Financing Water Resources Management in the Netherlands

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Colofon

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PART 1. SETTING THE SCENE – COUNTRY CONTEXT, POLICIES AND INSTITUTIONS

1.1 GEOGRAPHY OF THE NETHERLANDS[1]

The Netherlands is situated along the North sea in north-western Europe. The Netherlands consists of a land area of approximately 34.000 km^2. The total territory, including inland waters, amounts 41.160 km^2. About 30 percent of the Netherlands is situated below mean sea level, and 50 percent of the country is vulnerable to flooding. The lowest point is 6.7 metres below sea level. More than 70 percent of the GDP of the Netherlands is generated below sea level, and this is also where most of the population lives.

The Netherlands lies in the delta of the rivers Rhine, Meuse, Scheldt en Ems and is one of the 40 worlds largest deltas. Fifty million people live in the basins of these four rivers in Belgium, Germany and the Netherlands. The Dutch delta is similar to deltas such as the Nile in Cairo, the Mississippi in New Orleans and the Yangtze in Shanghai. The Netherlands has a waterway network of 3500 km of rivers and canals to transport goods.

Besides the Delta character of the Netherlands, the country is frequently associated with polders. A polder is a low-lying tract of land enclosed by embankments known as dikes, which forms an artificial hydrological entity. The first polders were constructed in the 11^{tg} century. The Dutch have a long history of reclaiming marshes and fenland, resulting in over 3.000 polders nationwide (see also §2.2). About half of the polder surface within northwest Europe is located within the Netherlands.

Soil map of the Netherlands: high grounds with wind-borne sand deposits drain into low-lying grounds with Holocene deposits

Figure 1| Soil map of the Netherlands ((source: Arnold et al, 2009)

Facts and Figures

- The name 'Netherlands' literally means 'low countries' ('Holland' is actually just an area within the country, now divided into the two provinces of North Holland and South Holland.)
- The total area of the country is about 41,000 km This breaks down into:
  - 17% water
  - 58% agriculture
  - 14% urban areas
  - 11% nature and woodland.
- Over 30% of the country is below sea level.
- 50% of the land area is vulnerable to flooding from the sea or rivers.
- The population is around 16 million (470 per km2: one of the highest national densities in the world). The highest concentrations are in the low-lying urban areas in the west of the country.

[1] Text largely derived from Unie van Waterschappen, *Netherlands Case Study Report: Climate Change and Dutch Water Management,* The Hague. Picture derived from Arnold et al, 2009.

1.2 BRIEF HISTORY OF THE DUTCH WATER MANAGEMENT[2]

The history of Dutch water management started approximately in the 9th century. The period until the 13th century is marked by loss of big portions of land. At that time the only defence against floods was to live on higher dwelling places, called 'terpen'. However, gradually we became more enterprising. Reclamation of peatlands started in the west of the Netherlands, causing a considerable drop in water level, and consequently subsiding lands. Especially these lands below sea level were threatened by floods from the sea. Regular floods claimed many victims and continued to do so for centuries, for instance in 1421, when tens of thousands of people died in the great St. Elizabeth Deluge.

But the Dutch fought back, conquering water by building dikes for the peatlands as well as for the densely populated clayey areas inland. The introduction of the mill between 1250 and 1600 came just in time to ensure a continuous use of the subsiding agricultural land and was also used for the drainage of lakes. At the same time it was costly to maintain the dikes and sluices. To share the costs of maintenance, community groups were established, which were the predecessors of the later water boards. In such a community, every farmer was responsible for a certain part of the dike. In a later period the waterboards started to maintain the dikes themselves to ensure a certain quality, and the farmers paid water taxes (see § 1.3).

Even after the Middle Ages, sea levels continued to rise and land continued to sink. Dikes had to be raised continually. But water management at times also took the offensive: in the early 17th century, the Dutch started draining the lakes and ponds that had been created by extracting peat. The last of the inland lake reclamation projects, Haarlemmermeer, was drained around 1850. By then, powerful steam-driven pumping stations had been developed that enabled draining this large lake.

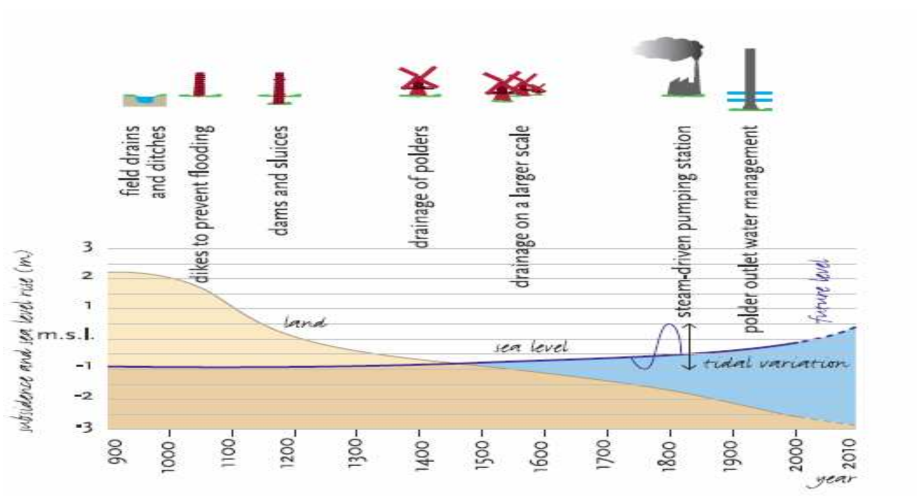

Figure 2| Overview of the history of Dutch Water Management (source: Arnold et al, 2009)

[2] Text is largely derived from Arnold et al (2009) and from www.waterland.net

Yet the war against water had not been won and water continued to lay claim to the land every now and again, e.g. during the catastrophic floods of 1953. The Flood Disaster in 1953 was a rude awakening for the country. The fatal combination of a north-westerly storm and spring tide resulted in the inundation of large parts of the provinces of Zeeland and South Holland. Over 1800 people died and the flood caused enormous damage to houses and property. Only one conclusion could be drawn: the country was not safe. Measures to prevent a repetition of the disaster were put forward in the form of the Delta Plan. The dikes in Zeeland and South Holland had to be raised to delta level: they had to be capable of withstanding storm surges as much as one and a half metres higher than those during the notorious storm in 1953.

The Dutch built the Delta Works and gained a reputation as a country that had won the war against water, rescuing a large part of its territory from its grasp. However, in 1993 and 1995 the Netherlands were faced again with floods, however this time the danger came from the rivers. Due to climate change, more melting- and rainwater was coming from the areas upstream. A new approach to water management was needed. Instead of a continued increase in height and size of dikes, possibilities have been explored over the past years to make more space for water. This lead to the implementation of the programme 'Room for the Rivers' (in Dutch: *Ruimte voor de Rivieren*). Room for the river is an alternative water safety solution in which the river will be given more room at 39 locations.

1.3 The institutional structure of Dutch water resource management[3]

National level

On national level, the state is responsible for infrastructure, flood defence and the water quality of state managed waters. This includes the major rivers which are part of international river basin districts as well as the Dutch part of the North Sea. The state is financed from the general budget (national security as public good). In the case of state-managed waters, Rijkswaterstaat is responsible for implementation. A number of government ministries are involved in policy-making and implementation in relation to different aspects of water management:

Regional level

On regional level, there are 27 regional water boards. These water boards are responsible for regional water quantity management ("dry feet"), water quality management (e.g. sewage treatment), and land reclamation. The water boards are democratically chosen and can finance their water management activities using own levies (e.g. surface water levies and water quantity charges). These levies should not be more than required to cover the costs since water boards are not allowed to make profits. At the same time, revenues should be enough to cover the costs, since no funds are available to cover losses.

Besides water boards, there are also 12 democratically chosen provinces. The provinces are responsible for groundwater management, which they can finance by charging a groundwater levy. Furthermore, each province draws up regional water management plans (increasingly as part of integrated environmental/spatial plans) and they supervise water management by the municipal authorities and water boards.

Local level

There are more than 400 municipalities in the Netherlands. These municipalities are democratically chosen and they are responsible for sewerage (provision, maintenance and operation of the sewage system) and groundwater quantity in cities. However, the water boards are responsible for the sewage treatment (except in the case of industrial plants with their own treatment facilities). Municipalities can charge citizens a sewerage levy, to pay for costs related to sewerage, but they can also use money from the public budget for this purpose. Finally, drinking water supply is in the hands of 10 drinking water supply companies, ownership of which is shared between various public authorities (provinces and municipalities).

[3] Text is largely derived from Arnold et al (2009) and Bouma et al (1999)

Water management a perfect example of the Polder model

In the Netherlands many different parties - government ministries, regional and local administrations, regional water boards, drinking water supply companies, NGO's, knowledge institutions and private parties - are all actively involved in water management. The way Dutch water policy is formulated and implemented is a perfect example of the Dutch 'polder model.' The Dutch 'polder model' is based on a broad consultative structure aimed at reaching consensus between all stakeholders through a bottom-up approach and decision-making on all levels. Consultations take place at all levels of government (national, provincial and local: the latter including both municipalities and water boards), at all stages (policy preparation, formulation and implementation) and with both strategic and operational objectives. As a result, the policy formulation process involves a whole network of consultative bodies in both the public and the private sector.

1.4 Policies for present and future water management challenges[4]

The Netherlands is getting wetter, dryer and saltier due to climate change. The sea level is rising, while rainfall is getting heavier at times (especially in winters), but it may also at other times hold off much longer (in summer periods). Soil subsidence continues, due to both geological influences (oxidation of peat) and human activities (gas extraction and soil settling). Land use is changing as well, the economic sectors are continuously changing and, socially speaking, new demands are made on water (e.g. economic growth and demographic developments result in ageing population with increasing demand for more living space and recreational facilities resulting in urbanisation and increased pressures on space and water). All this can hardly indicate anything else than the necessity for a change in water management and water use.

The changes ahead of us prompt the question whether our water system will still function effectively in the future. The search for a more 'climate-proof' design of our water management system will be continued in countless plans and projects over the coming years. These studies and projects will be based on several key policy and management documents. The most important ones are the Delta Programme, the National Water Plan, and the Management and Development Plan for National Waterways. These plans accommodate each other with respect to content and process.

Delta Programme

In September 2008, before the publication of the first National Water Plan, the second Delta Committee issued its report 'Working with Water'. The committee issued twelve recommendations intended to face the threat of an excess of sea and river water and to safeguard freshwater supply in the long term. These recommendations are elaborated in a Delta Programme and will lead to decisions concerning safety and water distribution. In the Committee's view, all of the Netherlands must remain an attractive country in which to live, work, invest and take leisure. The two pillars on which the water strategy must rest in the coming centuries are safety and sustainability.

National Water Plan

The National Water Plan is the official government water policy plan. A key point of departure is 'sustainable water management'. The underlying principle is to 'go with the flow of natural processes where possible, offer resistance where necessary and seize opportunities to foster prosperity and well-being'. In order to achieve this, water will have to gain greater significance in spatial development. While the National Water Plan upholds much of the policy from the previous National Policy Documents on Water Management, a new element is that with respect to spatial aspects this plan is also a framework vision based on the Spatial Planning Act. Moreover, this national plan looks much further ahead in order to arrive at a 'climate-proof' approach. The National Water Plan has come into effect at the end of 2009. The regional water plans and regional water management plans are the responsibility of provinces and water boards.

[4] Text is largely derived from Arnold et al (2009) and Bouma et al (1999)

Management and Development Plan for National Waterways

This plan describes how Rijkswaterstaat will manage the national waterways between 2010 and 2015. It combines the measures necessary to achieve the goals stipulated in the Water Framework Directive with those required for Water Management in the 21st century (in Dutch: "Waterbeheer 21ste eeuw," a Dutch policy document oriented towards water quantity management) and Natura 2000 (European Nature protection policies).

CHAPTER 2| FINANCING OF WATER MANAGEMENT[5]

The central government, provinces, water boards and municipal councils are investing approximately €6.1 billion (2009) annually in the protection of the Netherlands from flooding, waterlogging and drought, the improvement of water quality, the transport and purification of urban wastewater, and the maintenance of waterways. Almost one-third of all these costs are funded by the government, the remaining costs (circa €4 billion) are being covered by levying local taxes by the water boards, municipal councils and, to a lesser extent, the provinces (see table 1).

The costs of water management increased significantly the past decade. In 1998, the first year of the Fourth National Policy Document on Water Management, the total costs were approximately €3.2 billion (see table 1). In 2005, this increased until approximately €4.9 billion, while in 2007 the total costs of water management ran to circa €5.1 billion. Since 2000, the total local costs have risen annually by roughly 4%, while municipal sewerage charges have risen by about 7% a year. The increase in the water system and purification levies is 2-3% a year. Government costs have risen by approximately 3% per annum.

The costs for water management are expected to increase further in the comings years. The total costs are expected to be approximately €6.2 billion in 2015. The exact development of the local costs is difficult to predict, but it is possible to describe a number of developments that will influence it. For instance, additional expenditures on management and maintenance on flood safety, additional measures related to the European Water Framework Directive (WFD) to improve water quality and an increase in municipal sewerage costs due to replacement of sewerage systems. Table 1 shows a minor increase of annual costs between 2009 and 2015.

Table 1 also shows a shift in the distribution of the costs between the government, provinces, municipalities councils and the water boards. The share of expenditures in the total annual costs of the government (Ministry of Public Works, Transport and Water Management) increased from 25 percent in 2005 to 34 percent in 2009. In contrast, the water boards share decreased from 49 percent to 43 percent between 2005 and 2009. The municipalities share also declined. However, the municipality share is expected to increase in the future from 20 percent in 2009 to 29 percent in 2015, while the share of the government is expected to decrease. The remaining of this chapter will discuss the annual costs of water management in more detail.

Table 1|Overview of annual costs of water management in the Netherlands

	1998	**2005**	**2007**	**2009**	**2015**
Government (V&W)[1]	900	1.200	1.405	2.067	1.516
Provinces[2]	96	150	165	205	197
Municipal councils[3]	560	1.100	1.100	1.225	1.800
Water boards	1.660	2.400	2.453	2.620	2.661
Total	**3.216**	**4.850**	**5.123**	**6.117**	**6.174**

Source: Nationaal Waterplan, 2009; Water in Beeld, 1999, 2008, 2010

1 Excluding the €800 million set aside in the Coalition Agreement for 2008-2015 but not yet allocated.

2 In 2007, the provincial contribution was 3%. Costs in 1998 are unknown. The percentage has been set at a fictitious 3%.

3 Uncertainties in estimating the sewerage costs have been addressed in a letter from the State Secretary for Housing,Spatial Planning and the Environment to the Lower House (TK 2005–2006, 28 966 and 30 300 B, no. 6).

[5] Text is largely derived from Water in Beeld, 2010 and Nationaal Waterplan, 2009.

2.1 EXPENDITURES OF THE MINISTRY OF PUBLIC WORKS, TRANSPORT AND WATER MANAGEMENT

The state is responsible for the infrastructure, flood defence and water quality of the state managed waters. The state managed waters include the major rivers which are part of international river basin districts and the Dutch part of the North Sea (except the coastal zone which is the responsibility of the provinces and municipal councils). The total costs of the water management are financed from the general budget. In 2009, the Ministry of Public Works, Transport and Water Management has spent more than 2 billion euros on water activities (see figure 3). The expenditures rose on average with 21 percent per annum in the period 2006-2009.

One of the reasons for this increase was the increased cost of the project 'Room for the River.' Room for the river is an alternative water safety solution in which the river will be given more room. The main objectives of this programme are to complete the flood protection measures by 2015 and to improve the overall environmental quality in the river region. Also the costs of the Flood Protection Programme increased significantly. The Flood Protection Programme consists of improvement measures for the primary flood protection system. Every five years (since the *Waterwet* every six years), the hydraulic situation of The Netherlands' primary flood protection structures are checked and measures are taken when necessary.

Figure 3 shows the total annual costs of water management for the Ministry of Public Works, Transport and Water Management. The figure clearly shows a significant increase in the total expenditures. In 2001, the total annual costs amounted €1.2 billion, while in 2005 this increased to €1.4 billion. In 2009, it rose to almost €2.1 billion; an increase of 68 percent compared to 2001. The coming years the expenditures for the government are expected to decrease. Notice furthermore that the majority of the costs are related to the maintenance of the water system. In 2009, 61 percent of the expenditures were related to the cost of water management, while the remaining budget was used for improving the water barriers.

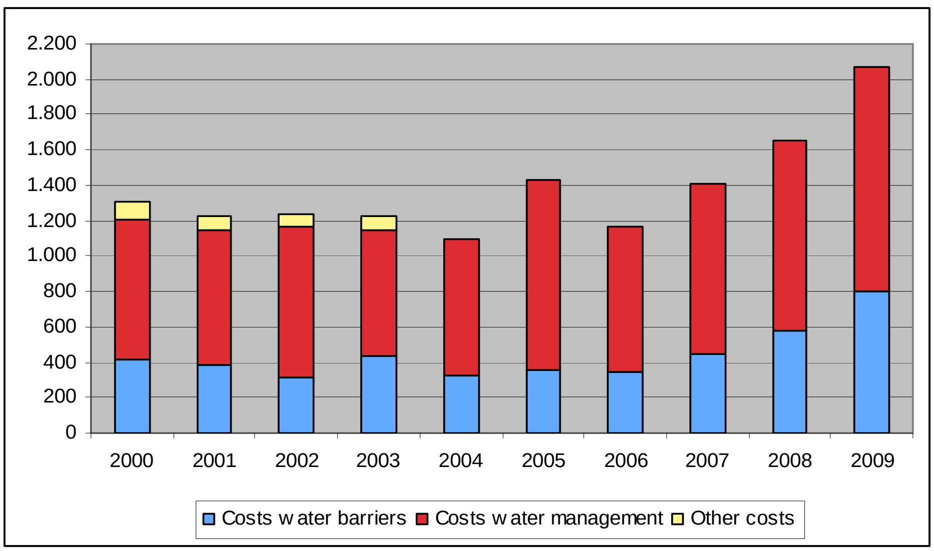

Figure 3| Expenditure Ministry of Public Works, Transport and Water Management

2.2 COSTS OF WATER BOARDS

The water boards are, within their territory, responsible for water quantity management of regional waters and rural areas, and surface water quality through wastewater treatment. In order to perform their tasks, each water board has the authority to impose levies. In 2009, the new tax system of the water boards was put in place. The funding structure of the water boards has changed. An important premise of the new tax system is simplicity. Before 2009, there were separate charges for the tasks maintenance of water barriers, water quantity management, waterways and road management and water quality. The new tax system has three charges:

- Water levy for the cost of 'dry feet and clean surface water.'
- Wastewater fee for the costs of wastewater treatment.
- Pollution levy for direct discharges into surface water.

The water levy is levied on households, on owners of buildings (houses and commercial buildings), on undeveloped land (e.g. agricultural area) and on nature areas. The distribution of the costs is according to the method laid down in the '*Waterschapswet*.' The cost share of households is based upon the population density in the water board area. The cost is minimal 20 percent and maximum 60 percent of the total cost of water system management. The remaining costs are shared between the owners of the buildings, undeveloped land and natural land owners based upon the property value. The new purification levy only covers the cost of wastewater treatment, and does not longer include the cost of measures to improve the water quality. The new pollution levy is imposed on households and businesses that directly discharge wastewater into surface waters depending on the amount of pollution (Polluter Pays Principle).

The total gross cost of water management for the water boards amounted €2.6 billion in 2009. This an increase of almost 7 percent compared to 2007 (see table 1 and figure 3). Figure 3 shows also the development in the total cost of the water boards per task. Before 2009, the costs were divided into 3 categories: water barriers, water quantity and water quality. In 2009, only 2 categories remained: water system management (includes pollution tax) and wastewater treatment. As can be seen, the total costs are expected to increase slightly in the future. Especially the costs of wastewater treatment are expected to rise in the future.

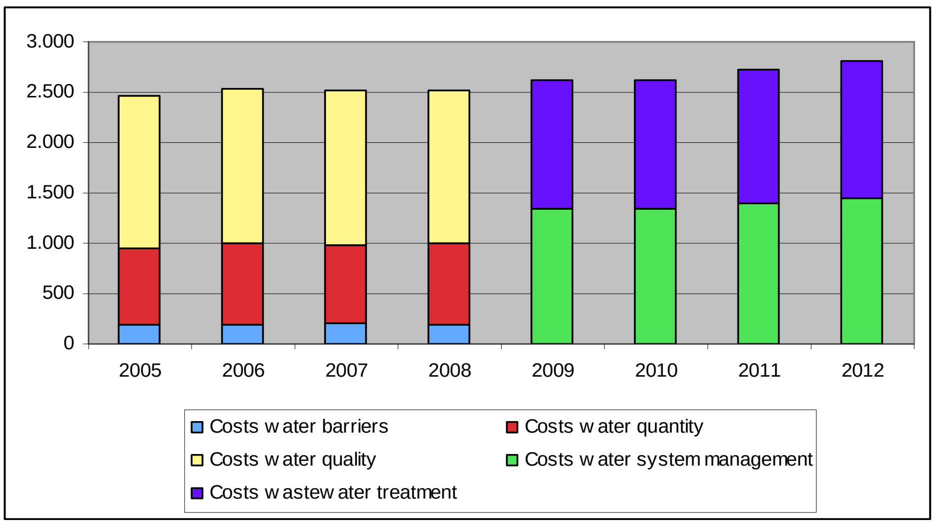

Figure 4| Total gross cost of the water boards (million euros in 2009 figures)

Figure 4 shows how the money of the water boards is spent. The vast majority of the revenues are spent on the operation of wastewater treatment plants (44,3 percent) and the design and maintenance of the water system (29,2 percent). The remaining of the revenues is spent on planning (5 percent), construction and maintenance of water barriers (4,8 percent), construction and maintenance of roads (1,8 percent), design and maintenance of waterways and harbours (0,3 percent), licensing and enforcement (1,7 percent), control of discharges (3,6 percent), levy and collection (5,3 percent) and governance and external communication (3,9 percent). However, the relative distribution of the revenues can differ for each individual water board.

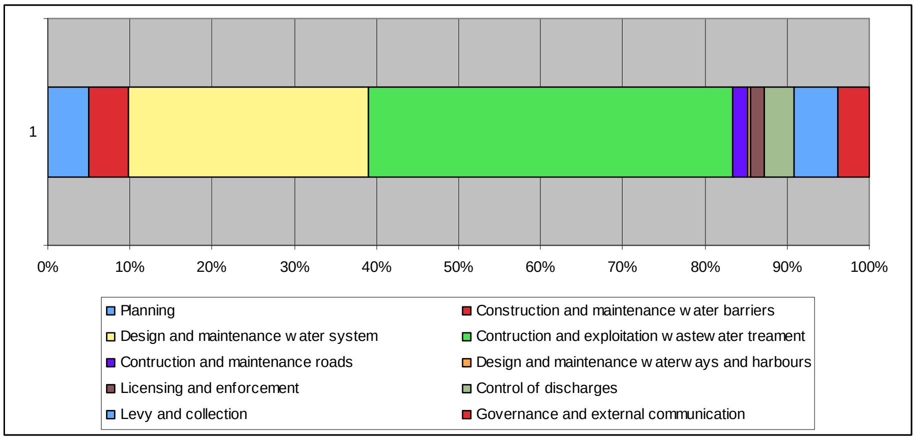

Figure 5| Division of costs on policy fields

The tax burden for households differs significantly between water boards. Table 2 in the annex shows an overview of the tax burden for a one-person household and a multi-person household for each water board. For example, a one-person household pays €102,20 in Hoogheemraadschap Rijnland, while it pays €340,74 in Wetterskip Fryslan. The same holds for a multi-person household. Furthermore, the tax burden for households has increased under the new tax system.

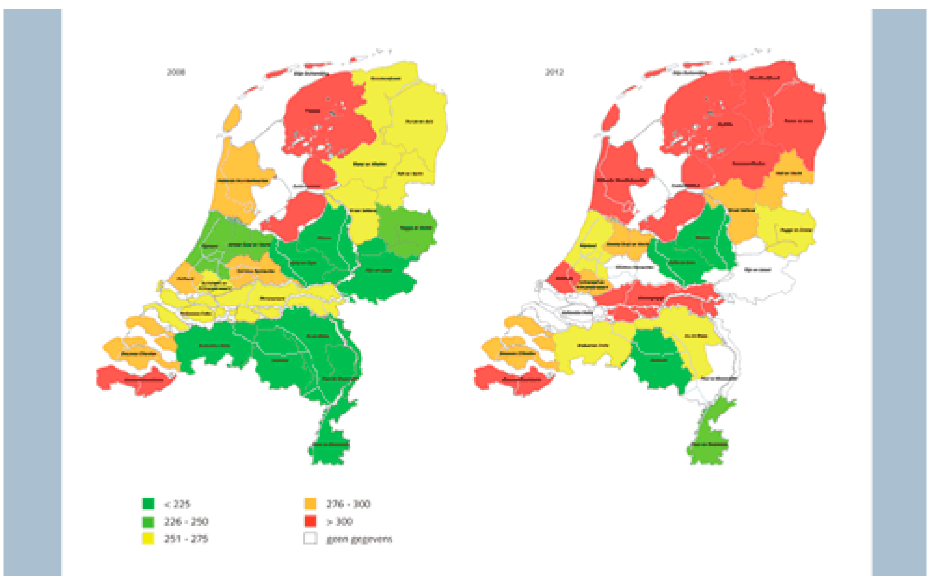

Figure 6| Difference in tax burden (old and new tax system)

2.3 COSTS OF PROVINCES

The provinces take care of the interpretation and application of the national policy in the provincial context. Furthermore, the provinces are responsible (with approval of the central government) for the creation and termination of the water boards. The provinces define the flood protection and water management tasks of the water boards and formulate the strategic policy for flood protection and water management issues. The provinces also supervise the policy realisation by water boards and municipalities. These activities are financed from the general budget of the province. This budget is supplied by the state budget via the Provincial Fund and by surcharges on the motor tax. Ground water issues can be financed by the ground water levy.

In 2009, the provinces have spent 205 million euros on water management. This is an increase of 24 percent compared to 2007. This increase is mainly caused by an increase in expenditure of quantitative management of surface water and groundwater. A large proportion of the total expenditures in 2009 – 45 percent – was earmarked for flood protection. The annual costs on water management for the provinces are expected to decrease slightly. In 2015, the annual costs are expected to be approximately €197 billion.

2.4 COSTS OF MUNICIPALITIES

The costs of investment in and maintenance of the sewage system are borne by the municipalities. The expenditures on the sewage system are passed through to citizens and businesses using a sewerage charge. The proceeds of the sewage charge are earmarked and can only be used for the management and maintenance of the sewer system. Because the sewage charge is a fee, it could only be used for activities that benefited the individual taxpayer. The municipal water activities, however, includes different tasks that are not only beneficial to the individual taxpayer. Examples of these activities are the drainage of superfluous precipitation and ground water. The expenses of these tasks are expected to increase. Therefore, the existing *rioolrecht* was changed into a sewage charge. This is an earmarked levy from which the entire municipal water tasks can be paid.

In 2008 and 2009, the municipalities could still choose between a sewage charge or *rioolrecht*. In 2009, 104 out of the 441 municipalities had choosen for a sewage charge. However, from 2010 onwards the municipalities can only use the sewage charge. The total expenditures of the municipalities totalled more than 1.2 billion euros in 2009. The municipalities also received more than 1.2 billion euros of revenues from the sewage charge and *rioolrecht* (see figure 7). This covered for 97 percent of municipal expenditures on sanitation. The extent of which costs can be covered from the sewage revenues has been increasing for years. An increasingly smaller proportion of the overall sewage expenditures is paid by the general municipal budget.

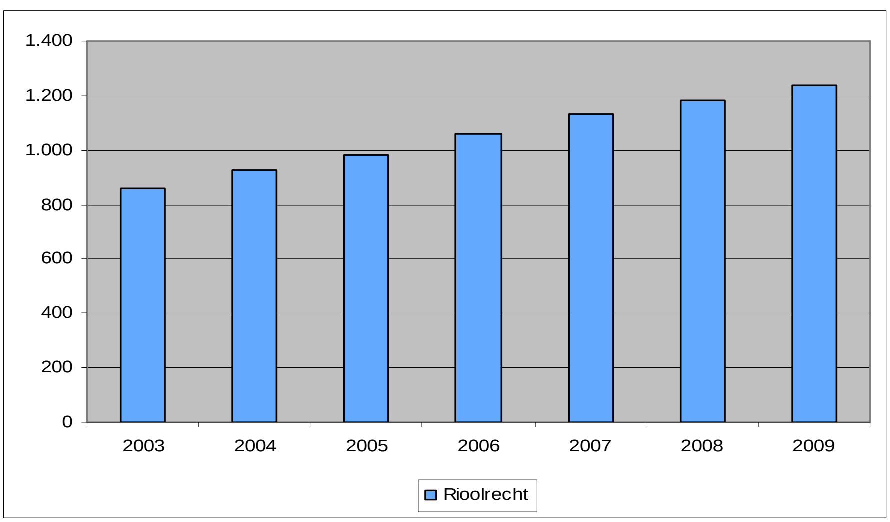

Figure 7| Trend of revenues municipalities

The average household costs for sewage has increase significantly. In 1998, the sewage costs amounted 560 million euro's, while in 2009 this increased to 1.2 billion euro's. In 2015, it is expected to increase till approximately 1.8 billion euro's. One reason is that municipalities have to invest significantly as a result of tighter environmental regulations and because of a peak in the replacement of sewerage systems.

2.5 AVERAGE COSTS HOUSEHOLDS

Households pay different fees for the use and management of water. Water boards impose a water charge, a wastewater fee and a pollution tax to cover their duties, while municipalities impose a sewage fee. In addition, households pay for the supply of drinking water to water companies and also contribute via the general taxes. Figure 7 shows the average cost that households pay on a yearly basis for the use and management of the water. In 2008, the average costs were €549 per households. This is a decrease of 3 euro's compared to 2007, and an increase of 55 euro's (11%) compared to 2003.

The majority of the costs (drink water costs, pollution tax, sewage charge) are related to the use of water. In 2008, households paid on average €460 for the use of water and €89 euro's for the maintenance of the water system (see figure 7). From the €460, €127 went to the water boards (pollution tax), 151 went to the municipalities (sewage charge) and the remaining €182 was paid for the supply of drinking water. The €89 euro's for the maintenance and management of the water system was received by water boards.

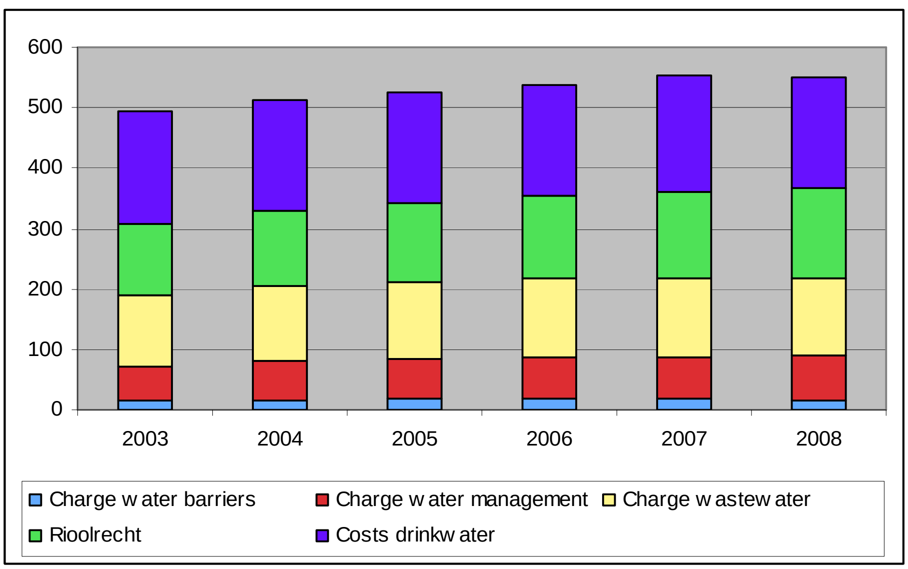

Figure 8| Average costs households (2003-2008)

PART 3. THE BENEFITS OF WATER RESOURCES MANAGEMENT

This part of the report will reflect on the benefits of water resources management in the Netherlands. In this section the results of available studies on the benefits of water resource management in the Netherlands, in terms of achieving national goals with respect to human well-being, economic development and environmental sustainability will be discussed. Consecutively the following topics will be discussed: the benefits of water quality and ecology, the benefits of water safety, the benefits of reducing excess water and the benefits of preventing drought.

3.1 BENEFITS OF WATER QUALITY AND ECOLOGY

3.1.1. Benefits of the European Water Framework Directive

Starting 2005, several cost benefit analyses have been performed for the European Water Framework Directive (WFD) in the Netherlands. These analyses had in common that they were meant to support the decision making process by informing policy makers and making the trade-offs as transparent as possible. The analyses also anticipated on questions from Dutch Parliament. Nevertheless, each time the analyses were slightly different, depending on the situation and (political) questions to be answered. Van der Veeren (2010) presents the backgrounds and the highlights of the various analyses. This paragraph summarizes what is done in the various studies with respect to the benefits.

In the first analysis, in 2005, a rough estimate was given on the potential costs of the various types of measures that the Netherlands would have to implement to achieve the EU WFD objectives. Achievement of these objectives is thus the benefit of implementing those measures. However, what does this mean? What does society notice? What benefits accrue to the society? These questions had to be answered.

In the Strategic cost benefit analysis, performed in 2006, an attempt has been made to monetise the benefits of WFD as far as possible (for a description on both the methods and data used, see Witteveen+Bos, 2006). From this first estimate, it appeared that the most important benefits of WFD measures are expected to be related to the value attached to living in a beautiful natural environment, as revealed in the increased value of the houses in the vicinity of water. Another significant benefit is related to the expected improvement in air quality (e.g. carbon sequestration), due to the increase in natural areas. Another way in which the increase in natural areas may influence society is the mere existence of these areas and the opportunities they offer for biodiversity. This benefit is comparable to the value attached to the existence of rainforests. People are willing to pay to preserve these forests, even though they will never go there (the so-called ‘existence value’). The benefit category recreation refers to people recreating alongside channels and lakes who prefer natural surroundings compared to concrete riverbanks. Also for them an increase in natural area will be interesting. Measures implemented for the WFD may also have positive health effects, due to increased chemical conditions. Since emission reduction measures only have a limited effect on algae blooms, these health effects are limited. Furthermore, clean and healthy water may also be an important legacy for future generations. Also this was expressed in monetary terms. In addition, it was expected that an increase in water quality might have a positive effect on the production of drinking water in terms of a reduction of purification efforts (and thus costs). However, it was not possible to estimate the size of these potential benefits. The same applies to a couple of other potential benefit categories, such as the benefits of increased water quality on industry and agriculture. Therefore, the estimated numbers were expected to be an underestimation of the total benefits. Finally, the WFD may not only have positive impacts for society, but also negative ones. Due to the proposed measures, both the abundance and diversity of fish will change. This will result in less production of commercially interesting species and therefore lower profits for the fisheries sector. The strategic cost benefit analysis showed that the estimated benefits are significantly less than the estimated costs. This is not surprising, since the WFD is aiming environmental improvement, not at commercial profits by private enterprises. Furthermore, costs increase with increasing efforts, more than benefits. Also this is a well-known feature in environmental economics.

In 2008 the Ex Ante Evaluation was performed. Part of this study was an in depth analysis of the benefits. From this it appeared that for a number of benefit categories, benefits were less than previously assumed. In addition, the reliability of the values attached to the various benefit categories – the so-called 'price tags' used to calculate effects into monetary terms – appeared to be questionable. Therefore, it was decided to present the most important benefit 'improvement of ecological quality of surface waters' in terms of ecological quality ratios and pictures, instead of monetary terms (see figure 1). These illustrations give a clear picture of what one could think of when talking about an ecological quality ratio of e.g. 0.3 or 0.7.

Good ecological quality (QR 0.6-0.8). Characteristics are a large variety in open and shaded places, deep and shallow, sand and stones etc.

Poor ecological quality (EQR 0.4-0.6). Only one river bank has a natural morphology, the required species are available, but in too small numbers

Insufficient ecological quality (EQR 0.2-0.4). Some small rivers are functional canals without variation in morphological structure

Bad ecological quality (EQR < 0.2). Bad water quality; animals can barely survive.

Figure 9| Examples of ecological quality ratio's

Box 1: Suggestions for further reading about the benefits of WFD in the Netherlands

Benefits of the WFD in perspective (Wienhoven, 2008)
The Strategic CBA gave a first estimate on the benefits of the EU WFD. This study gives a second opinion on the numbers presented and indicates whether these numbers tend to be an overestimate or an underestimate and why.

Benefits of the WFD for the drinking water sector (Schotsman et al, 2007)
In the Strategic CBA, no numbers could be presented for the benefits of the WFD for the drinking water sector. This report estimates those benefits. A serious increase in water quality could potentially result in cost savings, but the WFD measures will result in insufficient water quality improvement that would allow for significant benefits for the drinking water sector.

Benefits of the WFD for the industrial sector (Mierde et al., 2007)
This report estimates the potential benefits of the WFD for the industrial sector. An increase in water quality could lead to cost savings, but, since the industrial sector has strict requirements with respect to certainty and quality of the water, the WFD will not result in significant benefits for the industrial sector.

Benefits of the WFD for the agricultural sector (Bommel et al., 2007)
This report estimates the potential benefits of the WFD for the Dutch agricultural and horticultural sector. These benefits appear to be modest.

Benefits of natural buffer strips (Penning and van der Vat, 2007)
According to the Strategic CBA, natural buffer strips might result in benefits for society. This study tries to improve the estimate of those benefits.

Benefits of reductions of toxic algae (Burger and van der Vat, 2007)
According to the Strategic CBA, the reduction in presence of toxic algae might result in benefits for society. This study tries to improve the estimate of those benefits.

Benefits of living alongside water; a Hedonic Pricing study on the link between house prices, water types and water quality (Brouwer et al., 2007)
According to the Strategic CBA, measures implemented for the WFD will improve water quality and enhance the natural character of the area where people live. This might result in benefits for society, which might show in increased willingness to pay for houses in the vicinity of water and therefore higher prices for houses. This study tries to find the link between house prices and changes in water quality and the environment.

Benefits of living alongside water; an Internet choice experiment (Brouwer et al., 2007)
According to the Strategic CBA, measures implemented for the WFD will improve water quality and enhance the natural character of the area where people live. This might result in benefits for society, which might show in increased willingness to pay for houses in the vicinity of water and therefore higher prices for houses. In this study a large group of potential house buyers is asked for their willingness to pay by confronting them with choices between various houses with different characteristics. In this way, this study tried to find the link between house prices people say they are willing to pay and changes in water quality and the environment.

3.1.2. Benefits of the European Marine Strategy Framework Directive

The European Marine Strategy Framework Directive establishes a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status in the marine environment by the year 2020 at the latest. For that purpose, marine strategies shall be developed and implemented in order to 1) protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected and 2) prevent and reduce inputs in the marine environment, with a view to phasing out pollution, so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate uses of the sea.

One of the obligations the Netherlands has performed for this directive is an economic analysis of the Dutch part of the North Sea (Keijser and van der Veeren, 2009). From this analysis, it appears that of all economic activities taking place in and on the North Sea, shipping is the most important one, with a value added of €2.6 billion and more than 12,000 people employed, which outstrips the other activities by far. Next to the direct economic importance, shipping is also very important for a large number of other economic activities, for example in the Rotterdam harbour, the largest harbour in Europe. Offshore oil and gas production is the second important activity, with a value added of more than €1.5 billion and an employment of more than 1,800 people. The economic importance of this activity is largely determined by the oil prices. Other important sectors are fisheries, wind energy and tourism and recreation. For the latter, no data were available. Also for nature, cables, sediment disposal and defence no data were available, but these sectors are assumed to be of minor direct economic importance.

Also in the future, shipping will be the most important economic activity on the Dutch part of the North Sea. For 2015, value added is estimated to increase by 40% to be around €3.6 billion. The offshore industry is expected to face a serious decline in economic importance (more than 50%), due to the limits to the availability of natural resources. As a result of sustainable production and restrictions due to other uses, fisheries are expected to decline by 40%. Activities that are expected to increase significantly are wind energy (Dutch Parliament wants to install a capacity of 6,000 MW, where in 2004 there was practically none) and sand and gravel mining (for enlargements of the Rotterdam harbour and flood protection measures, production is expected to double). Next to these activities, plans exist to use the North Sea also for other purposes, e.g. aquaculture, carbon storage, and activities that need not take place on the (scarce) land.

At the moment, it is not yet clear what measures will be implemented for the European Marine Strategy Framework Directive, therefore, it is also not clear who will benefit from those measures. However, it can be expected that an increase in water and ecological quality of the marine environment might be beneficial for recreation, fisheries and related sectors. On top of that, the idea to leave a better environment for future generations might also be an important benefit.

3.2 Benefits of water safety

Dunes, dams, dikes and the Delta Project enable the Dutch to live safely in their country at, and (for a large part) below the sea. The standards that the water defences have to meet are laid down by law. Ironically, the gradual development of the system with which the Dutch gained control over the water created a safety risk in itself. In the event of higher river discharge rates the water is forced to remain in a limited space between dikes and can only rise. The Dutch have exchanged the inconvenience of a large area of wetland for a virtual guarantee of land that is permanently dry, but at the risk that water levels will be much higher than before in the event of a flood. This threat has increased even more by the ever continuing land subsidence and sea level rise. As the population behind the dikes has grown and investments in housing and businesses run into the billions, the consequences of a dike burst would be disastrous. In the distributaries of the Rhine, water distribution relates to safety in yet another way.

Just how safe the Dutch are behind the water defences depends on where one lives. The Flood Defences Act indicates the safety standards for every dike ring area. The standard is higher if more economic activities take place within the ring and if the number of inhabitants is high. Other important factors are the size of the area liable to flooding; the height to which the water may rise and whether the floodwater will be fresh or saline. The standard is expressed in a probability per year that a critical water level will occur, e.g. 1:1,250 per year. The requirements for a flood defence structure in terms of height and strength are derived from that standard. Furthermore, the level of safety depends also on the costs to keep the safety levels at the same level.

The Delta Committee, established after the flood disaster of 1953, has laid down our current protection policy. However, since then, a number of changes has taken place. Considerable investments were made in the areas behind the dikes and the number of people living there has increased significantly. These developments are not likely to stop any time soon. In addition, in the future a rise in sea level and river discharge volumes is expected. In short, the threat and the potential consequences of a flood are increasing. A large-scale flooding will cause widespread damage and long-term disruption of the Dutch society. They should no longer focus on the probability of a failure of the water defences, but on the risk (i.e. probability multiplied by consequences) of actual flooding. This provides greater insight into the possibilities of limiting the consequences of flooding and the potential damage. The risk based approach shows that, despite all the efforts, the risk can never be reduced to zero. By implication, the national government cannot be held solely responsible for protection against flooding. However, the preventive approach of high-water protection remains preeminent in water management policy.

Recently, The Delta Committee (Deltacommissie, 2008) has advised that the level of flood protection must be raised by at least a factor of 10 with respect to the present level. However, the Delta Committee also stresses the importance of combining water safety with the exploitation of opportunities for nature, housing, agriculture and other activities. An unequivocal ban on building on physically unfavourable locations is not recommended, because space is scarce. However, decision-making on planned new building in these areas (on soft peat lands, for example) must be based explicitly on an integral cost-benefit analysis. The costs arising from local decisions must not be passed on to another administrative level, or to society as a whole; rather, they must be carried by those who profit from them.

3.3 Benefits of reducing excess water

Excess of water is the collective term for situations in which there are large amounts of water in the form of precipitation or groundwater, but without endangering lives. Examples are a cellar full of water or a layer of water on the road. In most cases, the problem is temporary, such as after a heavy rainstorm. Heavy rainfall occurs mostly between September and March. This is also the period when the rivers carry more water. Excess of water usually affects low-lying areas, where the water gathers and from where it is difficult to pump out because of high water levels. The same is valid for polders. In areas with high groundwater levels, excess of water can occur whenever there is insufficient drainage and the water gets into basements. A frequent problem is spontaneous seepage under dwellings, which is difficult to solve without drainage or pumps.

Floods caused by rainfall often occur in cities or industrial estates, where almost all rainfall drains into the sewer. This is usually a combined sewer for wastewater as well as rainwater, even though segregated sewer systems for separate rainwater discharges are gaining ground. During heavy rainfall, sewers cannot cope with the amount of water and overflow, resulting in streets being flooded and, sometimes cellars are flooded as well. Moreover, if a combined sewer overflows, public health may become an issue.

With respect to for regional waters, flooding occurs when water levels are so high that the streams, lakes or waterways bursts their banks. In the main water system, floods are deemed to occur if national waterways are not sufficiently capable of storing or discharging regional water discharges. Given that national waterways are the final link in the discharge chain, it is important that they are not the weakest links, otherwise they will cause excess of water in upstream regional water systems. On the other hand, it is equally undesirable that regional water boards shift their drainage problems onto the national waterways. Agreements between water authorities concerning such matters are laid down in so-called water agreements..

In order to determine whether the systems operate as they should, it is necessary to know the requirements for water systems. Management goals have been set for this: a particular water level must not be exceeded more than once in a certain period of time. An assessment of whether the system is functioning properly does not so much focus on the extent to which the level is exceeded but on the frequency with which this occurs and, particularly, for how long. Regional water boards assess their water systems according to the operating standards stipulated in the National Administrative Agreement on Water, on the basis of which they can determine whether measures are required to keep damage due to flooding and waterlogging at an acceptable level. The operating standards indicate how often flooding is allowed to occur statistically. Different standards apply for different designated land uses. Grassland, for example, may be waterlogged once every 10 years, land on which greenhouses are built only once every 50 years and in built-up areas flooding should not happen more than once every 100 years.

3.4 Benefits of preventing drought

Drought problems are complex, and may affect many social sectors and interests. Even the Netherlands experiences water shortages (c.q. fresh water shortages) once in a while. The very dry summer of 2003 and the dry spring of 2005 are the most recent examples. As a result of the drought, crops withered in the fields, ships could only be loaded partially, power stations were limited in their intake of cooling water and nature suffered from drought. It is expected that due to climate change water shortages, such as in the summer of 2003 in Europe, will occur more frequently in the future. In extreme dry summers, water shortages are unavoidable, but generally, measures can certainly be taken to reduce or prevent water shortages.

Drought is defined here as a situation of a long-term shortage of area-specific water, which causes every process that is dependent on the water cycle to suffer. Drought manifests itself in a shortage of moisture in the soil's root zone, in extremely low water levels in rivers, and even in dry waterways. A water shortage can be caused by a severe lack of rainfall or low river discharges. The lack of sufficient infrastructure to supplement the shortage in rainfall may also be a cause. Occasionally, available water is not properly distributed. Finally, the water can be of inferior quality: too saline (for agriculture, drinking water and industrial processes), too warm (to be used as cooling water) or too polluted. Aside from all this, shortages can arise even when there is no drought, simply because demand exceeds supply.

Water shortages manifest themselves in three ways. A shortage of moisture in the soil is most common. This means that there is not enough water for plants, stunting their growth. Secondly, a shortage can occur in the surface water, meaning that water levels cannot be sufficiently maintained. This results in a lack of water for agricultural purposes and flushing. The inability to maintain water levels can have a negative effect on the stability of dikes, engineering structures and foundations. Bogs can become oxidised. In the third place, a consequence of insufficient water of the correct temperature and quality is that power stations have no cooling water, drinking water companies have to close their inlet points and farmers and horticulturalists cannot irrigate their crops.

Shortages are sometimes characterised by large regional variations. From region to region, there are substantial differences in the demand for water, supply possibilities and type of consequences (see figure 6). These shortages can affect almost every sector. Agriculture (lower production, salinisation), the navigation sector (less cargo) and to a lesser extent, power stations (insufficient cooling water) will all suffer economic damage due to water shortages. Furthermore, nature also suffers. Drought may also have economic consequences for recreation, the production of drinking water, the manufacturing industry and for households. The effects on the four sectors mentioned last are expected to be less serious.

Periods of drought can sometimes last so long that it is no longer possible to serve every designated use. Hence, choices have to be made: who or what takes priority in the distribution of scarce supplies of river water? This choice is not made all over again each time but criteria are laid down in a 'sequence of priorities'. These priorities were drawn up in response to the exceptional drought of 1976, and updated after the summer of 2003 when drought was almost as intense (see figure 9). Safety and the prevention of irreversible damage (category 1) has key priority over the other functions. The second category, which includes utilities, will be served when the category 1 needs are served. The activities of category 2 take precedence over small-scale high-quality uses, which form category 3. Finally, the least important category includes other economic consideration, such as shipping, industry and water recreation.

Category 1: safety and the prevention or irreversible damage 1. Stability of flood defence structures 2. Settling and subsidence of peat bogs and moorland 3. Nature dependent soil conditions	**Category 2:** Utilities 1. Drinking water supply 2. Power supply	**Category 3:** Small-scale high quality use 1. Temporary spraying of capital-intensive crops 2. Process water	**Category 4:** Others (economic considerations, also in term of nature) 1. Shipping 2. Agriculture 3. Nature, as long as no irreversible damage occurs 4. Industry 5. Water recreation 6. Lake fishing
Takes precedence over →	Takes precedence over →	Takes precedence over →	

Figure 10| Priority sequence in case of water shortage

PART 4. THE FINANCING OF WATER RESOURCE MANAGEMENT

The first section will focus on the principals of charging to finance the costs of water resource management. The second section evaluates the costs recovery of water services in the Netherlands, while the third section focuses on benchmarking. The last section discusses the use of new economic instruments.

4.1 PRINCIPLES OF CHARGING

In principal, the costs of water management in the Netherland are met wherever possible by those who benefit from the service provided. In other words, the principle is that 'the user pays' (or, in the case of water quality, 'the polluter pays'). For example, where water boards take measures specifically for the benefit of individuals or individual enterprises, the users concerned have to pay the full cost (e.g. wastewater treatment). In cases where the benefits and the costs of water management cannot be allocated individually, costs are recovered through local or regional levies (e.g. municipal sewage levy (see §3.4)). However, where it is not appropriate to finance work out of local taxation, for example because the interests of a larger area of the country are at stake, funding is provided by a higher tier of government out of general public resources. This is the case, for example, with flood protection for the state-managed waters.

The form and contents of water board taxes are determined by a number of tax principles, such as the interest-payment-say principle (dating back to the origins of the water boards), the polluter pays principle, the cost recovery principle and the solidarity principle (see also §2.1). The water board charges are based on the Water Board Act and embody the philosophy that those who benefit from water board activities should also contribute financially to those activities. These benefits are connected to the amount of use made of the existing physical infrastructure and the costs such use incurs. In addition every polluter of surface water pays a pollution levy, according to the Surface Water Pollution Act (1970). Every household or industrial discharger of wastewater pays this levy according to the amount of wastewater discharged directly or indirectly to the sewer and surface water system. The polluter is thereby made financially responsible for the costs of water quality management.

4.2 COST RECOVERY OF WATER SERVICES

Cost recovery for water service might read as to cover all of the costs associated with the water system, programme or service to ensure long-term sustainability. Table 1 presents the results of the calculation of cost recovery of water-services in the Netherlands. Five water services are distinguished: production and distribution of water, collection and discharge of rainwater and wastewater, wastewater treatment, groundwater management, and regional water management system[6]. The table shows that cost recovery rates in the Netherlands are relatively high. Varying between 95% for collection and discharge of rainwater and wastewater, to 100% for e.g. the production and delivery of water. In the following sections some more explanation is given for each of the water services.

[6] Note that water quantity management of seas and large rivers (e.g. flood defence) is seen as a national security issue and not a water service.

Table 1: Cost recovery of water-services in the Netherlands*

Nr	Water-service	Cost recovery (2005)	Provider of the service	User of the service	Cost recovery by means of
1	Production and distribution of water	100%	Drinking water companies, industry, agriculture	Households, industry, agriculture	Price per m3 for water used, fixed price for infrastructure, self-service
2	collection and discharge of rainwater and wastewater	95%	Municipalities	Households, industry, agriculture	Sewerage levy
3	Wastewater treatment	100%	Regional water boards, industry, agriculture	Households, industry, agriculture	Emission levy, self-service
4	Groundwater management	100%	Provinces	Households, industry, nature	Groundwater levy, groundwater tax
5	Regional water system management	100%	Regional water boards	Households, industry, agriculture	Watersystem levy

*Numbers are rounded at 5%. Numbers for 2005 are derived from Jantzen (2008) and own calculations.

1. *Production and distribution of water*
   The costs for production and distribution of drinking water are made by drinking water companies. These costs are paid for by the users by means of a part fixed price (for the infrastructure) and a variable part, depending on the amount of water used (for production and purification of water). In this way approximately 100% of the costs are recovered. Both costs and revenues amounted approximately €1.5 billion. In addition, costs are made by industry for the extraction of water for cooling and processing purposes (resp. €75 mln. and €230 mln.) and by agriculture for irrigation (€35 mln.). These are self-services for which the sectors incur the costs themselves.

2. *Collection and transport of rainwater and wastewater*
   The costs for investments and maintenance of sewerage are made by municipalities, but largely paid for by households and industries using a sewerage levy. However, a number of municipalities has chosen to pay these costs from general municipal budget. This means that households and industry do not pay for the use of this service directly. This is illustrated by a cost recovery of less than 100%. For the year 2000, the cost recovery was a little over 80% (costs: €921 mln.; revenues from municipal levies: €764 mln.). Since then, sewerage costs increased to a little over 1 billion €. At the same time, general municipal budgets have been cut and more and more municipalities that did not yet apply the sewerage levy have chosen to use this earmarked levy. As a result, the cost recovery rate increased from a little over 80% in the year 2000, to 95% in the year 2005. For the year 2008, cost recovery rate is expected to increase to more than 100% (Jantzen, 2008).[7]

3. *Wastewater treatment*
   Costs of wastewater treatment are recovered from polluters by means of an emission levy. The amount of money that has to be paid depends on the size of the pollution, expressed in population equivalents, and the expected costs (the levy only covers the costs that have to be made for water quality management by water boards). In the year 2000, for public wastewater treatment, the revenues were €970 million, and the costs €986 million. In addition, treatment of wastewater also takes place as self-service by industry (€360 mln.), agriculture (€6 mln.) and some households (€33 mln.). For these self-services, costs are fully recovered by definition. As a result, the cost recovery rate for wastewater treatment was approximately 100% in the year 2000. In the years 2000 – 2005, both costs and revenues increased, but cost recovery remained around 100% (Jantzen, 2008). The fact that cost recovery for public wastewater treatment is around 100% is not a surprise, given that the regional water boards are responsible for their own financing, without

[7] Jantzen. J. (2008). Visiedocument Waterprijsbeleid 21e Eeuw (Vision Document Waterpricing policies 21st century (in Dutch)).

opportunities to significantly overcharge (not allowed to make profits), or undercharge (water boards should cover their own losses).

4. *Groundwater management*
   Large groundwater extractions are subject to a levy that has to be paid to the province. Almost all larger groundwater extractions take place by industry and drinking water companies; therefore, they have to pay all of the costs of this water service. In the year 2000 costs were €14 million and revenues €13 million, resulting in a cost recovery rate of 95% in 2000. According to Jantzen (2008) this rate has increased over the past years and is 100% by 2005.

5. *Regional watersystem management*
   The costs made by regional water boards for quantitative regional water system management is paid for by users of the water service, by means of levies. Households pay a fixed levy depending on the value of the houses, industry pays a levy depending on the value of the real estate, agriculture pays a levy depending on the value of the agricultural land, and also nature organisations pay a levy depending on the value of the natural land. Costs and revenues for regional water system management by regional water boards were approximately €512 million in the year 2000. On top of that, agriculture also incurs costs for self-services in terms of drainage (€25 mln.) and water storage (€12 mln.). Therefore, the cost recovery is approximately 100%. Although various data sources present different numbers for costs and revenues for the year 2005, also for this year cost recovery rate is expected to be around 100% (Jantzen, 2008).

4.3 NEW ECONOMIC INSTRUMENTS

As stated in previous chapters, Dutch water policy has challenges on several fronts. Because future changes in water supply and water demand and the associated changes in the economic value of water and space, choices have to be made about how to deal with them in water management. Two changes are of great importance. Firstly, the increasing water scarcity requires a more efficient use of water and space. Secondly, further implementation of the polluter / user pays' principle leads to changes in the financing structure.

Economic instruments have been used in water management in the Netherlands for centuries (see also previous chapters). E.g. sewage treatment is paid using a levy, drinking water is paid per m3, and there is a charge for the extraction of groundwater. The question now is whether there is scope to make the financing system for Dutch water management more effective, efficient and equitable and / or to provide more price incentives, in the light of new policy developments such as the increasing scarcity of water (fresh) water and the implementation of the European Water Framework Directive and the European Marine Strategy Framework Directive, which mention water pricing and economic instruments explicitly as possible actions to encourage sustainable water use. Most recently, the report of the Dutch Delta Commission also suggests using price incentives and innovative financing mechanisms for both fresh water supply and flood security. This (incomplete) overview shows the wide interest in the application of economic instruments for different aspects of water management in the Netherlands.

Therefore, the Dutch ministry responsible for water management has issued a number of studies over the past years to explore the opportunities for improvement of the present financing system and to identify potential use of economic instruments where they are not used to the full extent possible. This chapter presents the main findings of the various studies and concludes with a description of future work in the field of economic instruments in water management in the Netherlands.

Vision document water pricing policy 21st century

The first study was a critical review of the present Dutch water pricing and financing policy (Jantzen, 2008). This study analysed the possibilities to adjust current water pricing and financing policies to further exploit the potential of economic incentives. The review came with the following observations and suggestions:

- Presently, there are few economic incentives for households and small industries for more economical use of water (water saving, reduction of pollution). Integration of different water related levies (for drinking water, sewerage, and treatment) into one water tariff, where this tariff is depending on water use, could lead to a more efficient and sustainable use of water, but may result in substantial higher costs for larger households. Another option would be to give households who invest in green roofs (reduction of storm water run off) subsidies for the initial investment and rebate on the water discharge levy;
- The water sector is dominated by the (semi-) public sector. Benchmarks can be used as an incentive to come to structural cost savings. E.g. due to the benchmark in the drinking water sector, the costs of water supply has barely increased (nominal) and even declined in real terms since the year 2000. May be this instrument could be used more widely;
- The funding sources for expenditures on water ecology (for reducing fertilizer in agriculture or ecological management of water (side)) are not clearly defined. For these activities, either new instruments could be developed (which could generate additional funding) or existing financial instruments could be stretched (use levies for regional water management also for this type of measures). One option would be to involve farmers in ecological water management by using collective management contracts in which farmers receive compensation depending on the size of the zone that is not longer using for agricultural purposes.

Payment for ecosystem services; an interesting option for water management?

The last suggestion of the vision document discussed above refers to the financing of ecological management of water. This has to do with the concept of payment for ecosystem services; a concept that is often put forward in international discussions as a new idea. To learn more about payment for ecosystem services, and to see whether it could be an interesting option for Dutch water management a separate study was issued. From this study it appears that this concept is already largely applied in Dutch water management although it is often not called that way (Linderhof et al., 2009). For example, the drinking water company that provides the Dutch capitol of Amsterdam with drinking water owns a part of the dunes. These dunes are used as a final purification step. At the same time it is a nature reserve area where people have to pay for when they want to go in. The costs of maintaining this nature reserve area are partly covered by the entrance fees, but are largely paid for by the consumers of the drinking water. However, these costs do not appear explicitly as costs for the ecosystem service on their drinking water bill (as is done in New York; Linderhof et al., 2009). This however does not mean that this ecosystem service is not provided or paid for.

Linderhof et al. (2009) stress that in many cases, water-related ecosystem services have a public good character, which means that nobody can be excluded from the use of the ecosystem services and its use is not rival (e.g. enjoying natural scenery). Therefore, the link between payment for the service and the provision of the service is often unclear or non existent, and users often pay only partially or at least not directly for the use of ecosystem services. As a result, economic incentives to reduce the use of the services are often not possible. In addition, the public good character also implies that PES programs are often public mechanisms, with the government as applicant of water-related ecosystem services. This role as intermediary is obvious, because ecosystem services are often of a public nature.

Variable water chain tarifs: (no?) contribution to effective and efficient water policies

At the moment, drinking water is partly paid for based on a price per m3 used, and a fixed rate to pay for the infrastructure. Also the sewerage levy is often a fixed tarif, e.g. based on the property value. A fixed rate resembles the fact that the largest part is meant to cover costs of infrastructure. However, sometimes the levy depends on m3 used. Since sewerage is a responsibility of the municipality, the cost recovery mechanism, and thus the sewerage levy base used, depends on the municipality. Wastewater treatment is the responsibility of the regional water boards, with own levies, with a typical distinction between a one or a multi person household. This means that two-person households pay a little bit too much, whereas large families pay a little less than strictly according to polluter pays principle. Therefore, one of the suggestions made in the Vision document Water pricing policies in the 21st century, was to introduce a water chain tarif. The idea is to recalculate the costs of the three water services production of water, transport of wastewater (sewerage) and treatment of wastewater, on the base of the number of m3 drinking water used. This would enhance the polluted pays principle, and at the same time, due to the increased price per m3 result in an additional incentive to save water and thus contribute to the sustainable use of water.

However, a large part of these costs are related to the realisation of infrastructure. For a sewer, there is hardly any difference between the amounts of sewage. Whether this is the amount of a three person household or a one person household; there should be a sewer in place. This makes a fixed rate a logical pricing mechanism.

If one looks at the amount of drinking water used in the Netherlands, it appears that the water saving campaigns that have been running over past decades, have been very successful. Water saving technologies are commonplace and the spoiling of drinking water is limited. This has resulted in a rather modest use of drinking water, which is even close to the minimum amount of water use one could expect for a Western society, with dish washing machines and so on. The limited number of water saving opportunities left, also result in a highly inelastic water demand, meaning that even a very drastic price increase would result in only a very limited reduction in water consumption.

The introduction of the water chain tariff would require a hudge administrative operation, since many different organisations are involved: E.g. more than 400 municipalities, who responsible for the sewerage and 27 regional water boards who are responsible for wastewater treatment. These organisations are used to take care of their own responsibilities and determine their own levies, with benchmarking studies to assure efficiency. An adjustment of the current water pricing structure will therefore be a challenging task in such a complex institutional set up.

Present water policies are in line with the polluter pays principle and also include an incentive to reduce water consumption. So there is no direct need to adjust the present pricing policies. In addition, since an adjustment in the present pricing structure towards a variable water chain tarif, requires a huge administrative operation, and will probably result in only a marginal impact on the water total consumption, policy makers will probably not be be eager to implement variable water chain tariffs.

Which role for economic instruments in the management of water resources in Europe?

In order to get a good idea of potential improvements in the current use of economic instruments in Dutch water management, it was not only decided to look at possible improvements in the current water pricing and financing structure, but also to make an international comparison across different European Member States to get insight in innovative financing mechanisms which could be relevant for the Netherlands. From this study it appears that economic instruments are a well-proven means of water management all over Europe, with most Member States relying on charges for water supply and sanitation services and on environmental (abstraction & pollution) charges (Mattheiß et al., 2009).

In recent years, the emergence of the concept of environmental costs, the recognition of the need to apply more fully the polluter-pays principle and the adoption of the European Water Framework

Directive (WFD) are elements that have widened the scope of economic instruments. Economic instruments, for example, are applied today to reduce morphological alterations or the management of excess water. Public budget constraints have furthermore motivated the search for innovative instruments, turning away from purely public investments and subsidies towards more elaborated economic mechanisms for environmental aims.

Tradable rights: (only) nice in theory

Economic theory will learn us that water markets could be a very interesting option to combat environmental problems, since the introduction of water markets would allow actors who can reduce emissions cost effectively, to do so which would enable them to earn money from selling emission rights to those with high abatement costs, who will be happy to buy rights instead of installing expensive abatement measures. The end result is that water quality targets are achieved at least costs to society. And since actors can always earn money when they would reduce their emissions, there is not only a static, but also a dynamic impetus for abatement as well. So far the textbook theory, now turning to practice:

If we look at the various emitting activities, we are talking about industry, agriculture and households. For industry, emissions are regulated by IPPC, which requires industry to implement best available techniques. Agricultural emissions are regulated by the Nitrate Directive and the Pesticide Directive. And finally the Urban Waste Water Directive poses requirements on emissions by the wastewater treatment plants. For emission trading to take place, it should be possible for one actor to reduce more, so as to allow another actor to reduce less. However, if this latter actor would really reduce emissions less than required by law, that actor is breaking the law and will be punished. Therefore, it is legally impossible to implement an emissions trading scheme (Jolink, 2010).

Secondly, it is important to be able to pinpoint the exact source of emissions. Large parts of the Netherlands exist of polder areas, where (ground)water flows are very slow, often more than 40 years before emissions enter surface waters. This means that if a farmer reduces his emissions today, the impacts will only be visible after 40 years. This makes it technically less interesting to apply a system with tradable emission rights. More or less the same applies to water quantity rights, where infrastructural barriers exist which prevent the individual delivery of water to those farmers who have paid for it (Budding et al., 2009).

Thirdly, it is undoable for farmers to watch every night the weather forecast to determine how much water or emission rights they need for tomorrow (Jolink, 2010). Therefore, the administrative burden might completely dissipate the economic efficiency gains. This especially applies to situations where efficiency gains are expected to be rather modest, compared to the present policy (e.g. the water hierarchy, when it comes to water quantity management).

Fourthly, the potential savings of a permit trading system are too small to offset the higher transaction costs and the necessary changes in regulation (both in terms of legislation and regulatory culture; Budding et al., 2009).

And finally, one should take into account the potential side effects of the instrument. If emission trading takes place, market power may become important, resulting in large farms with financial capacity to buy rights, whereas the small scale enterprises disappear (Jolink, 2010). This may result in a transformation of diverse landscapes with many small farms, into large farms with rather monotone landscapes. If such a development is considered to be unwanted, this should be taken into account before implementing this instrument. Therefore, tradable rights are only nice in theory, but not in practice.

With respect to flood management, one approach for storm water management by reducing runoff could include the promotion of green roofs, an option also mentioned in the vision document presented previously. This could be done by providing subsidies, but also a reduction in wastewater charges could be envisaged as incentive. The promotion of areas open to percolation goes into the same direction (e.g. greening of public areas by having more grass and fewer pavements). Incentives could be given to (urban) landowners through linking for example wastewater charges to the share or the total area of impervious surfaces on his property. These measures could help managing excess water in cities by reducing runoff through the increased use of the storage capacity of soils. It would also relieve sewage systems by reducing the water quantity flowing into it.

With respect to water scarcity, the increased use of alternative water supply sources, e.g. rainwater, can be promoted by an income tax reduction like in France. This is an alternative with minimal transaction costs. The costs at the expense of the state budget could be counterbalanced with lower storm water management costs combined with reduced pressures on drinking water resources.

With respect to both water quality and water quantity management, tradable permit systems are often advocated as an interesting solution in long-term strategies against e.g. diffuse pollution (Mattheiß et al., 2009; Verduijn, 2008, Jantzen, 2008). However, transaction costs are considerable and European long-term experiences are still missing (see textbox below for more second thoughts to the use of permit systems in water management).

Socio-economic consequences of the use of economic instruments

The use of economic instruments has often not only impacts on the stakeholder who has to implement a certain measure, but may have wider socio-economic impacts. Therefore, it is important to know how to make sure that economic instruments are used in the most efficient way. This was the most important reason to analyse the socio-economic consequences of the use of economic instruments (Budding et al., 2009).

The Dutch water sector is characterized by mostly local issues and local solutions. The administrative establishment in the Netherlands reinforces this in many cases. This means that it is often not optimal to look for one single policy, which has to be applied to the Netherlands as a whole, but to search for regional solutions which are linked to local challenges and conditions. As a result, wherever possible, the practical implementation of economic instruments should take place demand driven (starting from a particular issue or problem) and bottom-up (by the relevant local authorities). For example, there are successful examples where regional water boards experiment with economic instruments to solve regional agro-environmental water management problems.

An interesting option: economic instruments for agro-environmental measures

After the studies above were concluded, the Dutch ministry responsible for water management decided to focus on economic instruments is in the field of agro-environmental measures.

The reasons why Dutch water managers (including the ministry) are interested in cooperation with agriculture are:

- Due to climate change, the Netherlands is increasingly threatened by sea level rise, salt intrusion and fresh water allocation problems. One of the solutions would be to increase water storage. Of course this cannot be done in cities because this would be disproportionately costly, but requires additional storage capacity in rural (agricultural) areas.
- As most European Member States, the Netherlands has appointed Natura 2000 areas. Since nature conservation areas in isolation will not contribute to biodiversity, but for these areas to be more successful, corridors are needed. And again, this can best be realised in rural (agricultural) areas.

- The most important problems with achieving the objectives of the European Water Framework Directive are hydromophological changes and diffuse pollution from agriculture. For this, the solution would be to implement additional measures in agriculture.

However, if the Dutch would be the only one to impose additional measures on agriculture, this would seriously disturb level playing field. Therefore, the Dutch are interested in innovative economic instruments for agro-environmental measures that could solve all problems presented above simultaneously; increase water storage capacity, increase nature corridors, and decrease agricultural pressures on water (e.g. nutrient emissions).

As can be concluded from previous sections of this report, the Dutch water boards are

- responsible for water management in rural areas;
- interested in storage capacity, nature corridors and water quality;
- paid by levies from farmers industry inhabitants in same region;
- democratically chosen (representatives of public interest).

And since they want to be prudent with the money they ask from their citizens, they are also very interested in cost-effective measures, especially in the capillaries where the agricultural activities take place. The question then comes up, whether they could pay agriculture for agro-environmental measures to increase water storage, prevent flooding, and enhance nature? This would correspond with the user pays principle (comparable to when one wants to have bread, one has to pay for it). One interesting option would be to pay farmers for the opportunity to use part of their land to create wet buffer strips. However, financial compensation cannot be done just like that. E.g. a variety of rules have to be taken into account before compensation is not regarded as illegal state aid.

Legal implications of introducing economic instruments

In order to learn more about the legal implications of introducing economic instruments in the field of European and Dutch water management Jolink (2010) analysed a variety of European and national rules that has to be taken into account when using and introducing economic instruments. With respect to the above mentioned issue of preventing illegal state aid, it appears that it has to be made clear that when farmers are compensated for providing ecosystem services, e.g. to provide land to the water boards which will construct wet buffer strips on this land, those farmers receive compensation for measures which will improve the natural environment and the quality of that environment. This type of payments could fall under aid which is accepted by the Commission. There are even special EU programmes which provide the agricultural sector with money in order to realise these objectives (Rural Development Programme), which could also provide assistance to farmers involved in the creation of wet buffer strips, as long as they perform ecosystem services which go further than what is obligatory under European law. Furthermore, some services will never be performed if there is no compensation to help farmers with the additional costs which they would incur. Therefore, when it is certain that without compensation an ecosystem service would not be performed, compensation is allowed. The most important conclusion of this study is that compensation is allowed and subsidies not, but much is still unclear (for more details and juridical caveats, see Jolink, 2010).

An interesting instrument: Payment for wet buffer strips

There is one instrument that the Dutch are very interested in. That is the creation and management of wet buffer strips and other types of wet zones, since they can contribute to the abatement of various water management problems at the same time, for example flood prevention, improving water quality, nature, landscape and sustainable energy. Therefore, the creation and management of wet buffer strips and wetlands can be a very interesting option.

Up until now not many landowners in the Netherlands seem interested in the various existing payment schemes to stimulate the creation and management of these wet zones. A major problem with the implementation of buffer strips in the Netherlands, besides issues with hydrology and effectiveness, is that farmers do not want to participate because agriculture is highly productive even at field margins, land prices are high and a significant number of dairy farmers already have to export their manure surplus. Converting agricultural land into wet buffer strips may increase the total amount of manure exported. Another issue, which is not isolated to the Netherlands, is the potential reduction in direct payments farmers receive under the Single Payment Scheme of the Common Agricultural Policy due to the loss of eligible land area as a result of implementing buffer strips and other permanent land use changes.

Referring to the previous comment on when one wants something, that person should pay for it, if the regional water boards, as representatives of public interest, are the ones that are interested in the various objectives, they should pay. They could pay farmers a compensation for taking land out production, pay for the management of the wet buffer strip, and invest in developing the buffer strip.

How to make buffer strips more attractive?
The interest in payment schemes for buffer strips appear to be low. How can those buffer strips be made more attractive? Paying more than only income loss, for example payment for the provision of the services provided on that land; water retention, nature conservation, etc. Especially when more than one service is provided, this should enable the payment of more than one water service and thus also payment of more than just income loss. If farmers get more than income loss, they will be happy, and if water boards have to pay less than what they would otherwise have to pay, for example for each individual objective separately, they will be happy too. Therefore, this is a system with only winners! Since we are now at the eve of the new CAP reform, it might be an interesting option to explore the opportunities to include this measure in the new CAP.

Environmental payments to farmers: Not a polluter paid principle

One of the discussions that comes back over and over again when talking about economic instruments, and especially when it comes to agriculture, is the issue of polluter pays principle and the idée fixe that farmers do not pay for the use of water or the environment.

The mere existence of one of Dutch oldest democratic organs, the regional water boards, stems from farmers sitting together and trying to adjust water quantity to their needs, i.e. discharge of excess water, but enough water for irrigation. Those farmers had a common interest, they discussed and decided together, and they paid together. This is the interest – payment – say principle, which is still the basic thought behind the financing structure of the regional water boards.

Over the past years, also non agricultural interests have become relevant in the regional water boards, e.g. nature and recreation. One of the requirements posed upon the agricultural sector is that they should reduce their emissions so as to increase the water quality and enhance ecological functioning. Often people say farmers should bear these costs themselves. However, these people often forget that farmers already pay a lot to meet legal objectives such as the Nitrate Directive and so on. If one wants the agricultural sector to reduce more than required by the Nitrate Directive, one asks more than what has been agreed upon at the European level. Most of Dutch agricultural products is exported to other European countries, where Dutch agriculture has to compete with other European farmers. Therefore, asking the Dutch farmers to do more than required by European law, would result in a disturbance of the level playing field. To prevent this, the costs of additional measures should not be borne by the Dutch agriculture, but by others. But than those people will immediately respond that the polluter pays principle is not held anymore, because in fact the polluter gets paid. However, why should recreating people who want to have a nice natural scenery enjoy this for free?

In the Netherlands, but also elsewhere in Europe, examples exist where farmers get paid by water companies to reduce their emissions, so that the water company can save on drinking water purification costs. In situations where the farmer was there first, it sounds reasonable that the farmer gets paid. Also examples exist of payments for water retention on agricultural land, bird sanctuaries, and so on.

The main message: If you want something, you should pay for it (just like in everyday life).

Review of Dutch case studies in the field of instruments for agro-environmental measures

In the Netherlands there are already a large number of voluntary, non-statutory initiatives in the agricultural sector involving a form of payment for water-related ecosystem services (Klooster et al., 2010). In order to learn more about these initiatives, Klooster et al. performed a review of these case studies. They started with an inventory of innovative economic instruments that stimulate agricultural water management measures. This overview was restricted to arrangements that are on top of regular 'catalogue of green blue services' and other current policies, and on a voluntary basis. They found 120 case studies which are highly diverse in status (research, pilot, formal arrangement), spatial scale (local, province, national), type of arrangement (advice, technical support) and the ecosystem services they relate to; water quality (nutrients, pesticides and ecology), water quantity (storage) and landscape values. Of these 120 case studies, 13 were analysed in more detail to get an idea of factors determining success and failure. The general characteristics of the reviewed payment schemes were that they are focussing on compensation of the initial investment, maintenance, or the depreciation of value, but not on payment for the ecosystem services themselves. Furthermore, the payments largely depend on regional circumstances, and there is often no direct link between financing sources (demand) and ecosystem provider (supply), an issue also mentioned in the vision document.

Factors contributing to success: process	Factors contributing to success: content

• Acceptance is key. Increases when advisors go to the farm
• Realistic ambitions (according to farmers)
• Allow for learning by doing; may result in new innovations
• Permanent involvement during implementation:
  o Courses (compensation for time spent);
  o Monitoring performed by farmers
• One stop shop (involve agricultural organisations in this)
• Short term implementation
	• Adequate payment
	• Also compensation for maintenance and administration
	• Possibilities for tailor made arrangements (location specific)
	• Arrangement and financing secured for medium term (> 5 years)
	• Arrangement should suit the new CAP requirements
	• No definitive change in land use (agriculture > nature)
	• Multiple ecosystem services can be offered in combination
	• Costs for the payer should not be excessive; combination of objectives can help, since this often means multiple financing sources

International review on payment schemes for wet buffer strips

Just as in the review of economic instruments for water management in general, the Dutch ministry responsible for water management wanted to learn from international experiences with payment schemes for wet buffer strips. Therefore, Dworak et al. (2009) were asked to perform an international review. Right from the start it became clear that wet buffer strips are relevant for the Netherlands, but nowhere else in Europe. Therefore, the scope was extended to also include other types of wet zones along privately owned land, e.g. buffer strips, creation of wetlands, land purchase and preserving and developing nature conservation and water protection areas. Also in this study, after a broad overview, a limited number of case studies were carried out to investigate the details behind the payment schemes as well as other factors influencing farmer's behaviour. From the findings it came obvious that also at the international level, all of the payments offered are on a voluntary basis to farmers and linked to compensation of income losses and additional work but not for environmental benefits in terms of e.g. improved biodiversity, improved water quality or retention capacity (mostly because there is no market for such services). It appears that payment schemes are often either project based (payment to buy land and for investments) or continuous (to keep land converted, paid from the European Regional Development Fund, some Member States pay more when environmental benefits accrue). In addition, in some cases overcompensation was found to ensure participation. At the other end, if compensation is less than market conform participation rate reduces. Another lesson was that funding should be linked to easily understandable rules and limited administrative burden. Many of the factors contributing to success and failure found in the international review are largely similar to the ones found in the Dutch case studies. E.g. also in this international review it appears that stable, long term, trustful funding provided by one office (one stop shop for farmers, also when various organisations are involved) enhances participation rates. Finally, the required shift in practice should not be too drastic.

Review of experiments with economic instruments for non agricultural sectors

In order to determine the most interesting economic instruments for efficient and sustainable water management, not only a review was made of Dutch case studies in the field of agro-environmental measures, but also outside the agricultural sector, involving households, companies and organizations as targeted stakeholders (Kircholtes et al., 2010). Based on an evaluation on the criteria 'effectiveness of the stimulus', 'effectiveness of the measure', 'efficiency of the measure', 'justice of the stimulus' and other fail factors, three instruments appear to be most recommendable: compensation for green-blue services, stimulation of non-chemical weed control (brushing, pouring hot water), and the decoupling of sanitary sewer and water from local treatment plants. Less recommendable is the stimulation of separating rainwater, because its effectiveness is limited and the efficiency is low and often negative. Also the installation of green roofs appears to be an expensive measure for both the beneficiary and the provider: The largest benefit of this measure is the reduction of energy consumption through better insulation. But the installation of green roofs is more expensive than traditional insulation. At the same time, the increase of water storage is very limited. It is therefore only sensible to build or encourage green roofs in cases where no other alternatives for water storage exist. However, the disconnection through greening of public spaces and gardens (more grass instead of pavements) could be a promising option for decoupling water from local treatment plants.

An important notion from this study is that effective incentives are not always efficient. E.g. an incentive can effectively lead to the adoption of a measure, but if this measure does not lead to an improved water system, the instrument is not efficient. Furthermore, a stimulus may lead to a measure that is not efficient (this seems to be the case with subsidies for decoupling). The conclusion is that the optimization of economic instruments should start with a measure that is effective (improving the water system) and efficient (i.e. benefits outweigh costs). Furthermore, stimuli should be just, targeting the water management objectives, financially feasible, legally feasible (not conflict with legislation) and practical (not too much red tape). Often economic instruments require reinforcement through legal means and communication tools. Finally, it appears that every economic instrument needs customization, since for every measure there is a different combination of the ones who have to pay, the beneficiaries, those who have the knowledge, and the factors determining success and failure.

Effectiveness and efficiency of economic management instruments for water demand

Most of the reports presented above focus on economic instruments that contribute to water storage and water quality improvements. However, one of the future challenges in Dutch water management is, as stated before, freshwater scarcity due to climate change. Therefore, it was decided to also analyse economic instruments which can influence water demand by different types of water users. The analysis shows that not all economic instruments are suitable for water demand management. Some of the instruments currently used, are primarily intended to recover costs. The effectiveness of instruments for water demand management depends on the elasticity and the size of the group of users that can be reached, whereas efficiency depends on the costs related to enforcement and monitoring and (again) on the size of the group of users that can be reached. For taxes and levies, an enforcement and monitoring system is often already in place, and these instruments are often generic, which makes it possible to apply them for large groups of water users. In contrast, compensations, subsidies and water banking often require specific systems and are therefore only useful for limited applications, which reduce the effectiveness of these instruments.

A typical characteristic of water demand management is the (semi) public nature of water. Especially in the Netherlands, lots of water is used for flushing of low-lying polder areas and managing water levels. In situations where both water flow and water levels can be regulated for small areas, economic instruments can be effective, efficient, enforceable and applicable and also greeted with great support.

To make sure that water demand management can adapt to changing situations of water scarcity, it is important that systems are flexible. However, flexibility can also be a danger, since investments in 'dry' years may become uneconomical if water supply increases due to measures such as water retention. Decisions about the introduction of economic instruments to influence the demand for water, should therefore be taken in conjunction with decisions about water supply. This also requires some fundamental choices about how far the government should facilitate water supply and what is to be achieved with the introduction of demand-reducing policies. Ideally, costs and benefits of both types of measures should be compared.

Workshop on the role of economic instruments in water management in the Netherlands

In the end of 2010, a workshop was organised where the knowledge of the various studies presented above was presented in condensed form. After this presentation, representatives from the various policy issues within the Dutch ministry responsible for water management and representatives from the relevant research institutes were invited to discuss instruments that are currently used in the implementation of Dutch water policy.

The workshop showed that economic instruments were used more often in some water policy fields than in others. E.g. in the water chain management, the 'user / polluter pays' principle was introduced a long time ago. However, also in other water policy areas, implementation of economic instruments may become more and more important, among others, because of tighter financial situation.
The workshop also showed that in certain cases there is insufficient insight into the costs of implementing policies. A first step in introducing economic instruments could therefore be to make current costs of implementing policies more transparent. E.g. in light of the expected scarcity of water in the future, more efficient water management, and an increasing tendency towards user/polluter pays principle, it seems useful to first make clear what costs are currently made in water management and how both water and costs are allocated. Therefore, one of the first steps could be an inventory of current water use by different actors (including licences for water extraction) in order to understand the water balance as it currently is, and how this may develop in case of increasing scarcity in the future. With increasing transparency of the system it is clear to all users where costs and benefits of water accrue. Such a water-balance study can be used to discuss whether introduction of economic instruments will result in more efficient and more effective policies than if other instruments (e.g. regulations) would be chosen. Finally, another great opportunity for the use of economic instruments in water policy is by looking for possible synergies by combining the implementation of various water policy issues (e.g. look for joint goal achievement and use the most effective and efficient instruments).

PART 5. CONCLUSIONS

Being a country located at the mouth of four large rivers and largely below sea level, water management is an important issue the Netherlands. The Netherlands has also a rich history in water management. Already in the 11th century, landowners sat together to co-operate to prevent land from flooding. This resulted in the birth of the first regional water board in 1232. The water boards were democratic stakeholder organisations consisting of elected representatives from local farming communities. What changed over the years is that in later centuries also water quality became an issue, and that efficiency and professionalisation increased the size of water boards. This has resulted in a serious reduction in the number of regional water boards, from several hundreds to 27 at the moment.

Gradually, a shift emerged from regional water management towards a more integrated water management with an increasing importance of a national role. Integrated water management requires co-operation, which is aimed at making trade-offs between various interests with the various stakeholders in and open and transparent manner where the focus lies on synergy. The principle applied in the Netherlands, is to co-operate at the regional scale where possible (municipalities, water boards), and (inter)national where necessary (e.g. International Rhine Commission, OSPAR). But co-operation does not only take place vertically, but also horizontally; between various ministries (water, agriculture, finance,…) and with the various stakeholders (recreational, environmental, industrial, …), from the beginning. This is the Dutch polder model.

Integrated water management is also needed in the future. The Netherlands faces many new challenges with respect to water management. Climate change is forcing the Dutch to reconsider current water policy. In the coming decades, the Netherlands will not only be confronted with the increasing risk of flooding, but also with challenges regard to water quality, droughts and salinisation. Also socio-economic, demographic and spatial developments will have a great impact on the way of living and working, and hence also water management in the future. This will also have an impact on the future costs and financing of water management.

The central government, provinces, water boards and municipalities councils are investing approximately €6.1 billion (2009) each year for the protection of the Netherlands from flooding, the prevention of flooding, waterlogging and drought, the improvement of water quality, the transport and purification of urban wastewater, and the maintenance of waterways. Almost one-third of all these costs are funded by the government. The remaining costs are being covered by levying local taxes by the water boards, municipal councils and, to a lesser extent, the provinces.

The principal of charging is based upon the Interest-payment-say principle which results in solidarity and fairness: if your interest is larger, you pay more. For example, with respect to water quantity management ('dry feet'), payment is according to the value that is protected. In former days members of regional water boards were mainly farmers. Their protected value was the value of agricultural land. Nowadays also citizens want to have a say. They pay according to the value of their property (houses). Similar for water quality management (wastewater treatment): Here payment is according to emissions (measured in population equivalents). Therefore, the Dutch have a long history of payment according to polluter pays and user pays principles.

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Annex 1

Table 2| Water board tax burden households (2010)

Water boards	One-person household(€)	One-person household (%)	Multiple-person household (€)	Multiple-person household (%)
Hoogheemraadschap Rijnland	€ 102,20	9,76%	€ 188,60	9,10%
Hoogheemraadschap van Delfland	€ 113,82	7,91%	€ 204,16	8,88%
Waterschap Veluwe	€ 126,18	6,07%	€ 204,32	4,87%
Waterschap Hollandse Delta	€ 127,12	5,53%	€ 211,62	4,69%
Hoogheemraadschap van Schieland en de Krimpenerwaard (gebied Schieland)	€ 131,92	4,80%	€ 218,40	4,29%
Hoogheemraadschap Hollands Noorderkwartier	€ 136,92	4,22%	€ 230,18	4,19%
Waterschap Zeeuwse eilanden	€ 147,13	3,68%	€ 243,56	4,11%
Waterschap Peel en Maasvallei	€ 149,56	3,66%	€ 245,73	3,97%
Hoogheemraadschap van Schieland en de Krimpenerwaard (gebied Krimpenerwaard)	€ 153,50	3,61%	€ 247,50	3,53%
AA en Maas	€ 166,32	3,61%	€ 260,40	3,44%
Waterschap Vallei & Eem	€ 169,08	3,53%	€ 272,40	3,29%
Waterschap Velt en Vecht	€ 174,74	3,32%	€ 281,34	3,27%
Waterschap Rivierenland (gebied Zuid-Holland en Utrecht)	€ 178,20	3,18%	€ 286,08	3,13%
Waterschap Rivierenland (gebied Gelderland en Noord-Brabant)	€ 196,88	3,14%	€ 300,93	3,10%
Hoogheemraadschap Stichtse Rijnlanden	€ 204,15	3,02%	€ 303,00	2,70%
Amstel, Gooi en Vecht (via Waternet)	€ 209,88	2,90%	€ 334,97	2,62%
Waterschap De Dommel	€ 215,22	2,78%	€ 335,88	2,62%
Waterschap Regge en Dinkel	€ 229,53	2,69%	€ 339,65	2,58%
Waterschap Roer en Overmaas	€ 232,61	2,59%	€ 346,89	2,54%
Waterschap Groot Salland	€ 234,85	2,46%	€ 358,84	1,73%
Waterschap Zuiderzeeland	€ 237,80	2,21%	€ 360,73	1,32%
Waterschap Reest & Wieden	€ 244,95	1,37%	€ 372,34	1,30%
Waterschap Brabantse Delta	€ 266,22	0,34%	€ 372,65	0,84%
Waterschap Rijn en Ijssel	€ 267,41	0,00%	€ 375,22	0,62%
Waterschap Zeeuws Vlaanderen	€ 267,46	0,00%	€ 380,50	0,00%
Hunze en AA's	€ 273,90	-0,14%	€ 385,72	0,00%
Waterschap Noorderzijlvest	€ 289,59	-1,12%	€ 394,69	-0,12%
Wetterskip Fryslan	€ 340,74	-3,10%	€ 450,74	-1,70%
Average	**€ 199,57**	**2,93%**	**€ 303,82**	**2,89%**

Source: Vereniging Eigen Huis, 12 feb. 2010

Note: percentage change compared to 2009.