www.rivm.nl/milieucompencium/C_milieudruk (uit: CBS))

Table 2.5.2 indicates two developments: the amount of direct discharge on surface water has decreased dramatically. The explanation for this is that a large number of public wastewater plants have been built, financed by money from the levies. About 450 public treatment plants are in use. It also becomes clear that the discharge of effluent has not been increasing dramatically, so the theoretical assumption has to be that also the purification performance of treatment plants has improved. Together they treat about 78% of the pollution-entities. Table 2.5.3 gives a time-perspective on the purification performance of the public treatment plants.

| | | *1981* | *1985* | *1990* | *1995* | *1997* | *1998* | *1999* |
|---|---|---|---|---|---|---|---|---|
| *Weighted removal (%)* | BOD | 79 | 81 | 85 | 89 | 90 | 89 | 89 |
| | COD | 87 | 88 | 92 | 96 | 97 | 96 | 96 |
| | N-total | 45 | 46 | 52 | 57 | 61 | 60 | 74 |
| | P-total | 36 | 39 | 56 | 74 | 76 | 76 | 77 |

Table 2.5.3: Removal of oxygen-demanding substances and nutrients at public Treatment Plants (RWZI's) , 1981 – 1999 Uit: www.rivm.nl/milieucompencium/C_milieudruk (uit: CBS; Lievense et al. 2000)

Explanation: table x illustrates the improving performances of Public Waste Water Treatment Plants with regard to oxygen-demanding substances, expressed as COD (chemical oxygen demand) and BOD (biological oxygen demand). Furthermore it gives the purification performances for nutrients (Nitrogen and Phosphor). The increasing performance is caused by the combination of an increase of the influent and a decrease of the effluent (the exception is phosphor, this influent has decreased). It is clear that the money spend on building and improving treatment plants has led to substantial improvements.

*The* conclusion of all of this has to be that the strongly reduced emissions of oxygen-demanding substances to the surface water since 1975 is both the result of efforts by industry and efforts by public treatment plants. Roughly 50% of the improvement has been delivered by industry and the increasing number of public treatment plants that also improved their performances has delivered 50% of the improvement. If later on the analysis is on the improvements delivered by industry one should keep in mind that this is only half of the story of the success of the levies in Dutch policy on surface-water quality. That analysis is on the behavioral effects of variance in imposed levies and on variance in the development over time levies. The earmarked spending of the collected money causes the other effect. It had to be invested in efforts to improve water quality. With a levy that is not earmarked, outcomes would have been dramatically worse if the money was spend on other issues.

# 3 Charges and pollution decrease in the seventies: A Dutch success story[2]

## *3.1 Introduction*

The Netherlands is a small country; approximately the size of Maryland and Deleware combined. Yet it has much industry and, with a population of some 14 million people, it has one of the highest population densities in the world. Criss-crossed with thousands of miles of waterways of all sizes, it is also a country rich in surface waters. By 1970, the year the Pollution of Surface Waters Act went into effect, industry and private households were producing roughly 45 millions of population equivalents of oxygen-consuming organic pollution. As a result, overall water quality in the country had, in plain terms, become rotten - both figuratively and literally! By 1980, organic pollution caused by industrial production had declined by two-thirds. Almost half of the remaining organic pollution, from both industry and households, was removed in sewage treatment plants, many of which had been newly built. Everywhere biologically "dead" waters revived. In light of the results achieved, water quality policy is regarded in The Netherlands as one of the few examples of effective governmental intervention (Hoogerwerf, 1985).

Government intervention can take many forms and in the case of Dutch water quality policy many different instruments are involved. Production of collective goods by the state (the treatment of sewage in plants owned by local water boards) has been a major component of this policy. In this chapter, however, I want to focus on those aspects of the policy that deal with the regulation of industrial water pollution. This regulation works with a mix of different policy instruments, including not only instruments of direct regulation but also the much-disputed instrument of indirect regulation, the effluent charge.

The controversy between advocates and opponents of replacing directives by incentive strategies in various fields of public intervention has always been rather heated, though carried on more in terms of theory than of empirical evidence drawn from experience with charges in actual operation (compare Mitnick, 1980: 373-383). This chapter gathers some evidence on the actual effectiveness of the Dutch effluent charges.

*A brief survey of Dutch water quality policy*

In an effort to combat pollution at the source the 1970 Pollution of Surface Waters Act prohibits all non-licensed discharges into surface waters. Indirect polluters, those discharging into a sewage collector, must meet the conditions imposed by municipalities for those hooked up to the collection system. In turn, the municipalities are often subject to conditions from the water authorities regarding the quality of the sewage that they discharge into the treatment plants of the waterboards. In the Netherlands not the municipalities but the waterboards own and operate the treatment plants. In the seventies an enormous

[2] Versions of this chapter have been previously published in Policy Studies review 7, 3, 1988, 500-518 and in Jänicke and Weidner 1995, 27-42.

effort was made to expand effluent treatment capacity, with the result that the amount of organic pollution removed from sewages discharges increased to 25% in 1975 and to 46% in 1980. This removal rate put The Netherlands more or less on par with its neighboring countries.

The "polluter pays" principle is the basis for the effluent charges of the Pollution of Surface Waters Act. Officially, the sole purpose of these charges is to raise the money needed to finance sewage treatment measures. In view of the ambitious program for expanding treatment capacity, these charges involve large amounts of money. In 1971 they generated revenues of about Dƒ 50,000,000, in 1975 approximately Dƒ 340,000,000, in 1980 Dƒ 780,000,000, in 1985 Dƒ 1,080,000,000 and in 1990 Dƒ 1,300,000,000. In The Netherlands each firm has to pay a fee roughly according to the amount of pollution it produces. The amount of pollution is calculated in pollution units called "population equivalents." A population equivalent is defined as being equivalent to the amount of organic pollution in wastewater normally produced by one person. The fee per pollution unit rose sharply during the period the charge system has been in effect. The fee charged varies according to the region within which the firm is located. These regional differences are not, however, based on different environmental conditions or quality objectives but rather reflect regionally different costs of building and operating treatment plants.

The unique features of The Netherlands system make it an interesting example of the use of charges. The Dutch system of effluent charges has been in operation since 1970 and, in terms of the level of the charges is more than twice as large as the comparable German program (Brown and Johnson, 1983). But the most distinguishing feature of the Dutch system is that its use as a regulatory instrument has been "accidental". It was not intended to work in this way. Originally, the charges were to be used to finance the construction and operation of sewage treatment plants. In this sense, they did not replace the official intervention strategy of direct regulation. Given this situation, the Dutch case provides a unique opportunity to examine the effects of these two approaches as they were applied to the same case.

In the following section, the degree of effectiveness, our dependent variable, will be defined. In section three we will then look at three statistical analyses of the impact of the policy instruments used. These analyses are supplemented in section four by two expert assessments of these impacts. The final section presents some general conclusions regarding the Dutch experience with effluent charges.

### *3.2 Goal-attainment and effectiveness: What has been accomplished?*

The first question to be answered empirically regards trends in Dutch industrial water pollution during the period under investigation. These trends are examined in relation to the two most important types of industrial water pollution: oxygen-consuming organic pollution, measured, in p.e.'s (so-called population equivalents) and heavy metal pollution.

In 1975, the year in which the first Multi-Year Indicative Program on water pollution control was issued, Dutch industry still produced a staggering

19,670,000 population equivalents (p.e.) of oxygen-consuming organic pollution. This was substantially more than the pollution produced by all Dutch households taken together. By 1980, the end of the period covered by the program, the total amount of industrially produced organic pollution had dropped to 14,331,000 p.e. This represented a reduction of more than 5 million p.e., or 27%. A decrease of roughly this magnitude had been projected by the 1975 policy program. There were, however, enormous regional differences. In some areas (water board districts) organic industrial pollution had actually increased, whereas in other areas this type of pollution had been reduced by more than one-half.

The 1975 program had set no explicit targets regarding the abatement of industrial water pollution with heavy metals. As was the case with organic pollution, there have also been huge regional differences in the amount of reduction attained in heavy metal pollution. In general, however, it can be concluded that industrial pollution with heavy metals has, on the whole, been reduced by approximately one-half in the period involved.

*Figure 3.2.1 Index figures on the amount of industrial production (solid line) and oxygen-consuming industrial pollution in industrial waste-water (dotted line). (1965 = 100)*

The reduction of pollution is cannot be explained by changes in production volume. Figure 3.2.1 shows that, in fact, the volume of production has not declined, not even in the recessionary period of 1975-1980. There was a dramatic decrease in pollution between 1970 and 1975, a time when the economy was booming. If we look at the separate branches of industry, in order to make sure that this overall decrease in pollution is not the result of a decline in production in some of the heavily polluting industries, we find that there are only a few industries that have experienced a decrease in production. Even if we assume that any decrease in pollution leads directly to a proportionate reduction in pollution (an overly-optimistic assumption!), the production decreases in these industries would result in a decrease in total oxygen- consuming industrial pollution of only 2 to 3% as compared with the actually recorded overall decline of 27%. A similar situation can be found with regard to pollution with heavy metals. Given the fact that production has, on the whole, tended to increase instead of declining, we can conclude that pollution per product unit has decreased more sharply than total pollution and that the level of pollution reduction attained tends to under-estimate the effectiveness of water quality policy.

Theoretically, changes in pollution per product unit might very well be accounted for by other factors apart from policy outputs. Alternative explanations could be provided by (1) independent technical developments, (2) an increase in the value of waste matter as raw material (heavy metals), (3) an increase in environmental awareness with the companies or with the population as a whole and (4) information given by nongovernment institutions. Applying Michael Scriven's `modus operandi' method (Scriven, 1976) to the examination of these different factors provided support for the conclusion that the level of pollution reduction achieved cannot be attributed to other factors than the policy pursued. If the empirically observed decrease in pollution cannot be accounted for by other factors, then it would seem, logically speaking, that policy measures taken must account for it. As the next sections will demonstrate, this has indeed been the case in The Netherlands. The substantial reduction in industrial waste-water pollution has been the result of Dutch water quality policy. Since that policy contains a "mix" of different measures, the questions remains as to which of the various instruments applied has contributed most to the policy's apparent effectiveness.

### *3.3 The Contribution of Directives and Incentives 1: A Statistical Assessment*

*Introduction*

In the previous section we noted that there have been substantial regional differences in the extent to which the policy objectives have been achieved. However, these differences cannot, without further investigation, be explained by the extent to which the individual water boards applied the various policy instruments at their disposal. First of all, the water districts themselves vary greatly in size and thus in pollution loads. Along with 17 rather large districts, there were, during the research period, 23 of rather small area. In 1975, 97% of the total volume of organic pollution was produced in these 17 large districts. Since the per centage decreases in pollution often reached extreme values in the 23 smaller areas, based, however, on only a few observations (firms), these areas have been excluded from the analysis reported below. The impact of developments in these districts on the results of the analysis would have been out of proportion to their actual importance.

Differences in goal-attainment among the remaining areas can be accounted for by two sets of factors. On the one hand, they can be partly explained in terms of differences in the economic structure of the different water districts with regard to the relative weight of particular branches of industry. In the case of heavy metal pollution differences in abatement levels may be atributed to the relative share of the various metals in the total volume of pollution. Using data on the share of different branches of industry in the regional economy and, for heavy metals, the share of various substances in the regional pollution in 1975, and on the average decrease in pollution per industry and substance in The Netherlands between 1975 and 1980, the amount of pollution decrease that could be expected on the basis of the structure of regional economy was calculated for each water district. This expected value was closely correlated to actual decrease of pollution. In the case of organic pollution the Pearson's r was +.79 ($r^2 = .62$) and in the case of heavy metals pollution it was +.74 ($r^2 = .55$)

At first sight, it would seem that only the unexplained share of regional differences in pollution decrease is relevant dependent variable when we attempt, statistically, to assess the impact of various policy instrument on the level of goal achievement attained. This is, however, not entirely the case. Variations in organic pollution between industries can be examined as well and, as it turns out, provide important information on the effects of effluent charges in particular.

*Effluent charges and branch differences in pollution decrease*
In 1969,the first time organic pollution of industrial waste-water was measured by industrial branch, it was determined that fourteen industries accounted for 90% of this pollution. These fourteen industries form the research units in the analysis described below. Since they accounted for such a large part of the pollution, this analysis is not so much a sample study but rather a semi-population study. Nevertheless, in view of the small number of units involved, a word of caution is in order when drawing conclusions based on this sample of industries[3].

There are a number of factors that could account for the differences found between these industries with regard to the percent of decrease in their organic pollution. Most obviously, decreases or increases in the level of production of the different industries could affect the volume of pollution produced in the period under investigation. A second cause of differences in abatement rates can be found in the fact that in a particular industry it is much more difficult, and thus more expensive, to produce more "cleanly" than it is in another industry. Therefore, in addition to the increase or decrease in production, relative abatement costs can play an important role in determining the level of pollution reduction achieved. Finally and (in connection with the focus of this study) most importantly, it is also conceivable that a policy output, namely effluent charges, could lead to differences in abatement between industries. The more pollution units per unit of production value that are caused by an industry, the greater the impact that the charges (which are related to the number of pollution units produced) will have on production costs. This can mean that some industries will bear charges that are significantly greater than other industries. Efforts to reduce the number of pollution units produced will be greater to the extent that a given industry is liable for higher charges compared to its production value. In the discussion that follows this factor will be referred to, for convenience, as the "charge factor".

The extent to which organic pollution of industrial waste-water decreased between 1969 and 1980 appears to be related to the three above-mentioned factors as follows: production increase, r = -.21; abatement costs, r = .50; and charge factor, r = .73. The signs of these relations are all in the anticipated direction. The strong correlation with the charge factor is very striking. When the three factors are related simultaneously to pollution decrease, they account statistically for 63% of the decrease.

In the case of two of the fourteen industries (potato-starch industry and the stock-raising industry), charges had less influence than was to be expected on the basis of their charge factor. In anticipation of ultimately being hooked up to a "smeerpijp" (literally, a dirt pipe), the potato starch industry had been allowed to continue with untreated discharges. During this time, the industry was paying much lower charge-rates than were other industries. The stock-raising industry

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[3] A more extended version of this analysis can be found in Bressers (1983-2). Methodological problems, especially those in connection with the operationalization of the relevant theoretical notions to a model of analysis, are dealt with there in greater detail. Here we have limited ourselves to a survey of the findings and a reflection on the conclusions drawn from the analysis.

is composed of thousands of relatively small farms. Here the charges are seldom calaculated exactly on the basis of the amount of pollution actually produced. Hence it is to be expected that the impact of charges will probably be less in this case than in other industries with a similar charge factor. When these two industries are left out of the analysis, the correlation of the charge factor with the decrease in pollution is even stronger: r = .84. The correlation with the other two factors remains about the same, with production increase showing a r of -.24 and abatement costs an r of -.48. These three factors, taken together, account for 76% of the differences in the decrease of organic pollution in industrial waste water between these twelve industries.

*Policy instruments and regional differences in the decrease of organic pollution*
An important part of the regional variation in pollution abatement cannot be explained by differences in the industrial structure of the regions. In the conclusion of the above section is correct, this left-over variation can be explained entirely in terms of the degree to which different policy instruments are being used. The degree to which these different instruments are actually used will also vary greatly from region to region. In this section we will examine the extent to which this explanation is accurate.

The dependent variable for this part of the analysis is the *"relative success of abatement"*. This variable has been calculated as the difference between the actual percent of abatement and the percent of abatement expected in view of the industrial structure of the region. Regional variation in the charge level cannot, however, straightforwardly be related to this variable. The reason for this is as follows.

The relative success of abatement has been calculated for the period 1975-1980. Prior to this time, however, pollution of industrial waste-water had already declined substantially. Our analysis of inter-industry variations (see above) makes it plausible to assume that abatement in this period was also largely the result of charges. The 1975 amount of pollution was already more or less in equilibrium with the charge level of that time. For this reason, the charge factor influencing the abatement of pollution of industrial waste-water is indicated much better by the difference between the rate before 1975 and the rate at the end of the period 1975-1980 than by the level of the charge in any one of the preceding years.

However, it cannot be determined on theoretical grounds for which period the charge increase should be used as independent variable. On the one hand, there is a time-lag between the stimulus to abatement efforts and the installation and putting into operation of the relevant control measures. On the other hand, it is not implausible to expect a certain degree of anticipation by the companies to charges and rate increases (Bressers, 1983-2 and Ewringmann, Kibat and Schafhausen, 1980). It is better, therefore, to decide on empirical grounds which period should be considered in determining the rate increase. This period starts in the year in which the rate of the charge has the highest negative correlation with the relative success of abatement between 1975 and 1980. The rate in that year can be taken as the best indicator for the extent to which abatement efforts before 1975 negatively affected abatement activities in the subsequent period by the resulting increase of marginal costs of further abatement. The rate charged in that year should then be subtracted from the charge at the end of the period with the highest positive correlation in order to get the best possible indicator of the charge factor that stimulated abatement of pollution in the 1975-1980 period.

The increase in the rate charged in the period 1974-1980 has a very strong positive correlation with the relative abatement success for the years between 1975 and 1980 (r = +.86, n = 15, p = .000). This relation is not the result of one or two extreme values for the units analyzed, although the two water quality districts with respectively the most and the least relative success weaken the strength of the relationship somewhat. Without these two observations the correlation is even stronger: r= +.92 (n = 13, p = .000). Further analysis has showed that this correlation cannot be attributed to water authorities reacting on abatement efforts by industry by raising charge rates to keep the same amount of revenues.

With such high correlations between the charge factor and the pollution decrease it is natural that the relationships with the indicators of the great variety of other policy instruments used are absent or only weak. The influence of many other policy instruments examined, with 30 indicators, was assessed. Among all these indicators only water board permit-giving to municipalities and abatement schemes drawn up with companies show up with relatively substantial but still modest positive correlations with the relative abatement success.

The relative abatement success, the dependent variable in all these analyses, has been defined as the percentage decrease of oxygen consuming pollution of industrial wastewater, corrected to take the regional structure of industry into account. It should, therefore, be possible to explain the variation in the percentage decrease of organic pollution by:

a) the decrease to be expected as a result of differences in the regional structure of industry
b) the increase in the rate charged
c) the number of municipalities with a permit issued by water boards (thus giving these authorities indirect influence on sewage permits issued to individual plants)
d) the weighted number of abatement plans.

As it turns out, 96% of the percentage decrease of organic water pollution can be explained, statistically, by the first two factors ($R^2$ after correction is .95). Ninety-eight per cent can be explained by all four factors taken together, but this is due mainly to the fact that one research unit has been dropped from the calculation. If we take this smaller group of 14 units, the two first-named factors explain 97% of the differences in pollution decrease.

*Policy instruments and regional differences in decrease in heavy metal pollution*

Two water boards do not impose effluent charges on heavy metal polluters. Their results are not much different from those of the other districts. However, as a matter of fact, in their negotiations with industry, when demanding quite substantial reductions in pollution level, these boards did use the possibility of introducing effluent charges as threat. In this sense, their effectiveness in achieving decreases in heavy metal pollution is not totally independent of the effluent charge system. We will not include these districts in the following analysis.

The indicators for policy outputs used here are, for the most part, the same as those used in looking at organic pollution or they have been calculated in a similar manner. The indicators for permits issued and for technology, advice and informal negotiations are different. The indicator for permits has been calculated as the per cent of companies that discharge a taxable amount of heavy metals having a permit that stipulates conditions for these discharges in 1975, the per cent with such permits in 1980, and the increase in these numbers between 1975 and 1980. Technology development, advice and information negotiations are also indicated by the proportion of major dischargers contacted instead of by the weighted number.

The increase of the charge rate in the period 1975-1980 is clearly related to the relative success of the abatement of heavy metal pollution of industrial waste-water, although the relationship is not as evident as with the abatement of organic pollution. The $r = .65$, for an $n = 13$ and a $p = .008$.

Among the other indicators of the instruments used weighted number of formal reports by pollution inspectors and the proportion of compagnies with which an abatement plan was drawn up were positively correlated with the relative abatement success with heavy metal pollution.

The weighted number of inspectors turns out not to be related to abatement success. The same goes for both the number of infringements detected by them (as an indicator of their activity) and the number of times they threatend official enforcement actions. However, the situation is different with regard to the number of times these inspectors in fact officially report such infringements and use the police to enforce compliance. The weighted number of formal reports is positively related to the relative abatement success ($r = .30$, $n = 14$, n.s.). If we take the rate of increase for effluent charges into account, the correlation is even stronger ($pr = .43$, $n = 13$, $p = .082$).

The proportion of companies with which an abatement plan was drawn up is clearly related to the relative abatement success. Although this relation is at first relatively weak ($r = .30$, $n = 14$, n.s.) if we take into account the influence of the increase of rate charges, the correlation is stronger ($pr = .55$, $n = 13$, $p = .031$).

The combination of policy outputs that accounts for the greatest part of the variation in relative success in abating pollution by heavy metals includes (after a correction for the following:
- the increase in the charge rate 1975-1980;
- the proportion of heavy metal dischargers with an abatement plan;
- the weighted number of official reports on noncompliance.

Together these policy outputs explain statistically 82% of the difference in relative abatement success. These three policy outputs together with the abatement that could have been expected in view of the regional structure of industry and the shares of the various kinds of metal statistically account for 91% of the variation in decrease in heavy metal pollution (R2 after correction is .87).

### *3.4 The contribution of directives and incentives 2: An expert assessment*

Thus far three independent statistical analyses have shown that effluent charges have been a quite effective instrument of Dutch water quality policy. The contribution of each of the policy instruments applied to the substantial reductions of industrial waste-water pollution in the Netherlands can also be determined with the help of the assessments by insiders. In this section we will compare the results of the statistical analysis with the assessment of experts from both the water boards and industry regarding the relative effectiveness of these instruments. Both approaches have their strong and weak points (Reichart and Cook, 1979). However, should both methods lead to the same conclusion, our confidence would be increased in the reliability of this conclusion. As was the case with the statistical analysis, independent analyses based on different sets of data were used: on the one hand, the opinions of negotiators from the water boards and, on the other hand, representatives of the companies who were responsible for water quality.

*Assessment of policy instruments by policy implementors*
In a questionnaire sent to the regional water boards administrators were asked to indicate how much influence they thought the various policy instruments had on the abatement of industrial waste-water pollution. For both organic pollution and pollution with heavy metals the respondents could choose from five answers. The category "Not applied" could be checked to indicate that a particular instrument had not be used with regard to that type of pollution. In practice, "No answer" also nearly always indicated that the instrument in question had not been used at all or very little. This was the case for the seven smaller water authorities that did not fill in the questionnaire completely, adding such comments as "no experience" and the like. Regarding heavy metals, the question was irrelevant for seventeen smaller water boards since there were no companies in their areas known to discharge heavy metals. Table 3.4.1 shows the answers given to this question.

*Table 3.4.1 Assessment by regional water quality administrators of the relative effectiveness of policy instruments*

In general these results correspond with those of the statistical analyses, at least as far as the main points are concerned. Charges emerge as the most influential policy instrument for dealing with organic pollution, whereas in the case of heavy metals we see that the respondents attributed equal amounts of influence to a broader range of instruments. There are, however, some small but interesting differences between the results of the questionnaire and those of the statistical analyses.

According to the statistical analysis, charges also played the most important role in decreasing heavy metals pollution, although to a lesser degree than was the case with oxygen-consuming pollution. Why was it that the regional water quality administrators recognized the importance of charges for the abatement of organic pollution but not for decreasing pollution with heavy metals? The explanation seems to be as follows. These officials can clearly see that there are companies that are going to abate organic pollution because of charges. There are, however, hardly any companies that are going to abate their heavy metal pollution solely because of the effluent charges. Discharging heavy metals is simply too cheap. Abatement plans and inspections are almost always necessary to persuade heavy-metal polluters to take appropriate action. What these water quality administrators do not see (indeed, what they individually cannot see) is that the success of these abatement plans is much greater in districts where charges were increased than in other areas. In both cases companies have to be persuaded by the water authorities to get started; in some cases, however, officials must continue to exert pressure to ensure that the agreed-upon measures are in fact carried out. Even when they cannot in themselves motivate companies to take abatement action, charges apparently play an important role in facilitating the task of the water quality administrators in getting abatement measures implemented. This conclusion opens interesting perspectives on the possibility of applying charges not only as an alternative for but also as a complement to direct regulation.

Another point calling for attention is the role played by informal negotiations. It is clear from the questionnaire that water board officials attached greater importance to this instrument than we would have anticipated on the basis of the statistical analysis. It appears that this apparent discrepancy can be accounted for by the fact that negotiations do not constitute a separate instrument in addition to other policy instruments, but rather represent a manner in which the total "policy mix" is applied. In this regard there are two interesting aspects of informal negotiations. In the first place, they serve as a sort of "lubricant" to oil the machinery put into operation by the other policy instruments discussed above (compare for Germany: Hucke, 1978 and for Great Britain: Vogel, 1983, 1-2). The following statement by a water board official during one of the oral interviews that followed the written questionnaire is illustrative of this function: "When I'm going to have a talk with a company about the abatement of their discharges, I always take my pocket calculator along. I calculate their potential savings on charges and invariably get an interesting conversation started."

This, primarily informative, function of negotiations is especially important when other circumstances and the policy instruments applied have an influence strong enough to make abatement seem worthwhile to the companies to begin with. This situation will tend to occur more often in the case of organic pollution than with heavy metals. The implementation process with regard to organic waste matter is characterized by relatively small differences of opinion between administrators and companies regarding the amount of abatement aimed at. This is due to the pressure of the effluent charges, which make reductions of discharges economically attractive.

In the case of heavy metals negotiations not only fulfill an informative function; here they also represents the way in which power is wielded. This strategy reflects the fact that in such cases there are often quite substantial differences of opinion between water quality administrators and the companies regarding the desirable amount of further discharge reduction. In these situations the balance of power is such that neither party is in a position to impose its will upon the other. It appears, then, that unless the administrator is in a position to exert enough power and to apply a policy instrument vis-a-vis the company so that he can achieve his abatement goals without delay, it is quite rational for him to apply the available policy instruments selectively within a framework of deliberation and negotiation with industry.

### *3.5 Conclusions*

Taken together these analyses lead to the remarkable conclusion that the substantial reduction of pollution of Dutch industrial waste-water between 1975 and 1980 has been much more the result of a policy instrument, effluent charges, that nas not officially designed for this purpose, than a result of the use of the policy instrument, direct regulation, specifically intended to achieve this objective.

The Dutch case, with the most substantial system of effluent charges in the world, shows the enormous potential of this policy instrument. In the research reported here, I did not come across any evidence that would suggest that this result can be explained in terms of specific national characteristics of the Netherlands. Two points deserve however attention.

The implementation of effluent charges can be hampered by the need for a devoted executive body that is determined to actually collect the charges. Central government policies are often frustrated by lack of cooperation by local authorities appointed to implement them (Bressers and Honigh, 1986). This problem did not arise in Holland, thanks to the fact that there effluent charges function as so-called revenue raising charges. Through the charge system the water authorities are collecting their own money, needed very much for the building and exploitation of treatment plants, a task they were eager to undertake.

Another major problem with effluent charges is the massive amount of information that is required to assess the fee each company has to pay. Some authors even see this as the most important reason to discard this policy instrument altogether. In Holland this problem was reduced by not charging the millions of households and small industrial polluters (less than 10 p.e.) in proportion to the actual pollution they caused. Having relatively few opportunities of limiting pollution, this category of polluters is of minor importance to the instrument's regulating power. The amount of information required is again substantially reduced by basing the assessment of medium-sized polluters (usually between 10 and 100 p.e.) not on samples of their effluent, but on a coefficient table. On the basis of easily obtainable data such as the amount of water used by the firm or the amount of certain raw materials it processes with that expertly calculated coefficient table the probable amount of pollution can be established accurately. However, the incentive to reduce pollution remains intact. For, companies that feel they are overrated on the coefficient table can request their effluent to be sampled and to be charged on the basis of the results. Not always this leads to permanent sampling. Sometimes only an adjustment of the relevant coefficient is made. All these pragmatic adjustments make it possible to implement the charges at the cost of only a few per cent of the total revenue, without diminishing substantially the instrument's regulating power (as could be shown).

Implementation problems being solvable and the way in which effluent charges influence the negotiation process being consistent with what we would have been led to expect by the economics literature, the greatest problem seems to be the feasibility of introducing such charges. In the words of Senator Domenici: "Charges have only one problem: they lack political support" (Domenici, 1982). Perhaps the key question is: Who's afraid of effective government?

# 4 The impact of charges in the period 1986 – 1995

## *4.1 Introduction*

In this chapter an attempt is made to replicate the analysis done for the period of the seventies, for the eighties and nineties. Several restrictions are met while attempting this. The available data reach until 1995. Though more recent data might be available by now, obtaining them is costly and requires administrative procedures to get permission to use them. The analysis starts in 1986. The reason is that in that year an important redefinition of what a pollution unit is, was carried out. Data of earlier year can in principle be transformed into the new values, but only approximate. Furthermore data gathering is in the beginning of the eighties taken over from the Ministry of Public Works by the Dutch Central Statistical Office. In the first years this had to be developed and consequently quality of data in these years is rather doubtful.

Apart from the limits of the research period, also more in general the quality of data raised concern. The data on the 1975 – 1980 period were gathered in only one effort by the ministry, in order to produce the “second indicative multi-year program on water quality management”. As the name suggests this was a bottom-up program that basically related the situation and plans of the waterboards to the national objectives. For treatment plants it even was creating national objectives by adding the own plans of the various waterboards. So this was pretty much a congenial effort of the ministry and the waterboards. All cooperated by producing the desired figures. Filling in the forms was naturally in the hands of the same person(s), thereby minimizing the risk of inconsistencies, for instance including some firms in one sector in one year and in another in another year, etceteras. When the statistical office took over they were sending in yearly form to fill in by the waterboards. The chance that inconsistencies and varied interpretation occur over the years had thereby considerably increased.

When checking the data many inconsistencies were obvious. These are phenomena like: major discharges in sectors that were previously absent, doubling of discharges in generally improving sectors, halving the numbers of companies in a sector, while tripling pollution in a few years, almost falling away of discharges in a sector with many companies, etceteras. These proved to occur however mostly in the small waterboards with often none or only few companies in most industrial sectors. As in case of the analysis on the seventies we skipped these waterboards also for other reasons (with little consequence for the share of the pollution covered by the analysis, see below). Only in one case we had to decide to skip a major waterboard, due to serious doubt on the quality of the gathered data.

Apart of confining the research period and the units of analysis involved we also confined ourselves to the major waste producing industrial sectors. These are nine sub-sectors of the food industry (processing of meat, fish, fruit & vegetables, food oils, diary, potato starch, animal destruction, beverages and others), and the textile, paper, printing, chemistry, basic metal and galvanic sectors. All kinds of other industrial sectors, with much smaller impacts on organic water pollution are thus discarded. Together the selected sectors produced some 70-75% of all organic pollution produced by industry. The remaining quarter consists to some extent of still remaining discharges on national waters (e.g. Rhine, though untreated discharges are phased out) and to some extent are not related to the industrial production metabolism, but to facilities for the personnel (cf. the important electronics industry).

So all in all we believe that the analysis below deals with the by far greatest and most important share of the industrial organic water pollution.

Having said that, it is important to realize that the ecological relevance of industrial organic water pollution had changed dramatically during the seventies and the first half or the eighties. For 1969 the 14 most important sectors produced some 29 million pollution units (of approx. 180 gr. oxygen demand). By 1975 this had already dropped to 15 million – more or less equaling the contribution of households - and in 1980 to 9 million. By the time our analysis in this chapter begins, the 15 sectors in our analysis produce less than 4,4 million p.e.'s of 136 gr. oxygen demand). In the same period the collective treatment capacity of the waterboards was increased to some 25 million, in fact in most situations enough to treat all organic pollution discharged into the sewerages. Given that situation, the further decrease of industrial organic waste load, was seen in more and more situations by the waterboards as not a contribution to the environment, but as a weakening of their tax basis, without any environmental benefit, leaving the other parties (e.g. households) with higher charges.

So from a context of waterboard officials actively warning industry that they should deal with their pollution as much as they could, while pollution would become expensive (they themselves urged by the need to be able to assess the necessary dimensions of the treatment works they were planning to built) in the research period of this chapter we move into quite another administrative context. Only in case of complete renovations requiring a new dimension assessment anyhow, or in cases of growing pollution, for instance by population growth, the decrease of industrial pollution was really welcome. In many other cases ecological arguments were really neutral and economic ones negative for the waterboards.

### *4.2 Some backgrounds and methodological remarks*

Of the 30 waterboards with water quality tasks, 12 small ones were left out of the analysis for three reasons. Here we find much smaller pollution amounts than with the others, and often sectors are absent at all. So one or two plants can make huge differences, creating outlayers with a minor importance in real terms that can easily disturb the analysis. Secondly the quality of the statistical data is more doubtful with these regions, as indicated by strange jumps up and down in the number of companies per sector and the resulting pollution. Thirdly several of these waterboards were merged during the research period and some showed huge charge increases due to lagging investments in the seventies.

From the remaining 18 major waterboards intensive scrutinizing of the data revealed also particularly many strange developments reported for one of the major waterboards. So we decided to skip this region also from the analysis.

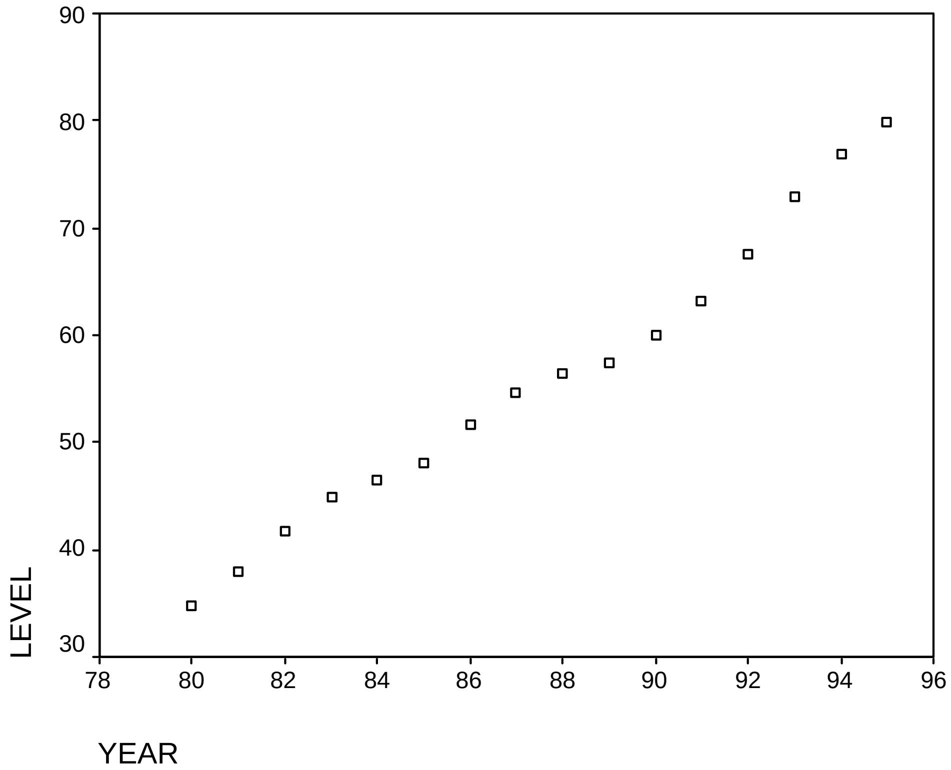
The remaining 17 waterboards contain nevertheless a major proportion of the organic pollution (in p.e.) produced by major industrial sectors:

| | 1986 | 1990 | 1995 |
|---|---|---|---|
| All 30 | 4,356,824 | 3,980,930 | 2,465,072 |
| Sample 17 | 3,962,043 (91%) | 3,657,530 (92%) | 2,142,117 (87%) |

Another phenomenon that one might observe from these figures is that the pollution decrease has been much larger in the second part of the entire period than in the first one. While it coincides with what the charge levers did in these periods (see below), it is tempting to connect these on this general level. This is however not really justified. Of the major decrease in the 1990-1995 period no less than 1,145,105 p.e. (76%) come on the account of the sanitation of one sector (the potato starch industry), leaving only some 370 thousand p.e. as remaining decrease (305 in the four year 1986-1990 period).

One might wonder whether after the initial investment period in the seventies the time for major increases in the change level wouldn't be over. But this proves not to be true at all. Over the period between 1980 and 1995 the average charge level of the major waterboards increased from Dutch florin (hereafter: f) 34,76 to f 79,93, a 130% increase! In our research period of 1986-1995 the increase was f 28,40, or 55%.

In the first part of the research period, 1986-1990, the average charge level rose much less steeply than before or after. In this period the average level rose from f 51,58 to f 59,93. This f 8,35 (16%) increase compares to an f 20,01 (33%) increase in the period 1990-1995, so almost at a double rate. These differences cannot be explained by general inflation rates. Generally there are slowdowns from 1983 to 1985 and from 1987 to 1989. The explanation is that after the first great investment period in which the treatment plants were build, from 1990 onwards a second period of huge investments followed, equipping the installations with de-phosphor devices.




In first instance one would be inclined to take the same period for the measurement of the independent variable, the charge level increase, as for the dependent variable, the pollution decline. But there is no certainty at all that the period of charge increase should be measured in the same period as the dependent variable. Instead, many causes and forms of delayed response are probable, while on the other hand the awareness of the possible future rises in charges in ones region will be high, considering past experience from the seventies onward. The combination of anticipation and delay makes it impossible to determine the period of measurement of the independent variable deductively. Even per period of analysis (and per region and per sector) it can be expected that the purest measurement of the independent variable will vary. Possibilities to lower emission have different time trajectories and consequently lead to different delayed responses. Similarly the degree of anticipation can be expected to vary, for instance according to the experience with charge increases in the recent past. So, all in all the period of measurement of the charge level increase as an independent variable can be best assessed inductively, of course within reasonable limits.

### *4.3 Charges and organic pollution in the second half of the eighties*

Like described in the above section 3.2 first calculations were made per waterboard and per sector what the pollution in 1990 would have been if all sectors in the region had the same development as the average of their sector. By adding all these sector estimates per waterboard we have calculated what the 1990 pollution in that waterboard would have been if all sectors in their region behaved like the national average.

This value could be seen as a way to eliminate all nation wide developments from the variance, leaving only the variance that should be accounted for by regional differences. It also eliminates the consequences of the different sector composition of the regional industry. This can be important, because some sectors can decrease pollution much more easily and cheaper that other, for instance because of new technologies that present opportunities in some sectors, but not in others.

While the calculated expected pollution in 1990 is very strongly correlated with the actual emissions in 1990 (r = .995 p =. 000, of course mainly a big correlates with big and small correlates with small artifact), the actual pollution decrease percentage correlates only moderately with the calculated expected pollution decrease (r =. 567 p =. 009).

By subtracting the calculated percentage pollution decrease (amount of pollution in 1986 minus the calculated amount of pollution in 1990 divided by the actual pollution in 1986, multiplied by 100) from the actual pollution decrease percentage, one gets “the relative success” of pollution decrease in that area. This variable is the number of percentage points that pollution has more declined in the region than one could expect on the basis of the nation averages per sector and the share of the various sectors per region (see table 4.3.3).

*Table 4.3.3, Pollution decrease, expected decrease and relative success in the period of 1986 - 1990*

| Waterboard | % p.e. decrease | calculated decrease | relative success |
|---|---|---|---|
| Groningen | 17,12 | 15,78 | 1,34 |
| Friesland | 23,64 | 10,01 | 13,63 |
| Drenthe | 8,65 | 8,74 | -0,09 |
| West Overijssel | 16,46 | 4,37 | 12,08 |
| Regge en Dinkel | -12,43 | 1,85 | -14,27 |
| Oost Gelderland | -4,29 | 2,48 | -6,77 |
| Veluwe | -24,85 | 5,23 | -30,08 |
| Rivierenland | -69,02 | -1,08 | -67,94 |
| Utrecht | 18,48 | 1,36 | 17,11 |
| Amstel- en Gooiland | 5,81 | 3,46 | 2,36 |
| Amsterdam | 24,89 | 10,77 | 14,13 |
| Rijnland | 6,9 | 0,54 | 6,36 |
| West Brabant | 10,14 | 1,64 | 8,5 |
| Dommel | -5 | 1,15 | -6,15 |
| Aa | 21,49 | 4,85 | 16,63 |
| Maaskant | 15,43 | 7,92 | 7,51 |
| Limburg | -24,24 | -0,79 | -23,44 |

The “relative success of the region” is indeed correlated to the increase of charge levels per region. If one takes the same period of charge increase than the period of pollution decrease, than the correlation is not statistically significant with this small n sample.

*Correlation of rise of charge level with % relative success emission decrease, both 1986 – 1990:*
*Pearson's r = .226 sign. = .191 n = 17*

But as stipulated in the previous section it is quite possible that there is some anticipation on charge rise or – alternatively – some delay in taking additional measures in industry. So, the charge rise period can best be derived inductively. The period of charge level increase that is strongest connected to the emission decrease, is the period of 1987-1991. This indicates that in this period – after the steep rises in the previous period, and with still some 'low hanging fruits' to pick, anticipation was somewhat more influential than delay (a one year lead).

*Correlation of rise in charge level 1987 – 1991 with % relative success emission decrease 1986 – 1990:*
*Pearson's r = .425 sign. = .044 n = 17*

In stead of calculation the degree of 'relative success' it is of course also possible to compute the partial correlation between emission decline and charge level increase, controlling for the emission decline that could be expected on the basis of the shares of various sector in the region's industries.

*Correlation of rise in charge level 1987 – 1991 with % emission decrease 1986 – 1990, controlling for calculated expected decrease:*
*Partial r = .453 sign. = .039 n = 17*

A linear regression model that includes both as independent variables, has and r of .679 and a significance of .013 (see below). Both independent variables are significant, though the charges only at a .008 level.

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .679[a] | .461 | .384 | 18.7853 |

a. Predictors: (Constant), DCP86.90, CHD87.91

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 4218.333 | 2 | 2109.167 | 5.977 | .013[a] |
| | Residual | 4940.422 | 14 | 352.887 | | |
| | Total | 9158.756 | 16 | | | |

a. Predictors: (Constant), DCP86.90, CHD87.91

b. Dependent Variable: DP86.90

**Coefficients[a]**

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | -25.019 | 9.544 | | -2.621 | .020 |
| | CHD87.91 | 1.502 | .789 | .374 | 1.903 | .078 |
| | DCP86.90 | 2.868 | 1.014 | .555 | 2.827 | .013 |

a. Dependent Variable: DP86.90

Our conclusion is that in the first part of the research period charges still had a considerable influence on the behavior of firms regarding their organic pollution load. However, the figures do suggest that this influence be by far not as dominant as it was in the seventies, when direct regulation was absent or lax and steep charge level rises created a seismic shock in many sectors.

### *4.4 Charges and organic pollution in the first half of the nineties*

The figures for the actual and expected pollution decrease and the difference between these percentages is shown in the next table. Again, the calculated expected pollution in 1995 is very strongly correlated with the actual emissions in 1995 (r = .933 p =. 000), the actual pollution decrease percentage correlates less dominantly with the calculated expected pollution decrease (r =. 652 p =. 002).

*Table 4.4.1 Pollution decrease, expected decrease and relative success in the period of 1990 - 1995*

| Waterboard | % p.e. decrease | calculated decrease | Relative success |
|---|---|---|---|
| Groningen | 94,07 | 93,9 | 0,17 |
| Friesland | -9,08 | 4,2 | -13,28 |
| Drenthe | -9,15 | 13,9 | -23,05 |
| West Overijssel | 22,06 | 13,94 | 8,12 |
| Regge en Dinkel | 31,62 | 18,68 | 12,94 |
| Oost Gelderland | 7,78 | 17,57 | -9,79 |
| Veluwe | 37,88 | 12,61 | 25,27 |
| Rivierenland | 43,54 | 12,88 | 30,66 |
| Utrecht | 23,89 | -4,63 | 28,52 |
| Amstel- en Gooiland | 0,7 | 3,25 | -2,54 |
| Amsterdam | 28,75 | 2,89 | 25,86 |
| Rijnland | 29,65 | 13,35 | 16,31 |
| West Brabant | 20,55 | 14,9 | 5,66 |

| | | | |
|---|---|---|---|
| Dommel | 30,31 | 19,68 | 10,63 |
| Aa | 6,93 | 6,52 | 0,41 |
| Maaskant | -43,96 | 12,53 | -56,49 |
| Limburg | 5,61 | 16,58 | -10,97 |

The “relative success of the region” is also in this case correlated to the increase of charge levels per region. If one takes the same period of charge increase than the period of pollution decrease, than the correlation is only barely statistically significant with this small n sample.

*Correlation of rise of charge level with % relative success emission decrease, both 1990 – 1995:*
*Pearson’s r = .340    sign. = .091    n = 17*

The period of charge level increase that is strongest connected to the emission decrease, is the period of 1988-1993. This indicates that in this period – after the relatively slow rises in the previous period, and with almost all ‘low hanging fruits’ already picked, so real investments needed, there was on average less anticipation and consequently a more delayed response (a two year lag).[4]

*Correlation of rise in charge level 1988 – 1993 with % relative success emission decrease 1990 – 1995:*
*Pearson’s r = .529    sign. = .014    n = 17*

In stead of calculation the degree of ‘relative success’ it is of course also possible to compute the partial correlation between emission decline and charge level increase, controlling for the emission decline that could be expected on the basis of the shares of various sector in the region’s industries.

*Correlation of rise in charge level 1988 – 1993 with % emission decrease 1990 – 1995, controlling for calculated expected decrease:*
*Partial r = .601    sign. = .007    n = 17*

A linear regression model that includes both as independent variables, has and r of .799 and a significance of .001 (see below). Both independent variables are significant.

---

[4] As an example we give here some correlations for different years, showing the 1988-1993 period came out as most indicative:

| | |
|---|---|
| 1990-1995 | .340 |
| 1989-1995 | .445 |
| 1989-1994 | .461 |
| 1988-1994 | .481 |
| **1988-1993** | **.529** |
| 1988-1995 | .420 |

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .799[a] | .638 | .586 | 18.6565 |

a. Predictors: (Constant), CHD88.93, DCP90.95

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 8582.987 | 2 | 4291.494 | 12.330 | .001[a] |
| | Residual | 4872.903 | 14 | 348.065 | | |
| | Total | 13455.890 | 16 | | | |

a. Predictors: (Constant), CHD88.93, DCP90.95

b. Dependent Variable: DP90.95

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -37.279 | 15.895 | | -2.345 | .034 |
| | DCP90.95 | 1.386 | .280 | 1.009 | 4.958 | .000 |
| | CHD88.93 | 1.997 | .711 | .572 | 2.811 | .014 |

a. Dependent Variable: DP90.95

The conclusion for this period is that – while the relationships are still not as strong as in the seventies – in the second half or our research period the impact of the charges has been somewhat stronger that in the first half. This could be seen against the background that in this period charges rose at double pace compared with the previous part of the research period. Another background is that more and more waterboards began to worry about the economic consequences of firms treating their waste water – often only for the easy part – themselves (the ‘thin water’ problematic). This means leaving the collective treatment system with a lower tax basis, while not improving the environment, since there was already sufficient treatment capacity.

*4.5The entire period*

The figures for the actual and expected pollution decrease and the difference between these percentages is shown again in the table below.

Again, the calculated expected pollution in 1995 is very strongly correlated with the actual emissions in 1995 (r = .892 p =. 000), the actual pollution decrease percentage correlates less strongly with the calculated expected pollution decrease (r =. 653 p =. 002).

*Table 4.5.1, Pollution decrease, expected decrease and relative success in the period of 1986 - 1995*

| Waterboard | % p.e. decrease | calculated decrease | Relative success |
|---|---|---|---|
| Groningen | 95,08 | 91,69 | 3,39 |
| Friesland | 16,71 | 12,76 | 3,94 |
| Drenthe | 0,29 | 31,68 | -31,39 |
| West Overijssel | 34,89 | 24,55 | 10,34 |
| Regge en Dinkel | 23,12 | 20,08 | 3,05 |
| Oost Gelderland | 3,83 | 16,59 | -12,76 |
| Veluwe | 22,44 | 19,45 | 2,99 |
| Rivierenland | 4,57 | 16,7 | -12,13 |
| Utrecht | 37,96 | 8,03 | 29,93 |
| Amstel- en Gooiland | 6,47 | 8,31 | -1,83 |
| Amsterdam | 46,48 | 20,02 | 26,46 |
| Rijnland | 34,51 | 14,17 | 20,34 |
| West Brabant | 28,61 | 17,39 | 11,22 |
| Dommel | 26,83 | 21,88 | 4,95 |
| Aa | 26,93 | 8,57 | 18,35 |
| Maaskant | -21,75 | 15,7 | -37,45 |
| Limburg | -17,26 | 18,23 | -35,49 |

The “relative success of the region” is also in this case correlated to the increase of charge levels per region. If one takes the same period of charge increase than the period of pollution decrease, than the correlation is already statistically significant with this small n sample.

*Correlation of rise of charge level with % relative success emission decrease, both 1986 – 1994:*
*Pearson’s r = .459 sign. = .032 n = 17*

The period of charge level increase that is strongest connected to the emission decrease, is the period of 1986-1994. The combination of the lead of the first period with the lag of the second part makes this period approximately balanced in terms of lag and lead, or delay and anticipation. A further indication is that the difference with the same period is only small.

*Correlation of rise in charge level 1986 – 1994 with % relative success emission decrease 1986 – 1995:*
*Pearson’s r = .478 sign. = .026 n = 17*

The partial correlation between emission decline and charge level increase, controlling for the emission decline that could be expected on the basis of the shares of various sector in the region's industries, is here as follows.

*Correlation of rise in charge level 1986 – 1994 with % emission decrease 1990 – 1995, controlling for calculated expected decrease:*
*Partial r = .524 sign. = .019 n = 17*

A linear regression model that includes both as independent variables, has and r of .764 and a significance of .002 (see below). Both independent variables are significant.

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .764[a] | .584 | .524 | 18.4472 |

a. Predictors: (Constant), CHD86.94, DCP86.95

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 6674.967 | 2 | 3337.484 | 9.807 | .002[a] |
| | Residual | 4764.191 | 14 | 340.299 | | |
| | Total | 11439.158 | 16 | | | |

a. Predictors: (Constant), CHD86.94, DCP86.95

b. Dependent Variable: DP86.95

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -38.404 | 18.865 | | -2.036 | .061 |
| | DCP86.95 | 1.290 | .292 | .920 | 4.424 | .001 |
| | CHD86.94 | 1.250 | .543 | .478 | 2.302 | .037 |

a. Dependent Variable: DP86.95

The figures presented in this section are a reasonable combination of the trends observed in the two partial periods. The overall assessment of the impact of the charges in the 1986-1995 period can be that charges are still an important aspect of the factors that influence the behavior of firms in this respect, but by far not as dominantly as during the seventies.

## *4.6 Conclusion and outlook*

The conclusion that the charges in the 1986-1995 period are still an important aspect of the factors that influence the behavior of firms, but by far not as dominantly as during the seventies, is about what one could expect. The shock effect has disappeared and it seems that more and more the possible cost savings by decreasing pollution are simply one of the parameters that are taken into account when making decision about new product or production equipment. More and more seldom the charges will be the drivers to change themselves anymore. These kinds of expectations require of course more in-depth analysis. In the next chapters first the paper industry and second the diary industry will be further studied.

# 5 The paper and cardboard industry

## *5.1 Introduction*

There are between 21 and 29 companies in the Paper and Cardboard industry in the Netherlands in the period of analysis. The variance is caused by whether or not small companies are included, variance is also caused due to corporate structures that sometimes fuse or sell factories. The number of companies that signed the Declaration of Intent, entering into a negotiated agreement with legislators, is 28 (Uitvoering intentieverklaring Papier-en Kartonindustrie, jaarrapportage 1997). The sector is concentrated in three of the twelve Dutch provinces. The explanation for this is historical and linked to the relatively large need for water in this sector. In the 1960s and 1970s the paper and cardboard industry emitted their wastewater without purification into surface water. Enormous pollution caused for instance fish to die. Large areas suffered under bad smell and the natural environment was damaged visually and technically. The mass media addressed the problems that were especially bad in the province Groningen. In this province the sugar industry polluted without any form of purification into the same surface water systems. This situation was in fact one of the drivers that initiated the Pollution of Surface Water law (cf. section 2). Initially in Groningen pipes were constructed that transported the waste water into the Waddenzee. The Waddenzee is an extremely vulnerable eco-system, connected by open water to the North-sea. Public conscience soon led to the invention of the concept ‘dirt-pipes’. Later on the companies had to purify their wastewater before emitting it into the pipes. After a few years the water treatment equipment of companies was optimized and stabilized. The frequency of disorderly functioning abatement equipment decreased dramatically. This re-opened the possibility to emit the wastewater into the surface water. In the other two provinces the possibility to emit into sea was not present, waste water had to be emitted into the sewage system or directly into surface water. In principle the abatement is not very problematic. Continuous supply of wastewater is essential a continuous influent is an important factor. Too much rough wood-fiber might cause problems (Practitioner J. Veenstra).

Table 5.1.1 gives the emissions of oxygen-demanding substances.

| | *1975* | *1980* | *1985* | *1990* | *1995* | *1997* | *1998* |
|---|---|---|---|---|---|---|---|
| *Industry* | 15,3 | 9,7 | 5,0 | 5,6 | 3,3 | 3,8 | 3,8 |
| *Paper and cardboard-industry* | 1,2 | 0,4 | 0,3 | 0,2 | 0,2 | 0,3 | 0,2 |

Table 5.1.1: Emission of oxygen demanding substances (expressed as millions p.e.) (source: www.rivm.nl/milieucompendium/C_milieudruk (bron CBS))

Table 5.1.1 shows that the emissions from paper and carbon industry are quite substantial and also strongly reduced. The table also shows that the

portion pollution from the Paper and Cardboard industry in emissions from all industry decreased.
Some benchmarks in order to enable the reader to position this sector of Dutch industry: The yearly production of the companies ranges from 10 kiloton to 250 kilotons. Sales in 1998 covered 3200 kilotons paper and cardboard, turnover was 4.2 billion Dutch guilders. The number of employees decreased from 8700 in 1991 to 6800 in 1999. Energy-use increased from 30.2 PJ in 1989 to 31.7 PJ in 1998. The amount of waste increased from 365 kiloton in 1994 to 409 kiloton in 1998. The use of waste paper as fiber material stabilized since some years and is approximately 75 %. This might still be slightly below the maximum that is possible deduced from the desired product quality (uit: Meerjarenafspraken over energie-efficiency resultaten 1998. Ministerie van EZ, p. 40.). The net environmental costs of the Paper and Carbon-board industry in 1999 is 3.6% of the sales minus costs of raw materials, other materials and bought services of third parties. The average for industrial companies in 1999 is 2.7% (www.rivm.nl/milieucompendium/tabellen/0895pg01).

### *5.2 Competitiveness and charges in the paper industry: an international comparison*

A possible distortion of economic competitiveness is an often-used argument against unilateral national environmental regulations. It typically leads to acknowledging the necessity of multi-scale arrangements. Sometimes this concern about competitiveness can be genuine, but it can also lead – even deliberately - to a complete halt to the built up of further incentives for a more sustainable development. Therefore it is interesting to consider an empirical study that illustrates that the negative relations that are embedded in many economic science theories have a far from certain empirical basis (Manolo dela Fuente 1994 – master thesis supervised by one of the authors of this chapter - see also Bressers 1995). In fact, the following example shows that strong ecologically defensive policies are not necessarily detrimental to a competitive position at global markets.

What kind of test would one like to have? Assume two countries of similar development, size and population, both with very open economies and exporting more than half of their production. Further, assume that they are adjacent, so both are in the same international region and share the same international economic and governance incentives. Further, suppose that one of these countries has a very vigorous policy for a certain environmental objective, while the other is completely lacking such policy, and that this situation lasted for twenty years. Additionally, this strong policy by the one country also includes the dreaded instrument of pollution charges, often regarded and opposed as having a detrimental effect on competitiveness because of the money transfer to government involved. Here, then, is competition hell in one country, and paradise for another! This would also be an attractive setting for real-life experiment.

This is precisely the situation that existed in the Netherlands and Belgium, concerning their water quality policies from 1970 to 1990. The Netherlands started in 1970 with a very ambitious policy, while Belgium during almost this entire period was in the process of federalization, splitting the Flanders and Walloon communities and discussing at what level future water quality policy should be placed. To make the 'worst case' character of this comparison even stronger, we can further refine 'hell."  What would be the most disadvantaged industrial sector? It should be a sector in the regulated country that produces bulk goods, thus unable to defend itself by brand images (cf. perfumes). It should be a sector that would be even more than usually dependent on exports (some 75%). It should be a sector that faces a lot of competition, also from many other countries, to increase its vulnerability. And, of course, it should be a sector with relatively high water pollution per unit of production value, so that the charges and environmental measures would exert maximum pressure on profitability. Following these criteria, the paper industry is the one to pick.

At the beginning of the period (1970-1974) the *profitability* of the Belgian paper industry tended to be somewhat higher than the Dutch counterpart. In the following period, when the first energy crisis struck somewhat harder at the Dutch paper industry than at the Belgian one and Dutch effluent charges – by far the highest in the world[5] - came in full operation, this profitability gap widened. At the end of the seventies the Dutch sector responded with a very high investment rate (cf. Porter 1990). After 1980 the gap in profitability closed rapidly and from 1985 onwards profits were even somewhat higher in the Netherlands. The *relative export-position* started equal, but declined in both countries. Nevertheless, in Belgium the decline was greater.. While the export quota stabilized from 1980 onwards in the Netherlands, it kept declining in Belgium until 1986 and remained considerably lower in the Belgian situation at the end of the period. The *rate of utilized production capacity* was about equal until 1976, lead by Belgium from 1977 to 1979, equal again from 1980 to 1985, then lead by the Dutch from 1986 onwards.

The crux of the matter is that, while losing competitiveness in an ever more integrated world economy is one of the main incentives to move up the scale of environmental governance, the empirical basis for this is far from self-evident. The Belgian and Dutch water policy example illustrates that even rather extreme differences in the economic burden of environmental policy didn't necessarily mean a competitive advantage for the nation with the less rigorous environmental regulations

[5] By 1995 some $35 per inhabitant equivalent (136 gr. BOD). During the seventies and eighties the exchange rate was however very different and the Dutch currency rated much higher against the dollar.

### *5.3 Quantitative analysis of the relationship between charges and organic pollution in the paper sector*

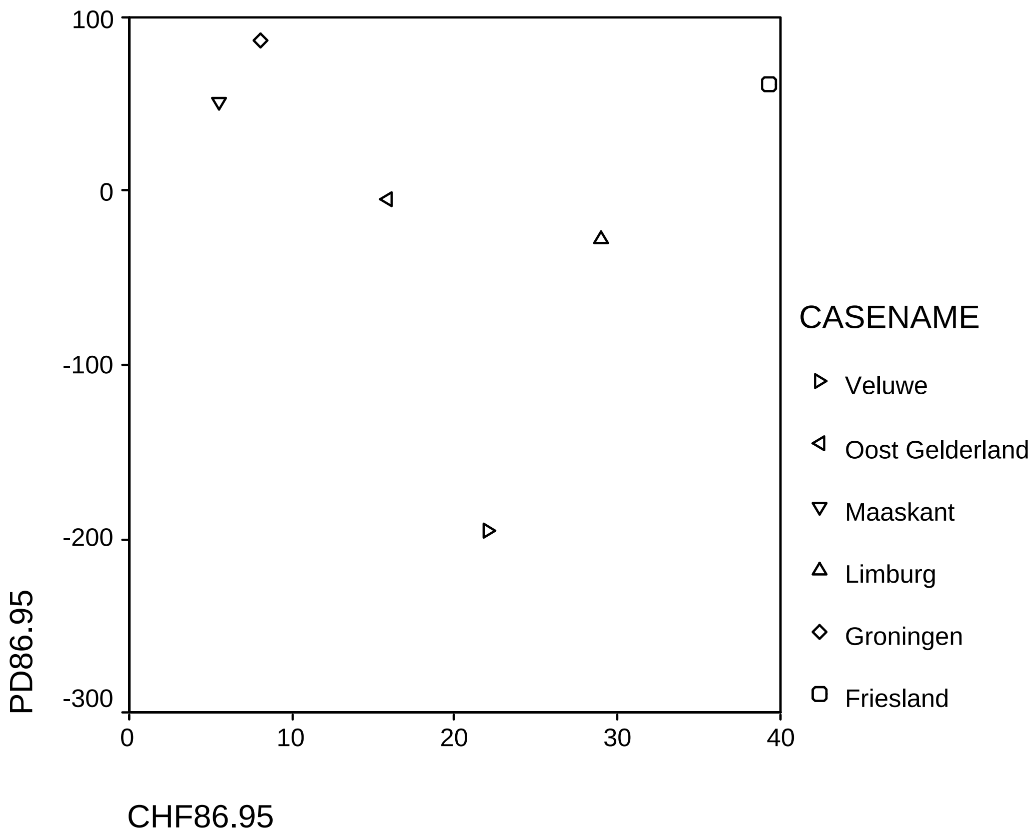
Of the 30 regional waterboards only 9 have companies in the paper and carton sector. One of these hadn't any in 1986 and one hadn't in 1986 ánd 1990 (probably these plants were discharging into state water then) and in one case the (very low) figure for 1986 is unreliable. So in comparisons with 1986 we have only 6 cases. In the comparison between 1990 and 1995 we have 8 cases. On the one hand these cases produce (almost) all pollution by the paper sector. On the other hand with this number statistical analysis makes no sense and only plots will be shown, identifying the waterboards to make qualitative remarks on their position in the plot possible.

| Pollution in p.e. | 1986 | 1990 | 1995 |
|---|---|---|---|
| All 30 cases | 156,748 | 130,159 | 164,397 |
| Sample 8 cases | 156,304 | 130,134 | 139,329 |

Interestingly the pollution discharged to the regional waterboards has not declined between 1990 and 1995, but has increased. The difference in the figures for 1995 is caused by a large new discharge of about 20,000 p.e. in the waterboard area of Dommel. This could have been a plant that had previously an own treatment plant and was reconnected to the sewage later.

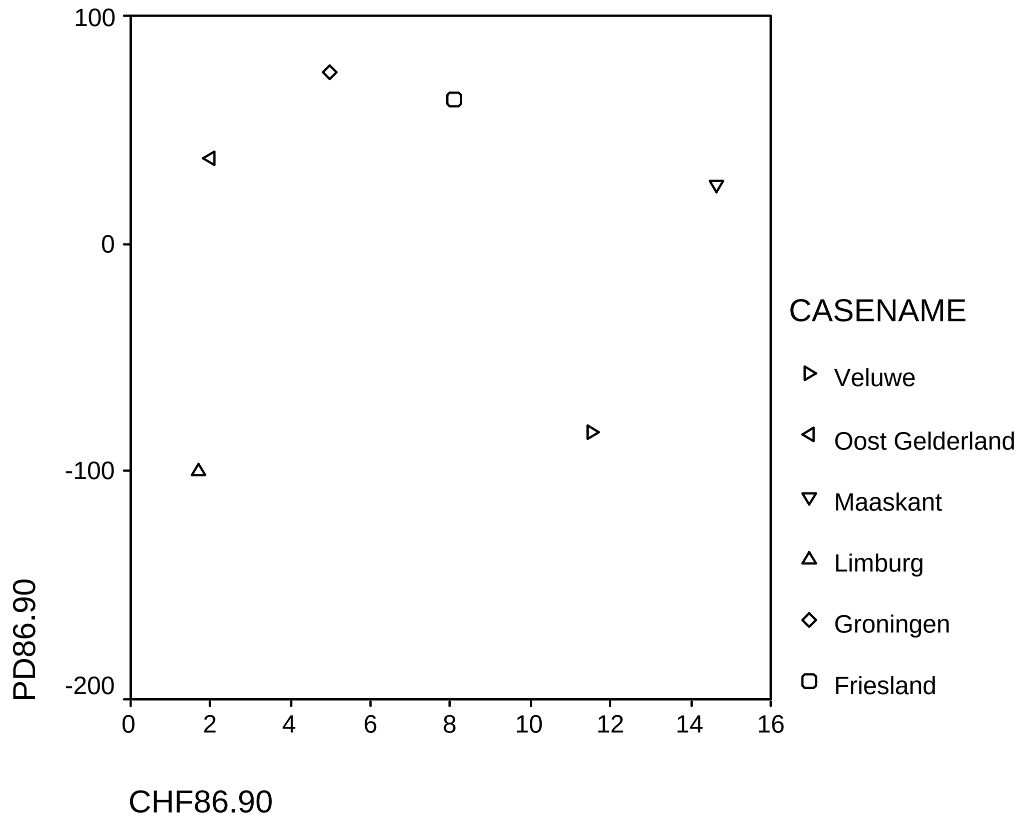
Generally there is no relationship between the increase of the charge level and the development of the amount of discharges of the paper industry to the regional water boards. In principle a search for a bit different period of charge increase than the periods of pollution development could strengthen the relations somewhat. But this is unlikely considering the plots and is therefor not attempted.

First the whole period 1986-1995:

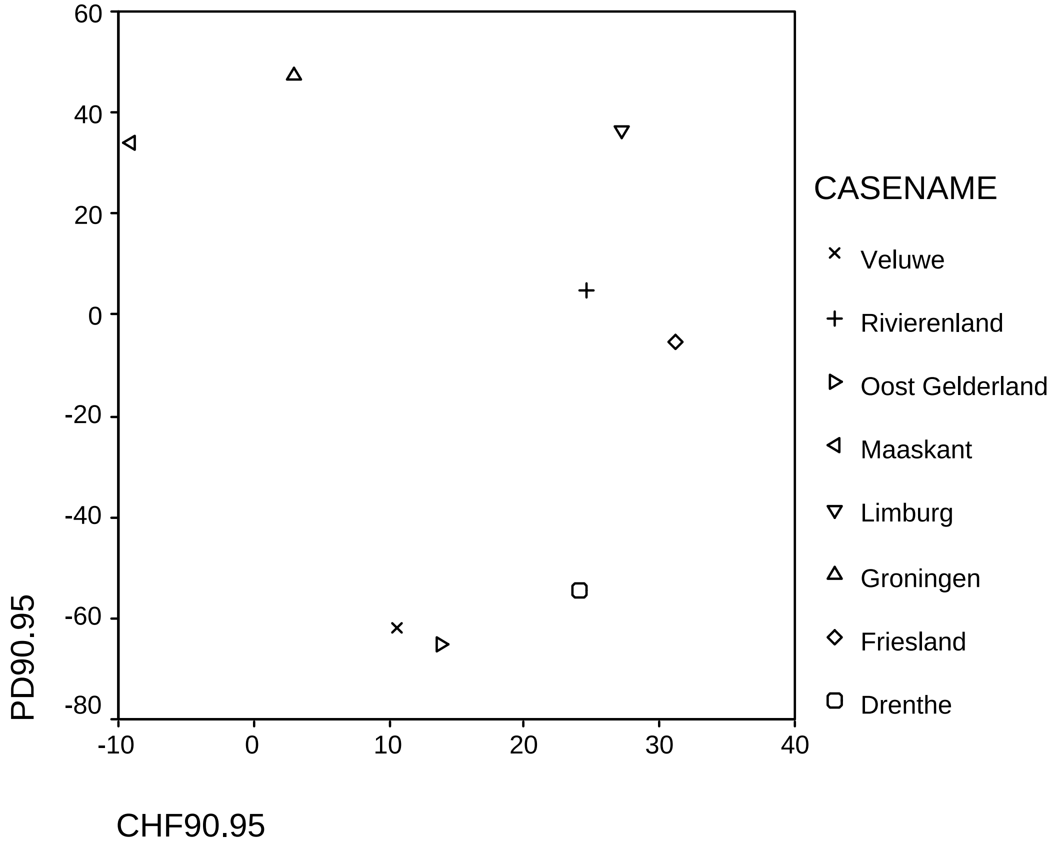



Waterboard Veluwe shows an enormous *increase* in the amount of pollution. This waterboard has already for a long time a policy to prevent companies from building own treatment plans, decreasing thereby the tax basis for the waterboards collective plants, if necessary by financial compensations. At the same time the paper industry in Groningen was in 1986 still by far the largest polluter with 35% of the total of organic pollution by the paper industry in regional waterboards. Groningen has also a history of disastrous pollution of surface water by straw cardboard plants and potato starch industry. In this region there is clearly a continuous drive to “combat pollution at source”. While in other regions, waterboards on the contrary sometimes resist the “detachment” from their collective system by companies.

For the sub-period 1986 – 1990 we see also no relationship between both variables. Again the position of Veluwe is the most striking deviation from the expected relation between the rise in charge level and the decrease of pollution.



The same holds for the second sub-period 1990 – 1995. Here also other waterboards display an large increase of the pollution discharged.




All in all, it is clear that the development of the organic pollution of the paper industry cannot be understood as a simple response to increasing charge levels in the period after 1986. This was about the time that the coverage of collective treatment plants for purifying water pollution was completed. Many factors play a role now, including political ones, like the way the waterboard is dealing with the problematic that their treatment capacity is sufficient, so that when large companies start own treatment it simply meant erosion of their tax base. This means an increase of the charge level for others including households, without any environmental benefit. So you see more and more that the waterboards resist a further decrease of organic pollution by companies instead of urging it, especially in case of firms that individually have quite substantial pollution loads, like the firms in the paper industry.

## *5.4 Other policy instruments and the Paper and Cardboard Industry*

The water quality managers approach companies in this sector similar as is described in section 2.3. This implies that the policy towards this sector is to check used materials on ecological impacts, to reduce the amount of water used by internal recycling, to prescribe an abatement line based on principals of biological purification and additional abatement of non-solvable components from the effluent. The implementation and the effects of the levy were analyzed in detail in the preceding sections. This was done by excluding possible disturbing circumstances from the analysis by focussing on the variance in the rates of levies by water boards, the relative increase in levies and the relative performance of companies. However for the aim of this analysis, given the methodology applied, the exact entanglement of effects of levies and regulation is not very relevant. Due to the heavy co-ordination regulatory pressure is comparable in all companies in a sector. The effects of levies as empirically analyzed on the basis of variance, are more than once assessed, over and over the conclusion has been that for reduction of oxygen demanding substances, the levies have been the prime drivers. More important are the insights on how different types on instruments interact in the whole implementation of water quality policy. The strategy of direct regulation has changed in the past 15 years. More and more it becomes an instrument for codification of progress that has been reached by other means, to push laggards forward and to solve local problems. A policy mix is nowadays used to activate companies, in this strategy an important role is played by the covenants, often revered to as the Declaration of Intent (DOI).

*Declaration of Intent of the Paper and Cardboard Industry*
The Declaration of Intent (DOI) concerning the Paper and Cardboard industry was signed on 6 March 1996 after negotiations between governments and the sector of industry represented by its trade association. The covenant last until 2010, it is evaluated every 4 years. Compared to the DOI of the Dairy Products Industry (cf. section 6.4) more possible emerging conditions are incorporated that might lead to reconsidering the DOI by re-opening negotiations. Mentioned conditions are of economic nature, emerging conflicting policies and regulations by the European Union, and the lack of technical options. These conditions are monitored by a consultation-group, composed of representatives of government and companies. Like in the case of the Dairy product sector the Declaration of Intent covers the whole range of relevant environmental topics, it can be considered as putting the goals of the National Environmental Policy Plan in operational terms, including the issue of waste water.

*Obligations*
The declaration of Intent for the Paper and Cardboard Industry contains an assignment for the emissions into surface water of chlorine phenols, copper, mercury, lead and chrome. It is part of the theme 'Avoidance spreading dangerous substances'. The assignment for spreading into the surface water implies that in 2000 the emission has to be reduced with 50% compared to 1985 an in 2010 with 90%. Some specific assignments by substance:

- Copper, spreading should decrease with 50% in 2000 en 80% in 2010, compared to 1985.
- Mercury with 50% in 2000 en 70% in 2010.
- Zinc with 65% in 2000 en 80% in 2010.
- Lead with 65% in 2000 en 70% in 2010.
- Chrome with 85% in 2000 en 85% in 2010.

Within the theme 'Fighting fertilization', additional assignments are incorporated that are relevant for water pollution: a reduction of emissions of nitrogen of 70% in 2000 and 75% in 2010 compared to 1985. For phosphor the percentages are 75% en 95%. The emissions of nitrogen and for phosphor in this industry are less than 1% of the emission of substances for the industry as a whole. Because of this relatively small share companies are expected to make an effort to reduce emission on the basis of existent policy.

It comes as no surprise that the emission of oxygen demanding substances is not an important issue in the DOI. The evaluation of this aspect is that the levy is doing its job. This is less true for the policy on the spreading of dangerous substances, it was argued earlier that the revenues of the levy on these substances are small and provide no strong incentive to abate pollution. This is caused by the fact that the levy is linked to the costs of water quality management and not to environmental damage or environmental risks.

In order to avoid spreading from sludge from water treatment plants, the sludge has to be burned 100% in 2000 in Waste Incineration Plants that are equipped with an extensive abatement line and comply with strict emission standards.

As mentioned there are also other environmental issues dealt with in the DOI, leading to assignments that parties negotiated. For instance to fight acidification: Emissions of NOx have to be reduced by 55% in 2000 en 90% in 2010, SOx have to be reduced by 80% in 2000 and 90% in 2010 (*Convenant and Uitvoering Intentieverklaring Papier en kartonindustrie, Sommatierapport BMP-2, Overleggroep Papier-en Kartonindustrie, oktober 2000).*

*Achievements in the sector*

The outcomes have been evaluated a couple of times. In general the obligations seem to be taken seriously by industry, although there are some emissions of some substances that are not in line with the obligations. The emission of chlorine phenols proved to be declining in 1998, this conclusion is based on a monitor-program implemented once in every 2 to 3 years, as agreed upon between the sector and the governments.

Table 5.4.1 enumerates other outcomes, partly based on estimations that calculate on the basis of programs, CEP's, of individual companies.

| Substance | Reduction compared to 1985 (%) | | | DOI | | Compared to DOI | |
|---|---|---|---|---|---|---|---|
| | 1999 | 2004 | 2010 | 2000 | 2010 | 2000 | 2010 |
| Copper | 73% | 55% | 53% | 50% | 80% | ++ | - |
| Mercury | 81% | 93% | 92% | 50% | 70% | ++ | ++ |
| Zink | 38% | 61% | 59% | 65% | 80% | - | - |
| Led | 74% | 55% | 47% | 65% | 70% | ++ | - |
| Chromium | 39% | 48% | 45% | 85% | 85% | - | - |

Table 5.4.1: Reduction of emissions into surface water 1999 and prognosis 2004 and 2010

*Explanation:*
++ : The prognosis of reduction of emission is more than 5% larger compared to the DOI.
\+ : The prognosis of reduction of the emission differs 5% or less (upwards or downward) compared to the DOI.
\- : The prognosis of reduction of the emission stays more than 5%, compared to the DOI.
*Source: Uitvoering Intentieverklaring Papier en kartonindustrie, Sommatierapport BMP-2, Overleggroep Papier-en Kartonindustrie, oktober 2000.*

Table 5.4.1 illustrates that for copper the DOI-2000 is realized. For the years 2004 and 2010 however the prognosis is an increase of the emissions, which probably will imply that the DOI-2001 cannot be reached. For mercury the DOI's are not realized, though a reduction of emissions is observed and expected by the planned measures in individual companies, one company is responsible for about 70% of the emission of mercury into surface water. The emissions of lead and chrome into the surface water add up to less than 1% of the total emissions of Dutch industry, in the case of the Paper and Cardboard industry. In the case of led the DOI-2000 is realized as opposed to DOI-2010. For chromium both are out of reach.

*Preliminary conclusions: In this sector the situation is in line with the general conclusions on the effectiveness of levies in water quality policy. For oxygen-demanding substances the levy works very well, for dangerous substances and for fertilizing substances this is not true. Additional regulatory efforts are necessary and implemented. The choice has been made to use negotiated agreements, which imply self-regulation. For companies that find themselves in the position of non-compliance compared to the agreed upon assignments, regulation will follow. The way the levies are calculated and collected are important to understand the necessity of these additional efforts.*

## *5.5 Paper and Cardboard Factory Crown van Gelder*

In order to have insights in the impacts of regulation and levies in an average factory in this sector we use the example of Crown van Gelder Factory. This company emits in the 'Noordzeekanaal' (channel) and operates its own water treatment plant. The capacity of the factory is 170 kton. Within the internal water-system the process water gets re-used several times, afterwards it is transported to water treatment plant. Since 1990 the company has installed an abatement line based on physical/chemical principals, since 1993 there is an abatement line is added based on biological principals (oxidation).

Important years in regulation were 1979, 1996 and 1999. Compared with the 1979 permit the 1996 permit reduces the allowed emissions drastically. Already installed abatement equipment was mentioned above, the permit codified the interaction process between the company and governments. Since 1981 substantial improvements are implemented in the fields of recycling of substances from water and reducing organic material. The emission of organic material is reduced while the capacity of the factory was increased. Table 5.5.1 indicates the standards this company has to meet.

| *Substance* | *I (max)* | *II (gem.)* |
|---|---|---|
| CZV | 200 | 150 |
| BZV | 75 | 40 |
| Total N | 20 | 10 |
| Total P | 2.0 | 1.5 |
| Not-dissolved substances | 30 | 20 |
| Cadmium | | 0.01 |
| Mercury | | 0.0001 |
| Chrome | | 0.1 |
| Copper | | 0.1 |
| Lead | | 0.1 |
| Nickel | | 0.1 |
| Zinc | | 0.2 |

Table X: Standards in permit Crown van Gelder

Explanation:
I = the maximum concentration based on a arbitrarily sample, expressed in mg/1;
II = the concentration in mg/l as the progressive arithmetic average amounts in ten representative twenty-four hours samples.

Some other requirements:

- Obligation to invest in alternatives for some toxic substances in order to decrease emissions and/or to improve the abatement line.
- The company has to report quarterly about a number of substances, temperature of the effluent of the water treatment plant.
- Acid value (Ph)
- Quantity of effluent
- Concentration of chlorine

Although this seems to be a list of rather demanding emission standards, they were rather easily within reach for the company, most of them are based on 'normal practices' at that time. However towards some issues problems emerged: The limits for phosphate and for not dissolved substances proved to be impracticable. The company uses phosphor-acid in the abatement line. The strict limit on phosphate emissions implies that this cannot be added and the effect is that organic emissions cannot be abated effectively. The advisor of the governors, RIZA, compared the requirements with national accepted limits and concluded that they were too strict. However, in 1999 the abatement line worked disorderly and the company asked for a temporary decision of the permitting authority in order to tolerate the non-compliance situation. First this was granted, a request to renew this decision was not granted. Tolerating the same situation of non-compliance more than once is not part of the policy of the permitting authority. Because the situation of non-compliance was caused by technical constraints no prosecution was considered. In the same period the company was thinking about changing the production processes. Instead of a Ph>7, in the future production would be in a neutral environment, Ph = about 7. Although the change in the production process might and almost certain will have positive effects, the changes were market driven. In any case, the use of some chemicals is reduced in the new process and especially the emissions of phosphates is reduced drastically. Meanwhile in 2002 the abatement line is functioning well, and the permit of the company that was adjusted in 1999 will be renewed (finally ending the procedures). The company asked for a permit on ‘central issues’. This new juridical instrument is introduced in order to use suitable and efficient regulatory approaches towards companies that are pro-active and show good environmental performances. The company at least has to operate an environmental management system that is ISO 14001 or EMAS certified and performs in line with or better than the Declaration of Intent. The regulatory authorities have to approve of the environmental program of the company (CEP), the company has to publish a yearly environmental report and it has to show positive compliance behavior. The yearly Environmental Report has to be in line with the ‘Besluit milieuverslaglegging 1998’ which is a piece of legislation. Next to these objective criteria, there is the issue of culture and trust. The company will most likely be granted this flexible permit in 2002, as has been confirmed by the governments. There are only a few procedural technicalities slowing things down. Enforcers of the province have visited the company six times in 2000, enforcers of Agency for Public Works have visited the company sixteen times in 2000 to check the emissions in waste water. In the Dutch context these numbers have to be considered as extremely high. Table 5.5.2 gives an overview on performances of this company:

| | *Entity* | *1985* | *1995* | *1998* | *1999* | *2000* |
|---|---|---|---|---|---|---|
| Purified process water | Million m3 | 1.97 | 2.44 | 2.63 | 2.78 | 2.98 |
| Floating substan-ces | Ton | 868 | 46 | 62 | 72 | 62 |
| CZV | Ton | 993 | 264 | 262 | 502 | 326 |
| BZV | Ton | 540 | 86 | 76 | 189 | 88 |
| Total nitrogen | Ton | 9 | 17 | 21 | 35 | 27 |
| Total phosphor | ton | 0.8 | 3.8 | 3.8 | 9.5 | 8.1 |
| Chloride | Ton | 372 | n.a. | 316 | 327 | 449 |
| Arsenic | Kg | n.a. | n.a. | 2.5 | 4.3 | 7.0 |
| Cadmium | Kg | 2.9 | n.a. | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Chrome | Kg | 24 | n.a. | 5.8 | 0.9 | 5.0 |
| Copper | Kg | 271 | n.a. | 17 | 25 | 7.9 |
| Mercury | Kg | 4.9 | n.a. | 0.11 | 0.13 | 0.19 |
| Lead | Kg | 39 | n.a. | 0 | 22 | 0 |
| Nickel | Kg | 2.3 | n.a. | 16 | 10 | 8.0 |
| Zinc | Kg | 222 | n.a. | 33 | 37 | 89 |

Table 5.5.2: Environmental performances of Crown van Gelder
n.a. = not available.

Because nitrogen and phosphor have been added as nutrient to the influent of the biological water treatment steps, the emission of these substances have increased 1993. A remarkable feature is that the company uses surface water as input. The heavy metals in the effluent to a large extent are already present in supplied surface water.

Crown Van Gelder considers the following items as environmental costs:
- Levies imposed by government on ground of emissions.
- Costs of environmental installations.
- External costs, which mainly are characterized as environmental costs, like drainage and costs for purification and treatment of environmentally harmful waste and materials, and costs of the environmental annual report.

Table 5.5.3 gives an overview of these costs (EURx1000):

| | *1997* | *1998* | *1999* | *2000* |
|---|---|---|---|---|
| Levies on natural gas and electricity | 563 | 560 | 602 | 626 |
| Waste levies on effluent | 199 | 222 | 401 | 240 |
| Costs of sludge drainage | 92 | 109 | 169 | 289 |
| Costs drainage remaining material | 60 | 50 | 41 | 9 |
| Costs maintenance environmental installations | 245 | 284 | 360 | 347 |
| Costs (variable) steam-injection for NOx –reduction WKC | 206 | 165 | 63 | 252 |
| Write-off and interest environmental installations | 599 | 560 | 532 | 487 |
| Remaining environmental costs | 120 | 30 | 27 | 76 |
| *Total environmental costs* | *2.084* | *1.978* | *2.195* | *2.327* |

Table 5.5.3: Environmental costs of Crown van Gelder
Source: environmental reports Crown Van Gelder

The levy on effluent refers to a large extent to the water-levies.

# 6 The diary industry

## *6.1 Introduction*

The Dairy products industry has a long artisan tradition. In the 1940s there were 600 Dutch companies that produced dairy products. The number reduced gradually. Up-scaling in the sector, especially in the period 1975-1980, reduced the number of factories to 67, owned by 15 corporations. Two corporations that own 70% of the plants dominate the sector. The two largest companies, Friesland Coberco Diary Foods and Campina Melkunie, are in world's top ten of largest diary companies (Baas et al: the world diary market, Rabobank international, Utrecht, 1998). In recent years some new factories open their doors, mainly producing specialized and often strict biological products.

The market share of the Dutch diary industry in the European Union is between 15 en 20%. Unlike the other analyzed sector of industry, the Paper- and Cardboard Industry, the permitting authorities describe the culture in the Dairy industry as rather passive. This is in line with the general view that the environmental activity of a sector is in general in line with the perceived regulatory vulnerability and perceived regulatory risks. For instance in the Chemical Industry, companies are often ahead of governmental intervention. In the Dairy sector innovation and attention for ecological arguments is limited in the perspective of practitioner (water board). One of the reasons for this has also to do with the requirements on hygiene and its importance for the company. The requirements on hygiene are extreme and increasing. This implies often increase in the frequency of cleaning and by that, the used amount of water. Surface water is used almost solely for cooling in this sector, process water is often withdrawn as groundwater. However due to efforts and despite the increasing demands on hygiene, the amount of withdrawn water decreases slightly. The Diary Product Industry hardly works with toxic substances, therefor it is not emitting a lot of dangerous substances. Indirectly it causes intensive farming that leads to fertilization/eutrophication. In the Netherlands 65% of cultivated land is used for dairy farming.

The general problems in the emission of wastewater from the Dairy industry are the emission of phosphor and the emission of salt. In general there is no levy paid on phosphor and the capacity of the Public Waste Water Treatment Plants have to be extended in order to be able to handle these substances. As explained the operators of Public waste Water Treatment Plants also have to comply to standards concerning chemical use of oxygen, nitrogen and phosphor in the effluent. Things are complicated due to the fact that the Netherlands does not comply with the European Directives on fertilizing substances. The Netherlands finds it difficult to comply with these standards, intensive farming and cattle is an important factor. Given the limited immission, the Dutch water managers have to decrease emissions. Since 1989 there are already rather strict national policies trying to reduce the inflow of these substances in the environment. This stimulated the de-phosphatification of the waste water of Diary companies. In fact the residue brings some cash: it is sold as animal feed.

A high amount of salt in the wastewater has a negative influence on the functioning of the Public Waste Water Treatment Plant. The used microbes are less active in a salty environment. Dairy Product Industry therefor has to meet strict limits for these substances and these limits might become more ambitious in the next future. Table 6.1.1 gives on overview of the emission of oxygen-demanding substances:

| | *1975* | *1980* | *1985* | *1990* | *1995* | *1997* | *1998* |
|---|---|---|---|---|---|---|---|
| Industry | 15,3 | 9,7 | 5,0 | 5,6 | 3,3 | 3,8 | 3,8 |
| Food | 9,9 | 5,6 | 3,4 | 3,3 | 1,7 | 1,9 | 2,1 |

Table 6.1.1: Emission of oxygen demanding substances (millions p.e.)
(Source: www.rivm.nl/milieucompendium/C_milieudruk (bron CBS))

This table has to be interpreted with care: the Dairy sector is only a part of the Food Industry, although an important part. The decrease has been realized by the extension of the water treatment capacity of plants and by measures in the production-process. The increase after 1996 is likely caused by higher production. The net environmental cost of the Dairy industry in 1999 is 2.2% of the sales minus costs of raw materials, other materials and bought services of third parties. The average for industrial companies in 1999 is 2.7% (www.rivm.nl/milieucompendium/tabellen/0895pg01).

The share of pollution that goes into the sewage system and the Public Waste Water Treatment Plants is 87% of the emitted p.e.'s. The requirements on the effluent of the Public Waste Water Treatment Plants have been sharpened (depending on the capacity 10-15 mg N-tot./l and 1-2 mg P/l). This has led to a decrease of indirect emissions of nutrients. These nutrients enter the wastewater by losses of product and raw materials, other materials and cleaning of the production processes. Since 1989 the policy on reducing nutrients became much stricter. For the Food producing sector this implies stricter emission limits for Nitrogen and Phosphates (*Coordinatiecommisie Uitvoering WVO, werkgroep VI, Levenmiddelenindustrie nutrientenemissies, 1994, p. 3*).

### *6.2 Quantitative analysis of the relationship between charges and organic pollution in the diary sector*

Of the 30 regional waterboards that cover the country 9 don't have companies in the diary sector, and one hardly any. These cases are consequently removed from the analysis. In two other cases boundary changes and unreliable data (extreme jumps up and down in pollution and strange differences in numbers of companies reported) were reasons to also exclude these. So a sample of 18 cases remained.

The smaller sample from the population of regional waterboards involved doesn't mean that only a small proportion of the organic pollution from the diary industry is included in the analyses. The cases that are left out of the analyses are hardly contributing to the pollution load.

| Pollution in p.e. | 1986 | 1990 | 1995 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| All 30 cases | 526,637 - 100% | 449,689 - 100% | 437,473 - 100% |
| Sample 18 cases | 510,962 - 97% | 433,664 - 96% | 411,905 - 94% |

*6.2.1 Relation between charges and pollution in the first period 1986 – 1990*

There is no positive relationship between the rise in charges and the decline of pollution in this period. In first instance there is even some hint of a negative relationship.

*Correlation of rise in charge level with % decline in pollution, both 1986 – 1990:*
*Pearson's r = -.314 sign. = .102 n = 18*

Studying the plot we observe – as we also see in the paper industry – that waterboard Veluwe takes a special position because of its policy to prevent own treatment by companies by offering compensations. Excluding this one waterboard makes clear that the negative relationship is not to be taken serious. However it is also clear that in this period the explanatory power of the rise in charges is absent.

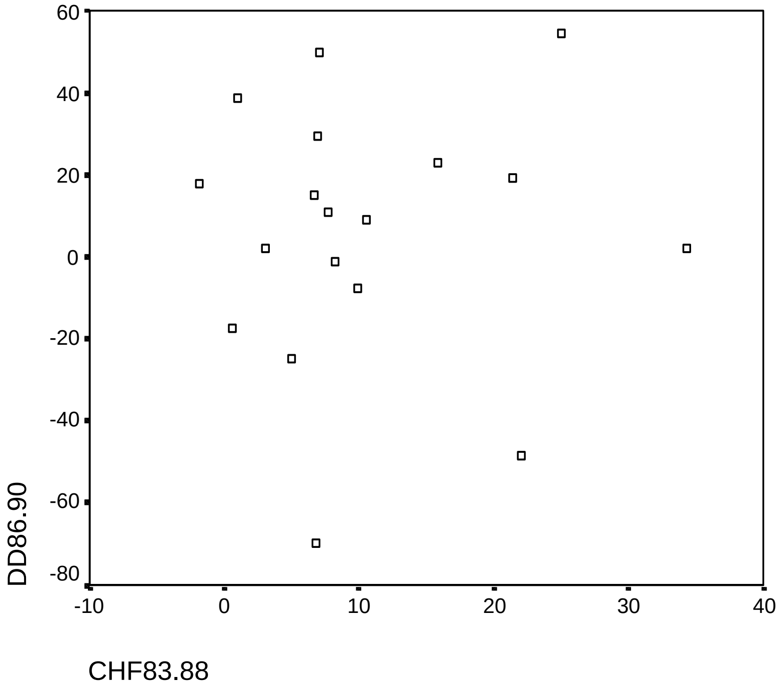
*Correlation of rise in charge level with % decline in pollution, both 1986 – 1990:*
*Pearson's r = -.202 sign. = .215 n = 17*

Until now, we kept the period of rise of charges the same as the period of the decline of pollution. But it is quite possible that there is some anticipation on charge rise or – alternatively – some delay in taking additional measures in industry. So, the charge rise period can best be derived inductively. But even the 'optimal'[6] charge level period of 1983-1988 does not provide a clear relationship:

*Correlation of rise in charge level 1983 – 1988 with % decline in pollution 1986 – 1990:*
*Pearson's r = .042 sign. = .434 n = 18*

As shown in this plot:

[6] Used is the period where the correlations of the pollution decline with the various yearly charge levels show the most positive development.




There are three obvious outlayers where the development of the pollution is rising fast with medium charge increases (Veluwe, Rivierenland) or is stable with a very high charge increase (Maaskant). If we exclude these three the correlation – naturally – gets more positive:

*Correlation of rise in charge level 1983 – 1988 with % decline in pollution 1986 – 1990:Pearson's r = .386 sign. = .078 n = 15*

The point here is of course not that charges statistically explain the decline of pollution after all, but that the fact that they don't is dependent on only a few cases, in which probably other strong forces where present.

So, all in all we can conclude that in the first period other factors than the rises in charges have impacted the development of the pollution load most. This could have been direct regulation, but also various other circumstances.

### *6.2.2 Relation between charges and pollution in the second period 1990 – 1995*

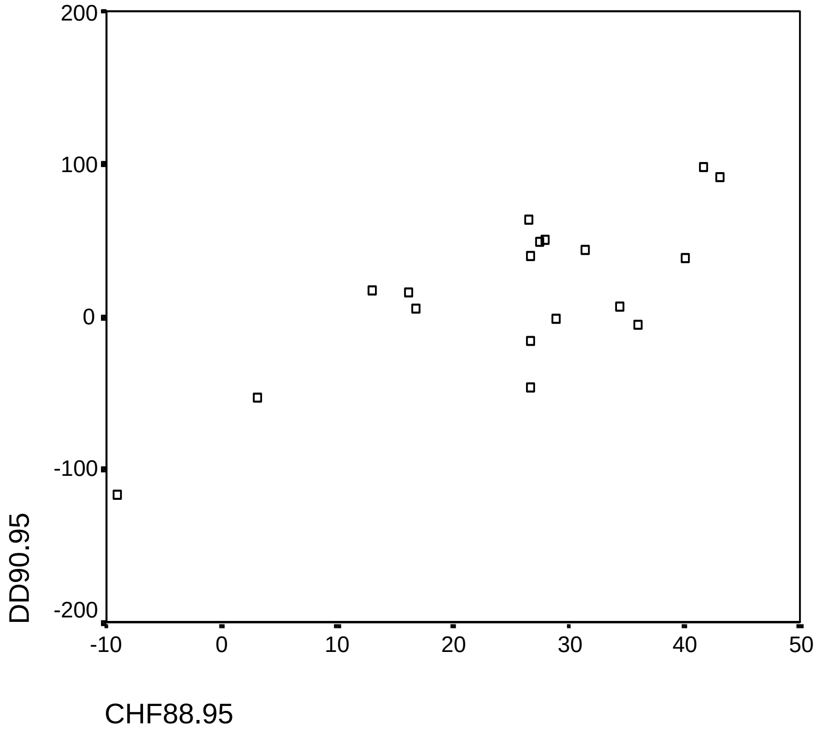
In the second period we do observe a positive relationship:

*Correlation of rise in charge level 1990 – 1995 with % decline in pollution 1990 – 1995:*
*Pearson's r = .722 sign. = .000 n = 18*

The optimal period for the rise in charges variable proves to be 1988 – 1995, so starting a bit earlier, but going right to the end of the period. The correlation is however only a bit stronger:

*Correlation of rise in charge level 1988 – 1995 with % decline in pollution 1990 – 1995:*
*Pearson's r = .760 sign. = .000 n = 18*

As shown in this plot:




This relationship is not really dependent on only a few cases. Even without the two most supportive cases, those at the left end of the plot, the correlation remains significant.

*Correlation of rise in charge level 1988 – 1995 with % decline in pollution 1990 – 1995:*
*Pearson's r = .449 sign. = .040 n = 16*

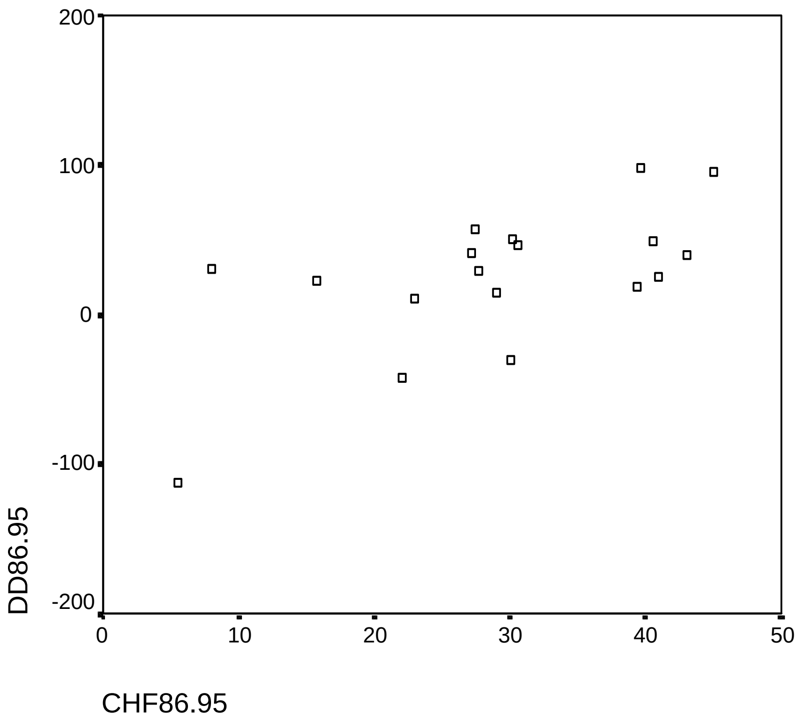
Therefor the conclusion can be that in this period the rise in charge levels probably has influenced the development of organic water pollution by the diary sector.

### *6.2.3 Relation between charges and pollution in the whole period 1986 – 1995*

For the relationship in the whole period about the same holds as for the second part of the period. The correlation between the rise in charges is indeed present, but partly dependent on only one case.

*Correlation of rise in charge level 1986 – 1995 with % decline in pollution 1986 – 1995:*
*Pearson's r = .630 sign. = .003 n = 18*

As shown by this plot:




The 'optimal' charge rise period is for this analysis is again 1988 – 1995, so the charge rises in the latter period. The correlation with this charge variable is then:

*Correlation of rise in charge level 1988 – 1995 with % decline in pollution 1986 – 1995:*
*Pearson's r = .740 sign. = .000 n = 18*

Without the two cases which are most supportive the correlation still holds:

*Correlation of rise in charge level 1988 – 1995 with % decline in pollution 1986 – 1995:*
*Pearson's r = .647 sign. = .003 n = 16*

Again, our conclusions should be drawn with some caution. Nevertheless there is some support for a relationship between the rise in charges and the development of the organic water pollution by the diary industry.

### *6.3 Other policy instruments and the Dairy Product Industry*

Like as has been described in the section of the Paper and Cardboard Industry also the Dairy Product Industry participate in a negotiated agreement with the government. In the years 1992 -1994 the emissions of all production facilities were monitored by the 'Nederlandse Zuivel Organisatie' in the program 'Coordinated Registration of Emissions of the Dairy industry'. These data became in 1994 the basis for the Declaration of Intent of the Dairy sector, an agreement with four governments. Individual companies co-signed the agreement next tot trade association. Also to this Declaration of Intend there is a group who is monitoring external disturbances that make adjustments of the agreement necessary. Both governments and the Dairy sector participate in this group. The Declaration of Intend (DOI) is valid until 2010. The DOI comprehends all environmental themes, towards water emissions a number of pollutants are especially addressed while for others the statement is made that any harmful emission has to be reduced wherever possible. Some substances and issues explicitly addressed are:

- The emissions of HCFK's, CFK's, , CO2, SO2-total, NOx-total, carbon monoxide, fine substances (all emitted into the air).
- Nitrogen total, phosphor and cheese brine (salt) (all emitted into the water).
- The quantity transported waste and the reduction of groundwater extraction.
- Smell.
- Noise.
- Ground re-development.
- Environmental management.

The individual corporations and companies draw plans for their factories (Company Environmental Plan), a similar procedure compared to the companies in the Paper and Cardboard industry. The first generation comprehends the period 1994-1999. The second generation is valid until the end of 2002. Evaluations show that all targets were achieved with the exemptions of the target for NOx emissions to air and an obligation to improve energy-efficiency.

In the case of chlorides, chemical oxygen demand and emitted 'inhabitant-equivalents' there are no quantitative requirements in the DOI, however the emissions are monitored and reported. The amount of chlorides and p.e. directly emitted on the surface water are decreased compared with 1998, the chemical oxygen demand also decreased. The amount of chlorides indirectly emitted into the sewage system has increased slightly. The chemical oxygen demand of these emissions in the sewage system remained stable. Tabel 6.3.1 shows the emission reduction of direct discharge on the surface water with regard to nitrogen (N) and phosphor (P) (fertilization) related to the DOI (Uitvoering intentieverklaring zuivelindustrie, jaarrapportage 1999).

| *Substance* | *Emission reduction 1999 compared to base-year* | *Prognosis 2002* | *Realization prognosis 2002 in 1999* | *IMT-2000* | *Realization IMT-2000 in 1999* |
|---|---|---|---|---|---|
| Nitrogen (total N) | 81% | 81% | + | 70% | ++ |
| Phospor (total P) | 75% | 82% | - | 75% | + |

Table 6.3.1

Explanation:
++ The realized reduction in the year of reporting is more than 5% larger than the DOI-prognosis.
+ The realized reduction in the year of reporting differs 5% less (upwards or downwards) of the DOI-prognosis.
- The realized reduction in the year of reporting stays more than 5% behind the DOI-prognosis

Table 6.3.2 shows trends in direct emissions to surface water for the Dairy Product Industry as a whole:

| Theme/ Substance | Entity | Year | Realized | Reduction compared to base year |
|---|---|---|---|---|
| Nitrogen | Ton | 1985 | 364 | |
| | | 1992 | 156 | 57% |
| | | 1995 | 53 | 86% |
| | | 1997 | 104 | 80% |
| | | 1999 | 68 | 81% |
| Phosphor | Ton | 1985 | 144 | 47% |
| | | 1992 | 77 | 68% |
| | | 1995 | 65 | 55% |
| | | 1997 | 66 | 54% |
| | | 1998 | 40 | 73% |
| | | 1999 | 36 | 75% |
| Chlorides | Ton | 1997 | 7173 | |
| | | 1998 | 5925 | |
| | | 1999 | 5378 | |
| CZV | Ton | 1997 | 1683 | |
| | | 1998 | 225 | |
| | | 1999 | 155 | |

Table 6.3.2
Source Bijlage C

One of the amazing aspects of the interaction between the levy and the emission of oxygen demanding substances is that in some areas it works too well: Some Public waste Water Treatment Plants face extremely thinned waste water streams that obstruct the efficient functioning of the Water Treatment Plant. The costs of water treatment increase while the amount of levy decreases. In these cases the water boards are looking for pollution. In the next section an example of this will be given.

*6.4 Example Friesland Coberco Foods Holding*

Friesland Coberco Foods Holding employs about 11843 people. This case is about two production-sites of this corporation. The case analyses an innovation that reduces phosphates and the interactions between different policy instruments and the outcome This primal analysis of this case was done by Hofman (2000). One factory operated Water Treatment Plant, this was however closed because of aging. The plan later on was to emit the wastewater unpurified in a new water treatment installation of Coberco.

Friesland Coberco Dairy Foods started an innovation-process to make the company more responsive to the market. A critical environmental issue is the availability of process water. It is not easy to get a permit for groundwater extraction and a substantial levy is imposed on water pollution. This led to a focus on in-house treatment. One of the interviewed business people says that the impact of the levy is big and has led to improvements in the production-processes, enlargement of the structures of management (like monitoring systems) and incremental innovations. However, quality and safety have been more important the last few years than environment. This development was threatening for the water board. After this pre-treatment it would be emitted to the sewage and the Public WasteWater Plant of a water board in the province of Drenthe. However in this case the Public Water Treatment Plant of the water board would lose 80% of its organic pollution and also a substantial share of its financial income.

The most important parameters and accompanying values of the to be emitted wastewater are for this site (in the permit):

| ***Parameter*** | ***Entity*** | ***On average*** | ***Maximum*** |
|---|---|---|---|
| DEBIET | $m_3$/uur | 85 | 120 |
| Pollution | p.e. | 18000 | 25000 |
| | | | |
| CZV | kg/dag | 2060 | 2860 |
| BZV | kg/dag | 1240 | 1700 |
| N-Kj | kg/dag | 85 | 115 |
| N-$No_3$ | kg/dag | 115 | 160 |
| P-total | kg/dag | 80 | 115 |
| Chloride | kg/dag | 1300 | 1800 |
| Ph | - | 6-11 | 4-12 |
| Temperature | Celcius | 30 | 35 (sometimes 70) |

The p.e.'s are calculated according to the State levy-formula addressed earlier. The permitting authority monitors the wastewater twelve weeks a year.

Next to the volume of wastewater and the oxygen-demanding load another aspect of interaction between regulators and government and the use of a policy mix concern the emission of phosphor. Both production sites (Beilen and Bedum) discharge a lot of phosphor. Phosphor comes from the ‘wheyprocessing' that contains salt, phosphor, protein and lactose (Hofman 2000: 8). Pressure to reduce the phosphor emission is in particular international pressure to reduce the emission in the North Sea (via the North Sea action program 1987) and by the development of Rhine-treaties with targets for reduction of p-emission. Finally there is regulation from the European Union earlier referred to. The reductions had to be realized by the best available technology. Regulation was issued with regard to phosphor emissions. Water boards were obliged to realize a 75% reduction of phosphor emission in every region by 1998. The new regulation led in 1988 to a covenant between central government and regional water boards about the introduction of elimination-techniques for phosphor in Public Waste Water Treatment Plants. Under a regulatory threat all parties committed to search for possible solutions to reduce this emission. From 1984 onwards there has been a search for solutions because the water board had to expand the capacity of its treatment plants to be able to cope with the wastewater of the company. The alternative would be that the company had to build its own treatment plant. This option is a threat for the existence of the Public Waste Water Treatment Plant of the water board because it would receive 80% less organic polluted waste water. The corresponding tax revenues would also b lost to a substantial extent. In 1989 the parties agreed on a covenant. The solution was that the water board would expand its treatment plant and the company delivers untreated wastewater for the period of the covenant with the informal agreement that the company discharges less phosphor. The water board benefits from these adjustments, seen in the light of the regulation. Solutions to reduce phosphor emissions had to be found by a common financed research-project. A solution was found after an earlier attempt failed. Dephospatation – separation of phosphor and re-use now became thinkable. The company was less enthusiastic because of the high costs of certain technical steps. A private consultancy industry was willing to apply a membrane technology which leads to separation of phosphor in wastewater to make re-use possible. By this technology there were no extreme investment costs. This technology was first installed in Bedum in 1997. This technology and its implementation got a subsidy from NOVEM, an implementing agency of the Ministry for Environmental Protection. The deciding factor for this was the process integrated character of this technology in development instead of the end-of pipe character of other thinkable solutions.

The merit of this case is that it proofs that a careful mix of instruments can prevent unproductive decisions. In this case it would have been very unproductive for the water board if the company had decided to build its own wastewater treatment plant. The financial basis for the public plant would disappear. On the other hand it is unattractive for the company to work in a context of uncertainty on regulatory demands and the possibilities to meet them and/or to be forced to invest in technology that is aged at forehand.

The conclusions of this specific case: CAC policies often do not provide the time necessary for a process of trial and error which is necessary for innovations and they often impose current available techniques even if these have an end-of pipe focus and are sub-optimal in the long run. While in this case the primary cause for the innovation was a stimulus of a CAC-nature, flexibility of implementation and the setting of a medium to long-term time horizon gave the company both the time and the incentive to actively look for a more optimal (cost-efficient) solution. The case makes clear that environmental policy can induce environment-oriented innovation. The company made very clear that in the case of absence of regulation they would not have altered their operations. It turned out, however, that in the process of searching for acceptable solutions, dealing with the anticipated stricter regulation could be turned into their advantage (by producing side products) (Hofman p.16).

Figure 6.4.1 shows the relation between the solutions for phosphor emissions offered by water boards, companies, and R&D partners, and the policy developments related to these research-solutions (to be shortened and adjusted).

| *Year* | *Actors* | *Activity* |
|---|---|---|
| 1984 | Site Beilen and en wat board | Negotiations regarding the expansion of capacit of the wastewater treatment plant in Beilen because of capacity problems. First planning of expansion and discussion of financing schemes |
| 1987 | Riparian Rhine States | Rhine Action Plan: long term plan to regain the original nature values of the Rhine by reducing emissions |
| 1987 | North sea countries | North Sea conference, second ministerial declaration with targets for the reduction of phosphate emission to the North Sea laid down an North sea Action plan |
| 1987 | Ministry of Environmen Protection and Ministry Public Works | Policy note regarding measures to reduce the phosphate load in surface water |
| 1988 | Dutch government and water boards | Covenant to introduce elimination techniques fo phosphates in wastewater treatment plants of th water boards |
| 1989 | Site Beilen en water board | Covenant between Beilen and water board. Bec can expand production and will continue to have wastewater treated by water board. Water board will make sure to be able to treat wastewater based on expected growth. Also on the initiative water board it was agreed to jointly start researc on eliminating phosphate from wastewater of Beilen |
| 1991-1993 | Site Beilen and water board and LUW (agricultural university Wageningen) | Analysis and research by LUW of options to eliminate phosphates from Beilen's wastewater. Research based on small samples. Research jointly financed by ZD and BDI. |
| 1993 | Beilen and water board | Permit for Beilen states that BDI has to do research into possibilities to reduce phosphate emissions in co-operation with ZD |
| 1993 | Site Bedum and Agen for Public Works | Permit for site Bedum with standards for wastewater emissions. Bedum also has to do research into the elimination of phosphate emissions focussed on a far-reaching reduction |

| | | |
|---|---|---|
| | | phosphates before jan 1, 1995 |
| 1993 | Site Bedum, Agency of Public Works, Court of appeal | Site Bedum appeals to the state court because finds the time of limits unfeasible |
| 1993-1994 | Water board, site Beile and an engineering consultancy bureau. | Pilot studies at laboratory level for precipitation phosphate with calcium on sand-beds. Researc jointly financed by water boards and Beilen. Conclusion reports: technique not satisfactory because it does not give stable results and does not produce a material flow that can be reused |
| 1995 | National government | Decree regarding phosphate removal. This decr states that water boards are obliged to remove a least 75% of the phosphate load of the wastewa intake at the public treatment plants before jan. 1998 |
| 1995 | Court of appeal, site Bedum | The court of appeal accepts the arguments of Bedum an prolongs the time limit to jan. 1 1997 |
| 1995-1996 | Site Beilen, water boar and Novem | Joint research project to precipitate phosphate v calcium and leave a re-usable product |
| 1996 | Site Beilen, Polysep, a Novem | After test with samplex, Polysep has set up a pil installation at BDI where it separates phosphate form the wastewater through the use of membra technology. The project is subsidised by novem |
| 1997 | Bedum, Polysep, and Novem | Bedum installs a treatment plant. Novem subsid % of the total project |
| 1998 | Beilen | Site Beilen installs equipment for the separation phosphate concentrate from the wastewater flov with membrane technology and the treatment of calcium. |

Figure 6.4.1 shows the relation between the solutions for phosphor emissions offered by water boards, companies, and R&D partners, and the policy developments related to these research-solutions.
Source: Based on Hofman, 2000.

The production site in Bedum operates their own wastewater treatment facility and emits afterwards in the Waddensea, so this is a direct emission into the surface-water. In this case the Ministry for Public Works and the Agency for Public Works are responsible. The example is taken from 'Envinno Innovation by negotiation**'**. A case study of innovation at the Dutch Dairy company Borculo Domo Ingredients Peter S. Hofman, Universiteit Twente, 2000.

# 7 Conclusions and outlooks

Generally speaking, the effluent charges have given good *results* compared with the other instruments, both in the period 1975-1980 and in the period 1986-1995 (Bressers 1980, 1983, 1988 and Schuurman, 1988, Bressers and Lulofs 2002).

The licenses introduced at the same time as the charges had had little effect in the period 1975-1980. This is a striking result, considering that it was the licenses, not the charges that were officially designed to manipulate the environmental behavior of businesses. Bressers (1983) attributed part of the charges' success in the seventies to the drastic change they bring about in the consultative climate between the water manager and industry. The keynote of the contacts is collaboration rather than conflict now that industry is able to achieve significant savings by cleaning up pollution. In practice, therefore, environmental charges do not function as a purely economic mechanism[7]. They do not replace consultation between authorities and industry, but actually increase its beneficial effects on environmental conservation.

This position is once more confirmed by the analysis for the 1986-1995 period (Bressers and Lulofs 2002). Analyzing identical economic incentives in an identical manner the effectiveness of the charges seemed to be somewhat decreased. One has to take into account that the context has changed strongly, the urgency of the issue of organic pollution in surface water vanished, as a matter of fact the technical and economic functioning of waste water treatment plants of water district boards was threatened by a further decrease. Meanwhile other polluting substances became more important. Also the policy mix became gradually broadened, moving into the era of covenants. Some examples were given how policies of a district water board (Veluwe) can turn over the previously existing relation between the magnitude of the economic incentive and the behavioral reaction of companies.

This leads to the conclusion that an assessment of the effectiveness of charges in this case cannot be done separated from possible interaction with other instruments and other aspects of the setting in which the incentives are used The economic incentive strategies might not exclusive, or even not dominantly, be effective due to the economic mechanism, however by, or at least strongly helped by, other mechanisms.

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[7] The argument is, among others, found in the case of the reduction of heavy metals in the period 1975-1980. In view of the damage that heavy metal pollution causes to the sewage water treatment process and to the quality of the resulting purification sludge, most water boards also introduced a charge on the presence of heavy metals in effluents. But as the charge was relatively low, the water boards felt it had little to do with the 50% reduction of heavy metals in industrial effluents achieved between 1975 and 1980. Without negotiations and licensing regulations, so they thought, industry would be unwilling to budge. Statistical analysis (Bressers, 1988) showed, however, that negotiations in districts that had substantially raised the charges were much more successful than in other districts. So the regression analysis revealed that the charges, far from being insignificant, were in fact the most powerful policy instrument! Nevertheless the charge on heavy metals is relatively low due to the fact that it, so says the law, has to be related to the costs of cleaning up pollution. The additional water treatment costs to abate heavy metals are relatively low compared to the costs of abating organic pollution.

Furthermore, in several meta-evaluations it has become clear that no absolute statements can be made about the feasibility and effectiveness of policy instruments. The effectiveness of an instrument or mix depends very much on the given circumstances, and no instrument will be effective in all circumstances[8].
This is clearly a case of effective government, however the EI strategy is embedded in other interacting strategies, CAC, consultation, negotiation and technology programs play a role as does the ear-marked character of the charges.

The Dutch case, with the most substantial system of effluent charges in the world, shows the enormous potential of this policy instrument. In the research reported here, we did not come across any evidence that would suggest that this result can be explained in terms of specific national characteristics of the Netherlands, however the success is strongly determined by the fit between the exact characteristics of the system of economic incentives and (I) the setting it was used in, among which other policy instruments and (II) changing characteristics of the setting, among which changing preferences and interests of involved actor-networks. Next to this three points deserve however attention.

Our analysis focussed on the improvements delivered by industry, one should keep in mind that this is only half of the story of the success of the levies in Dutch policy on surface-water quality. About 50 % of the reduction of emissions into the surface water is caused by a large number of public wastewater plants that have been built, financed by money from the charges. *The* conclusion of all of this has to be that the strongly reduced emissions of oxygen-demanding substances to the surface water since 1975 is both the result of efforts by industry and efforts by public treatment plants. Roughly 50% of the improvement has been delivered by industry and the increasing number of public treatment plants also delivered 50%. The total reduction of emission of organic material between 1975 and 1995 was beyond 80%. The earmarked character of the charges played an important role in this.
Secondly, the implementation of effluent charges can be hampered by the need for a devoted executive body that is determined to actually collect the charges. Central government policies are often frustrated by lack of cooperation by local authorities appointed to implement them (Bressers and Honigh, 1986). This problem did not arise in Holland, thanks to the fact that there effluent charges function as so-called revenue raising charges. Through the charge system the water authorities are collecting their own money, needed very much for the building and exploitation of treatment plants, a task they were eager to undertake.

[8] It is therefore essential that theories on the feasibility and effectiveness of instruments take these circumstances into account. Building on our experience with research into the effectiveness of large parts of Dutch environmental policy, a contingency theory has been developed at the University of Twente. This contingency theory assesses the feasibility and implementability of policy instruments, taking into account the circumstances in which the instruments are applied (see appendix 2). It therefore enables us to make global predictions and statements about the feasibility and implementation of the various (combinations of) policy instruments in different situations.

Another major problem with effluent charges is, thirdly the massive amount of information that is required to assess the fee each company has to pay. Some authors even see this as the most important reason to discard this policy instrument altogether. In Holland this problem was reduced by not charging the millions of households and small industrial polluters (less than 10 p.e.) in proportion to the actual pollution they caused. Having relatively few opportunities of limiting pollution, this category of polluters is of minor importance to the instrument's regulating power. The amount of information required is again substantially reduced by basing the assessment of medium-sized polluters (usually between 10 and 100 p.e.) not on samples of their effluent, but on a coefficient table. On the basis of easily obtainable data such as the amount of water used by the firm or the amount of certain raw materials it processes with that expertly calculated coefficient table the probable amount of pollution can be established accurately. However, the incentive to reduce pollution remains intact. For, companies that feel they are overrated on the coefficient table can request their effluent to be sampled and to be charged on the basis of the results.

Finally, the *political feasibility* of financial instruments is always a difficult point. The charges on water pollution were acceptable because they were introduced as charges for sewage water purification, i.e. as payments for services rendered. The employers' organizations in the Netherlands still maintain that other forms of charges are unacceptable to them. One of the reasons is precisely the effectiveness of the instrument. Another reason for this resistance may be that charges without compensation impose a heavier burden on industry than on government. Implementation problems being solvable and the way in which effluent charges influence the negotiation process being consistent with what we would have been led to expect by the economics literature, the greatest problem seems to be the feasibility of introducing such charges. In the words of Senator Domenici: "Charges have only one problem: they lack political support" (Domenici, 1982). Perhaps the key question is: Who's afraid of effective government?

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