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# Charging polluters for financing waterpollution abatement*)

**Introduction**

The Netherlands has a surface area of about 40,800 km² and is more abundant in water than most other countries in the world. One fifth of the area is covered by water and about one fourth part of the land is below the average sea level. More thans half of the land has to be protected by dunes or dikes against floods from the sea or the rivers. It seems paradoxical that a country so abundant in water has to scope with the vast and ever-growing problem of the quality of its surface waters. This problem is threefold, viz.

— in the low, northern and western, parts of the country the surface water is threatened with salting;

— in many places the surface water is contaminated by wast water effluents discharged into it;

— the river Rhine, which has a catchment area of 160,000 km² with large industrial zones in Switzerland, France, Germany and the Netherlands, with a population of about 40 million people, is heavily charged with organic and inorganic substances from population and industry.

Salting of the surface water is caused by salty seepages in polders. Salt also penetrates through the locks at the sea and the mouths of the lower rivers. The river Rhine also contains salt originating partly from the potash mines in Alsace. In dry periods the river's salt content may amount to as much as 300 mg $Cl^1/l$. Salting as a result of seepage can be combated only by flushing the surface waters with large quantities of fresh water. Of the total fresh water needs of the country the Rine supplies some 65 %. This is why the Rhine is of such major importance to the water economy of the Netherlands. Especially in the summer months, when the need of fresh water is highest, the situation may become precarious at low river discharges.
The problem of the water economy in the Netherlands is not just a continuation of the age-old struggle against the water, it is also, and especially, a struggle for the water.

Continued industrialization to roughly four times the present level, which is expected in the year 2000 to ensure the growing population of increasing prosperity, involves an ever-growing need of suitable water for both the population and the industry. By the end of this century the annual water consumption will presumably amount to four billion cubic meter, 2.5 billion of which will have to be derived from the threatened surface waters.
The production of domestic sewage in the Netherlands is now 13 million population equivalents, and that of industrial wastes 11 million population equivalents. Waste water with a 'pollutancy' (polluting effect) of 15 million population equivalents is discharged into the surface waters without any treatment. To improve the quality of the Netherlands surface waters to a specified degree in a period of fifteen years, an amount of 3,500 million guilders[1]) will have to be invested in sewage treatment plants. Besides, there is the special problem of the effluents of potato flour and strawboard factories in the north-eastern provinces of Groningen and Drente, which represent another 24 million population equivalents.

The struggle against water pollution — country-wide — in the Netherlands has recently become possible, since on December 1st 1970 the National Water Pollution Control Act came into force.
This is a so-called framework law based on two important principles:

— the discharge of waste water effluents to surface water is prohibited without a permit of the competent authority;

— he who discharges waste water effluents must pay to the management of the quality of the receiving water an annual charge which corresponds to the quality and the nature of the wastes.

The Act distinguishes between waters managed by the State and other waters. A schematic survey of some of its main features is given below.

| **For state-managed waters[1])** | **For other waters** |
|---|---|
| The State enforces the orders prohibiting the discharge of waste effluents. | Regional agencies, among which water boards, enforce the orders prohibiting the discharge of waste effluents. |
| The State levies charges based on the polluting effect of both treated and non-treated effluents discharged into State waters. | These agencies levy charges based on the amount and nature of the waste effluents discharged into their sewage treatment plants or surface waters. |
| The State contributes to the capital to be invested in the construction of sewage treatment plants.<br>The State itself does not build sewage treatment plants.[2]) | As a rule the regional agencies build and operate sewage treatment plants. |

[1]) These waters include the large rivers: Rhine, Meuse and Scheldt, as well as the main national waterways.

[2]) Sewage treatment plants discharging into state waters are built by regional agencies, among which water boards, some large municipalities and large industries.

It is expected that about thirty regional agencies will be active in abating the pollution of non-state waters. Besides their activities as water quality managers most of these agencies will be charged with building and operating sewage treatment plants which, until recently, were built and operated mostly by municipalities. The various activities, such as collection in sewerage systems, transport and treatment of waste waters, will now be distributed in such a way that in practice the municipality will operate the central sewerage systems, while transport and treatment will come under the responsibility of the regional agency. In order to make this scheme work, binding agreements are made between municipalities and the regional agencies.

The present paper is meant to provide information on the organization of regional water quality management in the Netherlands and describes a method to obtain the funds required for financing facilities for waste water treatment, which is based on levying charges from the dischargers of wastes into surface waters or sewage treatment plants in proportion to the quantity and the concentration of the wastes discharged.

**Regional Water Quality Management**

1. *General*

In various regions of the Netherlands agencies charged with the local water quality management have been active for

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[1]) circa 1100 million U.S. dollar.

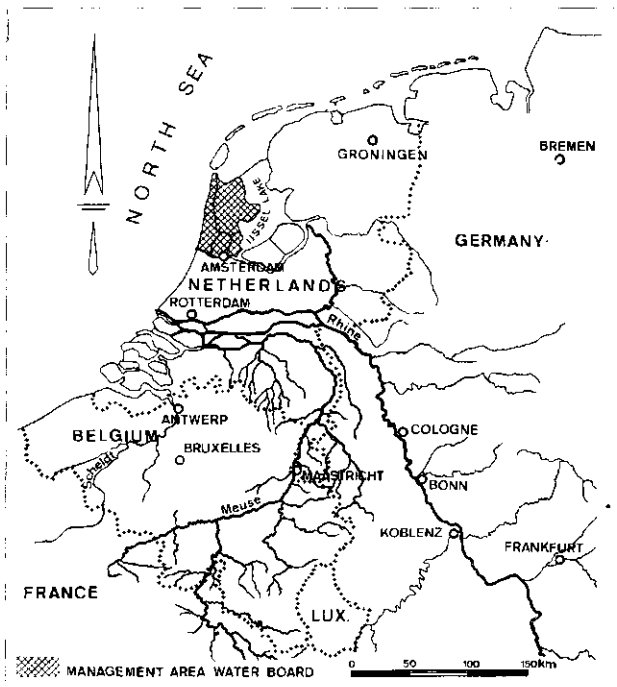


*Fig. 1 - The Netherlands and part of its surrounding countries.*

a number of years. They are mainly 'water boards', public bodies that operate within certain districts, and have for long times managed the water quantities in their districts. Within the framework of the National Water Pollution Control Act the task of a number of existing water boards will be extended to include water quality management, while a number of newly-to-be-created agencies will be charged with water pollution abatement only.

As an example of a regional agency which has for a number of years managed water quality in the sense of the new Water Pollution Control Act, the task of one of these will be described in some detail. The agency in question is 'het Hoogheemraadschap van de Uitwaterende Sluizen in Kennemerland en West-Friesland', to be called here the Water Board. Its activities covers the north-west part of the country, to the north of Amsterdam (see figure 1), and therefore almost the entire north part of the province of North-Holland.

2. *Description of the area and the organization*

The Water Board was founded as far back as in 1544 and in the course of the centuries its main tasks were to become flood-control, low-flow augmentation and irrigation. When, since 1960, the quality of the water in the district threatened to become a serious problem, mainly as a result of industrial waste discharges, the old organization was also charged, on January 1st 1965, with the management of the water quality. Its region, now about 1,000 km$^2$, will shortly be extended to cover an area of 1,700 km$^2$ and to include about eighty municipalities with a total population of 730,000. The industry in the area causes a pollution of 500,000 population equivalents.

That part of the country is almost entirely below sea level, in places even as much as 5 metres. The water levels are controlled with the aid of a large number of pumping stations. Almost every day fresh water is taken in from the IJssel lake, previously called Zuiderzee, which was shut off from the North Sea in 1932 and is now an inland fresh-water lake taking its water mainly from the Rhine. Fresh-water intake to the region is necessary for water supply and for flushing natural stagnant waters. It also serves to abate salting and favourably influences the self-purifying capacity of the waters.

The organization includes an executive and a general committee which are formed by representatives of agriculture, industry and the municipalities involved. The Water Board has two official services, one administrative and the other technical, the latter including a scientific staff to carry out the necessary investigations - e.g. into the nature of the surface waters and of the waste water effluents, or into the possibilities of improving treatment processes — and to solve the numerous problems that may arise.
The competence of the Water Board includes:

a. enforcing the orders prohibiting the discharge of wastes into surface waters (the so-called licensing policy);
b. making provisions for the abatement of water pollution, e.g. by the construction and operation of sewage treatment plants (the so-called treatment policy);
c. levying charges on those who discharge wastes into the waters in proportion to the quantity and the nature of the wastes, etc. (the so-called charging policy).

3. *The application of competences*

a. The licensing policy

From January 1st 1965 on, the activities of the Water Board have been directed first of all towards persuading various industries to take measures aimed at discharging the smallest possible quantities of waste water with the lowest possible polluting effect. This policy was adopted for two reasons:

— the nuisance caused by industrial water pollution in many places had to be kept within bounds as soon as possible;
— setting up a master plan for pollution abatement (see under b) required an insight to the gained into the possibilities of limiting discharge of industrial wastes.

A striking fact to state here is that the vast majority of corporate officers were not aware of the volume and polluting effect of the waste effluents of their industries.
The actions taken achieved remarkable results. Within two years the volume of industrial discharges fell to about 50 % and after five years it had reached the level of 30 % of the original figure expressed as population equivalents. Meanwhile, reduction of pollution caused by industry as a result of measures taken within the industry has come to an end; owing to the growing production the population equivalent figure of the industry now tends to increase slowly again.

The preparedness of industries to reduce their waste effluents was strongly stimulated by the fact that the annual charge levied for financing water quality management is directly related to the volume and the nature of the effluent. This made it economically attractive for any industry to try and find a solution to the — sometimes quite difficult — problem of how to limit the amount of waste to be discharged. Not only the industries, but also the municipalities in the region require a permit to discharge waste waters through their central sewerage systems into surface water or a sewage treatment plant. Before such a permit is granted, the municipal sewerage sysem must satisfy certain conditions as to type and nature.

b. The treatment policy

To arrive at a justified plan, a waste water abatement project has been drawn up for the area (see figure 2) which describes:

— the existing situation;
— developments to be expected;
— requirements to be put to the quality of the water;
— measures to be taken (masterplan).

A prognosis of the expected increase of waste water production by the population and the industry is given in figure 3, which also indicates the phasing of the connection of

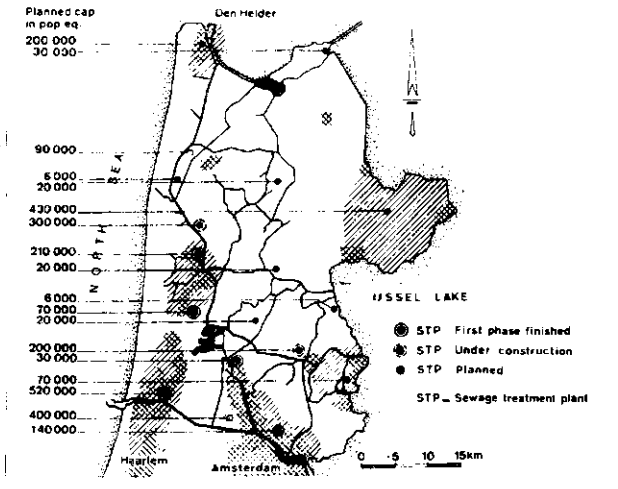


*Fig. 2 - Management area with sewage treatment plants according to master plan.*

waste water streams to sewage treatment plants, the utilization of the self-purifying capacity of the water for receiving non-treated waste water (from disperse buildings) and the effect of measures that have been — or will be — taken by industry.

The main quality requirements to be put to surface waters include the following:

— the oxygen content of the water should preferably exceed 5 mg/l (limit of favourable conditions) and not be lower than 3 mg/l (tolerance limit);

— the biochemical oxygen demand in five days at 20 °C ($BOD^{20}_5$) should preferably not be higher than 5 mg/l;

— the surface water must not contain harmful amounts of poisonous substances.

The area covered by the Water Board is surrounded by water: the North Sea to the west, the 'Wadden' (Shallows) Sea to the north, the IJssel lake to the east and the North Sea Canal, connecting Amsterdam to the North Sea, to the south. Through a system of canals running across the area water is discharged to the sea, directly or indirectly, with the aid of three pumping stations. In view of the interests of recreation and shellfish cultures, direct discharge of effluents to the west and the north is not allowed. Discharge into the IJssel lake should also be avoided. This is why the master plan is based on the principle that effluents from sewage treatment plants are discharged mainly to the south, i.e. the North Sea Canal, and to same main canals within the area. The master plan provides for the construction of 18 regional sewage treatment plants for a future total of 2.5 million population equivalents in 80 municipalities. Among the fourteen existing local municipal sewage treatment plants only four were found to fit in the master plan. For the estimated capital and operating budget of the plants to be installed the reader is referred to figure 4.

c. The charging policy

The costs involved in water pollution abatement by a regional agency can be subdivided as

1. costs for managing and operating sewage pumping stations, waste water mains and sewage treatment plants, including interest and depreciation of invested capitol;
2. a proportional part of the costs for forced flushing of the surface waters;
3. costs of management and administration.

According to the graph in figure 4 the costs under 1 will rise to about *fl.* 20,—, and the total costs also including those under 2 and 3 to over *fl.* 23,— per population equivalent per year.*)

These expences can be covered in various ways. In the present case a method has been chosen by which, in principle, the polluters pay the costs. This principle is attractive and justified for two reasons: not only does it associate the cause (pollution) with the consequence (treatment), but also has it become clear from practice that having to pay a charge makes an industry much more pollution-minded. This circumstance, combined with a strong licensing policy, may lead to a considerable reduction of the pollution and may often change a potential polluter into a practical partisan of water quality management. It is very important that the pollutancy of a waste effluent is determined in such a way that the same amount per year is paid per inhabitant and per corresponding industrial unit. To enable determination of the pollutancy in practice, use is made of a system based, among other factors, on the oxygen demand of the substances contained in the waste water and on the amount of settleable solids discharged. The pollution unit used is called population equivalent.

Past experience with the principle according to which the polluter pays in proportion to the pollution he causes has shown that in practice it is not possible to determine by measurements for every industry the pollutancy of their waste water discharges.

On the basis of a large number of measurements on industrial effluents various investigators (1) and agencies have therefore developed a system by which the pollutancy caused by several braches of industry is related to units of, for instance, production, base materials used or number of persons employed. This relationship is expressed as what is called a 'waste-water coefficient'. Multiplication of the above unit for a particular year with the waste-water coefficient gives the pollution caused by that particular industry.

*) *f* 20,— = circa U.S. $ 6.3; *f* 23,— = circa U.S. $ 7.2.

*Fig. 3 - Prognosis of waste water production in the management area and connected treatment measures.*

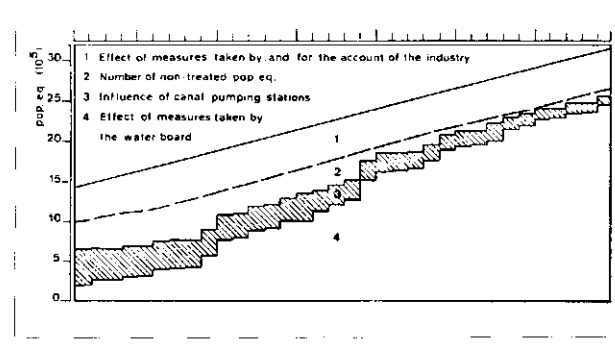


*Fig. 4 - Expected development of costs.*

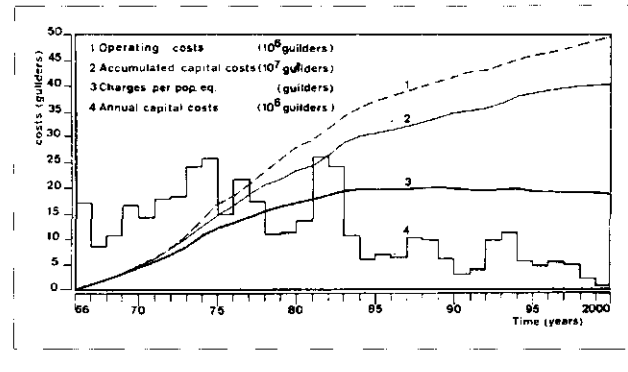

TABLE I

| Branch of industry | Unit to which refers the coefficient in the next column | Waste water coefficient |
|---|---|---|
| Brush making | Person employed | 3.5 |
| Vegetable washing | 1000 kg carrots | 0.09 |
| | 1000 kg onions | 0.4 |
| Glue factories | 1000 kg bone glue | 3.3 |
| Drum washing | $m^3$ of water used | 0.4 |
| Cattle-breeding | 1 cow, complete disch. | 10 |
| farms which discharge | 1 cow, liquid manure only | 3 |
| liquid manure and/or | 1 calf, goat or sheep | 1 |
| dung into surface | 1 pig, compl. discharge | 2 |
| waters | 1 pig, liq. man. only | 1 |
| | 1 chicken or other poultry | 0.1 |
| | 1 furred animal | 0.1 |
| Laundries | | |
| Wet cleaning | 1000 kg whitewear | 1.2 |
| | 1000 kg starched goods | 1.6 |
| | 1000 kg cotton prints, etc. | 2.0 |
| Dry cleaning | person employed | 0.5 |
| Clothes dyeing | $m^3$ of water used | 0.03 |
| Washerettes | $m^3$ of water used | 0.05 |

**Example:** A brush-making industry with 12 employees produces 12 x 3.5 = 42 population equivalents. A drum washing point which discharges 4500 $m^3$ of waste water per year produces 4500 x 0.4 = 1800 population equivalents.

Table I gives the waste-water coefficients for a number of selected industries.

At the request of an industry the pollutancy of its waste water can be determinated by measurements. This will be the case mainly for the larger industries. Large industrial polluters must sample their waste effluents themselves every day in a continuous-proportional way as prescribed by the Water Board, who carries out checking measurements at regular intervals.

For discharging domestic sewage a charge is levied, corresponding to the cost of 3.5 population equivalents per domestic entity. The Water Board now levies about 80,000 charges per year.

In the first year that charges were levied (1966) they amounted to fl. 2,50 per population equivalent. The largest polluter in the area thus had to pay over fl. 600,000,—. The charge has now risen to fl. 9.65 per population equivalent per year.

## Conclusions

The Netherlands surface waters are increasingly threatened by pollution from the population and the industry. An energetic and well-organised effort is urgently required to tackle the problem of waterpollution abatement.

The National Water Pollution Control Act opens the possibility of a well-organised water quality management. Its main features are that the Act prohibits the discharge of waste effluents without a permit and that the polluters have to bear the cost of all measures for abating the pollution of the surface water in proportion to the pollution they cause.

It is recommended to entrust this management and the authority to take measures as regards pollution abatement techniques to regional organizations covering large geographical areas. The application of the principle: the polluter pays in proportion to the pollution he causes, has a very favourable influence on the efforts to reduce industrial waste effluents by means of prohibitive measures.

### References

1. Wagner, H., „Bewertung von Abwassereinleitungen", Gesundheitsingenieur, 71, Jahrgang, 1950, Heft 5/6, Seite 73 - 87.