Managing Dutch Water

By Corine Otte and Stef Smits[1], January 2002

Abstract

The Netherlands are threatened by three water sources: rain, rivers and the sea. This article explores how the Dutch, through centuries of experiences, have learned how to manage these waters and how to do so in the future. Since medieval times regional water management is carried out by water boards. Their functioning is based on two basic principles: stakeholder involvement and democratic representation. Whereas water control has always been the main task of water boards, nowadays also water quality management and wastewater treatment are equally important. In the light of the current policies of Integrated Water Resources Management, water boards will be getting extra responsibilities and will need to coordinate their work more closely with other policy domains. Incorporating interests of stakeholders will remain the key-issue for managing Dutch water. This article is meant for foreign professional staff working in water management, interested to learn from the Dutch situation. The authors think the experiences with water management at regional level are most interesting in that respect. Major national infrastructural works such as land reclamation from the sea and the Delta Works therefore are beyond the scope of this paper. Unless stated otherwise, information is obtained from the official promotion material of the Dutch water boards (Unie van Waterschappen 1995; 2000).

Introduction

The Netherlands with an area of approximately 34,000 km^2 are physically characterized by two words: wet and flat. Annual precipitation in the Netherlands amounts up to 775 mm while evapotranspiration is only 501 mm (see Table 1). This and the fact that rainfall is evenly spread over the year, mean that the Dutch climate can be considered humid.

Figure 1: The Netherlands: below and above sea level.

The Netherlands are located in the delta of three European rivers: the Rhine, the Maas and the Schelde. As most deltaic areas, the Netherlands are flat and are full of rivers, creeks and, formerly, of lakes and swamps. The highest point of elevation is 321 m above sea level. Reclamation of swamps and lakes has resulted in one third of the Netherlands lying below sea level on reclaimed land. Figure 1 shows this situation. The western part is the area below sea level.

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The combination of rainfall excess and flat lands makes large parts of the Netherlands susceptible to inundations. As can be seen in Table 1 the rivers are used to get rid of the rainfall excess. A large system of water courses and pumps exist to get the rainfall into the rivers. However, rivers also pose a threat. The river discharge is quite high, as can be seen below, with peak discharges for the river Rhine of about 10,000 m^3/s. Dikes and floodplains prevent the rivers from causing flooding of inhabited areas. The necessity of the dikes was made clear in December 1993 and the winter of 1995. Due to extremely high water levels in the Maas, heavy rainfall, and no dikes to protect the people, serious floods occurred in Limburg. More than 250,000 inhabitants and millions of livestock had to be evacuated. This disaster resulted in a call for more rapid dike enforcement (Unie van Waterschappen 1995).

Table 1: Water balance of the Netherlands in an average year.

		Volume (km^3)	*Layer (mm)*	*Average flow (m^3/s)*
Inflow:				
	Precipitation	30.1	775	
	Rhine	69.0		2,188
	Maas	8.4		266
	Other rivers	3.0		95
	Total	110.5		
Outflow:				
	Evapotranspiration	19.5	501	
	Domestic and industrial use	5.0		
	River discharge	86.0		2,727
	Total	110.5		

Adapted from: van Hoorn, 1994

Last but not least there is an inundation risk by the sea. The dunes, dikes and dams protect the areas of the Netherlands that lie below sea level.

Past

When the first people arrived in the Netherlands, they found swampy land. In the western part of the Netherlands, people could only live safely on the higher parts. As the naturally occurring high ground was gradually brought into use and, the number of people increased, people built small artificial hills, (*terpen* in Dutch) to live on. A *terp* was people's private property and the owner himself took care of its maintenance. A closed earth wall (*ringdijk* in Dutch) around a group of *terps* to protect the houses and land from the water became more interesting as more *terps* were built. With the start of the *ringdijks* therefore the individual system shifted to a collective system with a high degree of social control. If someone of the community neglected his responsibility for maintaining the earth wall, the sea could break through at high tide, flooding everyone (Bosma and Wissink, 2001).

As population increased further, from the 10^{th} century onwards, it became vital to connect the hills with dikes and protect the land behind it from the sea and rivers. Due to exploitation of peat soils many lakes came into being. People succeeded in reclaiming these lakes as well and keeping them dry by pumping out excess rainfall by means of newly invented windmills (for the functioning see Figure 2). By doing so, the land became permanently inhabitable. These lands were called *polders*. Such kinds of works required collective action and organization. Communities elected governors to promote their interests, including water management. The

farmers and land owners executed the water management tasks, such as maintenance of canals and dikes (Bosma and Wissink, 2001).

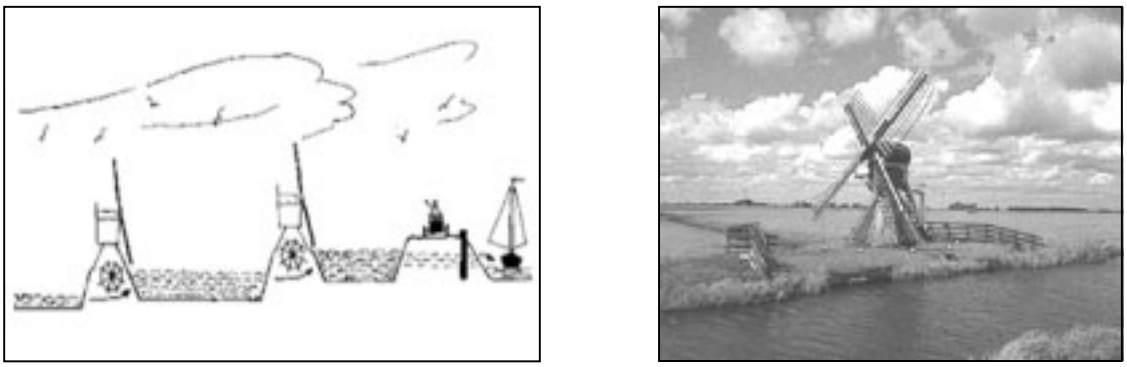

Figure 2: Cross-section of the polder system and a windmill in a polder landscape (Poldermuseum Gemaal de Hooge Boezem, 2002)

Water does not flow according to communal boundaries and management of it often demanded for inter-communal cooperation. In the 13th century the inter-communal cooperation was achieved by the establishment of *waterschappen* (water boards). These were responsible for the water control in their region, and often encompassed several communities. In particular, one had to build and improve the dikes constantly to protect them against the water. This required large efforts and investments of the population in the form of labour and assets, like horses (Unie van Waterschappen 1995; 2000).

The water boards were the first democratic institution in the Netherlands. The communities elected the governing body and participated in the day-to-day water management tasks. The costs of the water board were covered by all inhabitants, as all inhabitants had an interest in water management. Accountability was created through a system of election and participation in decision-making. While democracy did not exist in respect to other aspects of life, it did with regard to water management, as this was crucial for survival in the wet lowlands (Bosma and Wissink, 2001).

The number of water boards increased from about 700 in the 13th century to some 3,500 in the 19th century, so each *polder* had its own water board. The main tasks remained flood protection and water level control through artificial drainage. As populations grew, distance between the people and water management executers grew as well. Whereas in the beginning of medieval times, direct participation of individuals was still large, as time went on more and more tasks were externalised to specialists in the water boards, although these remained accountable to those they served. Many people had become unaware of all activities needed to keep out the water (Bosma and Wissink, 2001).

In 1953, the Dutch population became aware of the dangers of the water in a shocking way. In two of the provinces, Zeeland and Zuid-Holland, dikes broke and many people drowned. Before this national disaster it was already realised that the number of water boards had to decrease because the large number of small water boards was not capable of effectively fulfilling all their tasks. The process of centralisation prior to the disaster meant that by 1950 there were ‘only’

about 2500 water boards. The disaster made the process move rapidly. The number of water boards was further reduced by merging them. In 1955 only 88 water boards were left. In the year 2000 there were 57 water boards, which will further reduce to 45 water boards in 2002.

When the Surface Water Pollution Act came into force in 1970, the tasks of the water board were extended to water quality control. This additional task was the result of many discussions about the treatment of polluted water. Also, managing the dropping groundwater table, maintaining the natural environment and provision of recreation were added to the tasks of the water boards. In other words, the management of water became more aimed on coherent control of surface water and groundwater. This is known as Integrated Water Resources Management. The extensions of tasks also implied involvement of more stakeholders. Although more stakeholders have become involved and the number of tasks has extended, the organisational structure has not changed a lot since the water boards were first established (Bosma and Wissink, 2001).

Present

To understand how regional water management functions firstly the organisation of the water board and its actors are outlined and visualised in figure 3. After this the policies, which influence the organisation of the water boards are dealt with, and the different tasks of the water boards are explained. Finally, the finances of the water board are outlined, followed by a paragraph about how the water boards are supported.

Organisation and actors

Nowadays, a water board is a regional level elected government institution overseen by the democratically chosen provincial authorities. Each water board is responsible for the essential aspects of water management in a given area defined by a “natural” water system and not by historical or cultural border.

The governing body of the water board consists of a general council, an executive body and a chairman (called *dijkgraaf*). The general council is made of elected and appointed representatives. The representatives are chosen by the tax payers once every four years. The general council appoints by and from itself an executive body. The chairman is appointed by the Crown[2]. The period of office of all board members is between 4 to 6 years. The composition of the general council is organised in such a way that all stakeholder groups are represented (see figure 2). Landowners (farmers) and property owners elect their representatives directly. This means in practice that per land or property owning households only one vote can be made. In many cases land or property is officially on the husbands’ name. Gender equity is thus not specifically addressed in the Dutch sector. Residents (whether or not they own property) are considered a different interest group and are represented indirectly by appointees from the municipalities, which they live in, in the water board. These also secure other interests of the municipalities that lie within the area of a water board. Those that own the house they live in, are represented twice; once directly via elections and once indirectly via the municipality.

To complicate things further, in some areas residents directly vote for their representatives. This depends on the traditional rules of the water board in each area. Other special interest groups like

[2] The Crown is the assembly of the Dutch Government and the Queen.

nature conservation organisations or wastewater discharging industries are represented as well on basis of appointees. In this way, a balance is found in representation. The governing board is supported by a technical and administrative service section, whose staff members are all public servants. In total about 9,000 people work for the water boards in the Netherlands.

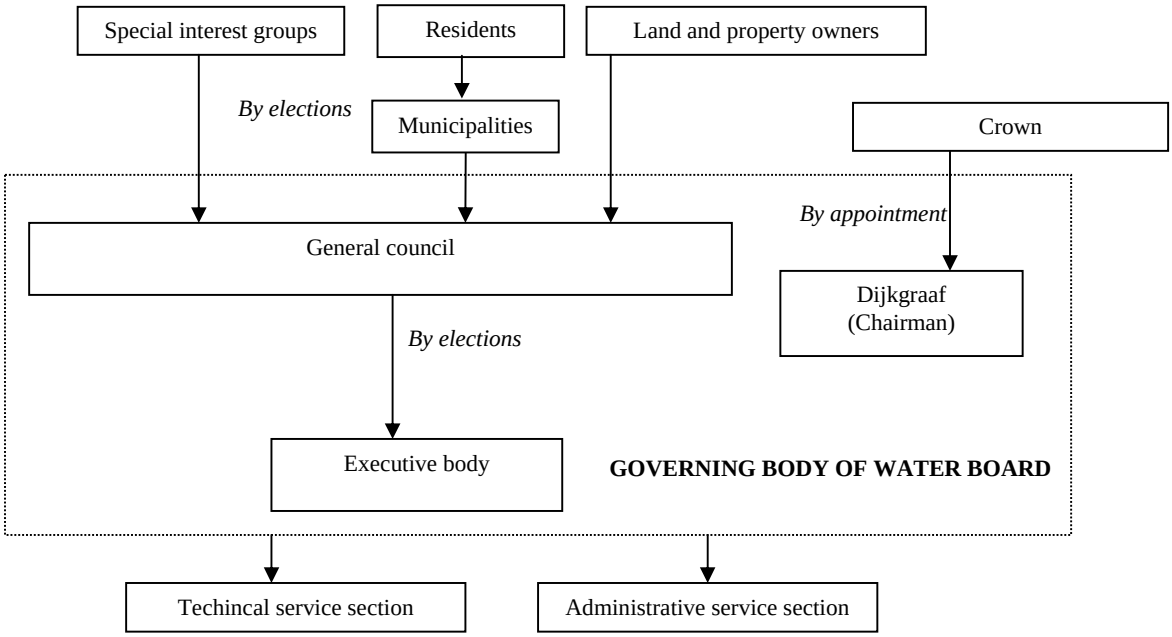

Figure 3: Organogram of water board

By means of representation and election, accountability between service providers and receivers is ensured. However, this form is very indirect and in practice the majority of Dutch inhabitants is not at all aware of water management tasks done by the water boards. Only 20-25 % of the persons that have a right to vote actually do so. Only those dealing directly and daily with water issues, like farmers, are seriously involved and have regular contact with water board staff. To create transparency, water boards are obliged to inform citizens about their activities and planned policies. The water boards organise, for example, meetings for citizens to explain their plans and to hear their voices. In this way it is hoped to increase public commitment and more careful use of water.

Although this article focuses on regional water management, it is important to outline the water management at higher levels, as this sets the limits in which water boards can carry out their tasks. The central government manages the large rivers, lakes, estuaries and coastal seas. It also sets the broad policies for water management. The provincial government sets more specific policy objectives. This can be seen as the framework for water boards to operate in. The province also controls the work of the water boards. There is thus a clear separation of regulation and service provision tasks. Besides, provincial authorities are responsible for groundwater management. Drinking water is provided for by drinking water supply companies[3]. The authority of water boards thus only lies with surface waters and only within the broad policy guidelines set

[3] One can read more about the drinking water sector in the Netherlands in the article ‘Drinking Dutch Water’, written by Boom and de Vreede, 2002.

by the national and provincial governments. Changes are ahead in this set-up and will be discussed in the last paragraph.

Policies

As made clear above, national and provincial governments have an important task in setting water management policies. Integrated Water Resource Management (IWRM) is increasingly becoming important in these policies. This means that the links between quantity and quality of surface and groundwater are recognized and taken into account in water management. IWRM in its turn relates to other policy areas like land use planning, urban development and environmental protection. Provincial authorities try to coordinate water management policies with these other policy areas, while water boards coordinate water management policies. Also *Commissie WB21*[4] re-emphasised the need for open and integrated decision making, not only within water management, but also with other policy domains (Commissie WB21, 2001).

Next to this general policy guideline, several national and international policy acts are of importance. First of all, the *Water Authorities Act* outlines the responsibilities for water management of the different authorities. It also sets the regulations for representation of interest groups in water boards. Secondly, two major Acts with respect to water control are the *Delta Act* and the *Major Rivers Delta Plan*. These give the guidelines for enduring safety from the sea in the delta areas and from the lands bordering the large rivers.

For water *quality* management, the most important policy act is the *Surface Water Pollution Act*, already dating from 1970. This Act states that all discharging of pollutants requires a permit. It also includes the principle of "the polluter pays". Officially, the responsibility for executing this act lies with provincial authorities. Nowadays, however, this task is delegated to water boards or *zuiveringschappen* (purification boards), which are water boards concerned only with water quality.

In 1999 the European Parliament approved the *Water Guidelines*. The establishment of river basin authorities is one of the most important recommendations of the guideline. These authorities would have to be responsible for the quality and quantity of the ground and surface water for a whole basin. In future the Netherlands might have to accomplish these recommendations and change water boards into river basin authorities. When and how this will take place remains to be seen. One thing is sure, European legislation will increasingly influence Dutch water management (Bosma and Wissink, 2001).

Tasks of the water board

Which tasks are carried out by a given water board depends on the local situation in which the water board finds itself. Not all water boards execute all tasks. Today a water board can execute the tasks, which are given below.

- Water control
  The provision of protection against flooding by means of dunes, dikes and canals.

[4] *Commission WB21* is a temporally established commission to give advice over the organisation of water management in the Netherlands in the 21st century.

- Water quantity management
  The management of the water to ensure that it is kept at the right level
- Water quality management and treatment of waste water
  The combating of water pollution and the improvement of the quality of the surface water
- Other tasks
  Some water boards handle also other related aspects of water management like road and waterway maintenance

As said above, next to water boards, purification boards also exist. They only execute water quality management tasks. Increasingly, in reorganisations water boards and purification boards are joined into water boards with an extended package of tasks.

Water control

Water control is understood as protecting people, animals, land and property against flooding. This means that water boards have to monitor the state of all dikes, dunes and flood barriers and maintain and re-strengthen them, if necessary. In addition, the water board are responsible for protecting the dikes against damage by third parties. This is sometimes a difficult task if the 'third' party does not have natural enemies, like in the case of the muskrat.

> *A long time ago, this North American animal was introduced for its beautiful fur but its introduction had and still has serious consequences for the Netherlands. The muskrat is fanatic burrier, who likes to make a giant system of burrows, preferably in the dikes. The dikes become weakened by the burrows. As the muskrat does not have a natural enemy in the Netherlands, the water boards are responsible for controlling this destructive animal. Luckily the water boards have the problem under control; each year they catch and destroy 300,000 of these animals, half of their population. Any damage to a dike must be repaired as quickly as possible.*

Water control is an enormous and essential task. The total length of dikes in the Netherlands is about 3,000 kilometres. Not all of them can be raised unlimitedly because of the enormous costs involved and competition for space with other uses, like nature or housing. Alternatives for raising dikes are being sought, like creating buffer zones and the Maaslandkering[5].

Water quantity management

Water quantity management in the Netherlands is mainly achieved by means of water level control. A distinction must be made between the slightly higher areas of the Netherlands and the lower parts.

In the higher parts, water courses and ditches evacuate water by gravity in case of excess rain. During the dry summer months, water level is kept artificially high in these water courses by means of weirs and dams. By maintaining a high water level in the ditches, the level of the shallow groundwater is influenced in such a way that it is able to provide crops with sufficient water. Through this sub-irrigation, the need for extracting deep groundwater by pumping is reduced.

[5] The Maaslandkering is an open dam in the Nieuwe Waterweg that is only closed in times of extremely high tide. In this way the Rotterdam area is protected in these occasions, without having to raise the dikes in this city. For more information see Ministry of Transport, Public Works and Water Management (2002).

In the lower parts throughout the year water needs to be evacuated by means of pumping. Near the coast however, sometimes extra fresh water must be let into the polders to prevent subsurface sea water intrusion. In both cases, for different periods of the year and for different uses, water levels are established by the water boards, known as Target Water Level Ordinances. As different uses require different water levels, conflicts can and do arise between these uses. Provinces set the functions of different water sources for different uses. These are translated into a management plan by the water board.

Another task within water quantity management is the maintenance of the water course, which has to be in good condition to ensure the supply and drainage of water. The water boards usually maintain the larger watercourses, while the smaller ones are generally maintained by the owner or user of the land bordering the water. Maintenance mainly involves the removal of plants from the canal slopes. For environmental reasons the water boards try to avoid the use of herbicides, instead biological methods are preferred like the release of Chinese carp which eat water plant in large quantities.

Water quality management

Water quality management not only means ensuring water quality that is high enough for possible conversion into drinking water or use in agriculture or industry; increasingly it means that it meets quality requirements for ecosystem functions. Nevertheless, water quality management continues to involve mainly waste water treatment from cities and industries and issuing strict permits for point source pollution. With the focus on ecosystem quality, non-point source pollution needs further action. This diffuse form of pollution occurs via leaching of fertiliser, deposits from acid rain and leaking from ships.

The diffuse nature of non-point source pollution makes it very difficult to control. Co-operation with other government bodies is needed. An example of this is the recent attempts to reduce eutrophication by nitrogen. Nitrogen is leached from fertilizers and manure by rain and ends up in shallow groundwater and surface waters. This affects algae growth and can change ecosystems in ditches and brooks. It is very difficult to trace the exact origins of pollution and strict water management measures are not effective. Efforts are focussing on reducing of fertilisation and better timing of fertilisation.

Road and waterway maintenance

In some of the water boards, secondary roads and waterways have to be maintained. This is not a major task however because in general the municipalities and provinces take care of the roads.

Finances

The water board finances its expenditure entirely from taxes, which are decided according to use category. Five categories of tax payers are distinguished: owners of built-up land, owners of un-built land, inhabitants, tenants and businesses. Some people have to pay several taxes (e.g. tax for the house, tax for the land, tax for a household as a whole and tax per household member). The rate of taxes depends on the degree of service but is determined on a cost allocation system. For example, those with more land pay more for water level control, and larger households pay more for waste water treatment. In addition inhabitants who live under the Dutch poverty line do not

have to pay the taxes. Tax rate differs between regions; however, for an average household the taxes equal an amount of € 115 per year.

The budget of all water boards together is € 2.5 billion. Of this amount € 1.8 billion goes into operation and maintenance costs and € 0.7 billion into capital investments like dike reinforcements.

Support

Water boards are supported by and cooperate with research institutes and Universities. Special study programs at Universities can prepare people for jobs at the water boards. Through this, human capacity of water boards is guaranteed.

All 57 water board are organised in the Union of Water Boards. This union has several tasks. For example it tries to deal with issues that are common to all water boards, like legislation and it functions as the voice of the water boards to committees and work group, which are set up by the government to give advice for their policy (like the previously mentioned *commissie WB21*). The union works closely with water authorities abroad. Activities in this context include excursions and advisory missions to share their knowledge and experiences.

Future

The future will provide Dutch water resources management with some important challenges. These can be clarified after reading the case study of one of the oldest water boards of the Netherlands, called Hoogheemraadschap Delfland.

> *Delfland is the area around Delft, between Rotterdam and The Hague. In the last years several inundations have occurred in this region. These occurred in periods of extremely high rainfall. The frequency of occurrence of extreme rainfall events has increased. At the same time the storage capacity in the soil and water courses has decreased. This means that rainfall has to be evacuated more quickly out of the polder, but pumping capacity for that is not sufficiently available. Increasing the pumping capacity and buffering capacity of the water courses is one of the solutions for preventing future inundations. More importantly, efforts have been made to stop the decrease and even increase storage capacity. The decrease has occurred as a result of rapid urban expansion and greenhouse construction. The water board now seeks better co-ordination with provincial and municipal authorities to regulate urban expansion so that storage capacity does not decrease. Water boards now have to approve building plans and these plans should contain mitigating measures, like infiltration zones and the construction of ditches and ponds in the neighbourhoods. Not only municipalities and provincial authorities are involved in these new plans. All concerned parties are involved in the planning process and decision making. Next to that communication and awareness raising activities are held.*

This case shows that the water boards face both organisational and technical challenges. Most of these challenges are resulting from new visions and policies on integrated water management, like the advice given by *Commissie WB21* (see the earlier section on policies).

Organisational challenges

The case from Delfland shows that integrated water management includes co-ordination between water policies and other policy domains like on urban planning. This integration and coordination of policies was one of the most important points articulated by *Commissie WB21*. Although the

interests of the people are already covered by democratically elected entities like water boards, special participatory meetings are often held to further involve stakeholders in spatial planning.

Integrated water resources management also includes integration of surface and groundwater resources. A logical step therefore is the transfer of groundwater management from provincial authorities to water boards, which will probably take place in the nearby future. In many cases groundwater and surface management are so much interlinked that the separation of responsibilities is counter-productive. This in its turn will increase the need for cooperation between water boards and water supply companies, which now deal mainly with provincial authorities. Probably, provinces will keep a controlling function, while the water board gets the management function.

This shift of responsibilities coincides with the current trend to bring together *all* water management tasks under the authority of one water board. An example of that is the before mentioned merging of water boards and purification boards into larger bodies with an extended set of tasks. Next to that, some water boards are being merged in order to improve their capacity. This process is now nearly ended.

Technical challenges

Not only in Delfland are technical challenges at stake. In many areas storage capacity has decreased due to urban expansion, resulting in the need for increased buffering capacity of water courses and increased capacity of pumps. Next to that a rise in river discharge is expected, due to climatic change. This rise can be mitigated by using the floodplains. However, also here urban expansion takes place. Alternatives for increasing floodplain buffering capacity are looked for. These include emergency polders (polders without inhabitants that are deliberately flooded in case of emergency) and creating more space for water courses and rivers. In other areas, water boards are increasingly being involved in combating groundwater over extraction and the resulting loss of nature. On national level, a possible rise of the sea level will pose a major threat.

To face these challenges a combination of knowledge and experience and stakeholder involvement are considered essential. These are provided for by the organisational structure of water management and the support and capacities, built up during the course of time. The continuous fight with the water is best reflected by the coat of arms of the Province of Zeeland “luctor et emergo”: I struggle and will survive.

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