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

In search for innovative ideas for application in the Netherlands

Final report

A study undertaken for the Ministry of Transport, Public Works and Water Management, The Netherlands

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Executive summary

Economic instruments are a well-proven means of water management all over Europe, relying in most Member States on charges for water supply and sanitation services and on environmental (abstraction & pollution) charges. 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 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.

In the search of cost-effective solutions, the Dutch Ministry of Transport, Public Works and Water Management has launched a review of economic instruments currently applied to water management. The study aims in particular at giving insight in existing innovative financing mechanisms which have been introduced only recently and/or which could be relevant alternative adapted to the water management system of the Netherlands.

What are economic instruments? – A short introduction

Economic instruments are systems of economic incentives (positive or negative) put in place with the aim to change behaviour and decisions in order to enhance environmental protection. They are often divided into market-based and non-market based instruments. The former relies on market price mechanisms to internalize environmental costs and benefits and provides financial incentives to economic actors. This approach is either based on the use of existing markets (e.g. change of charges on water uses or subsidies) or on creating new markets. The establishment of new markets is a relatively recent approach and consists basically in the creation of a system of tradable permits and rights. In addition to

market based instruments, voluntary approaches are increasingly applied. They include for example contracts on specific agricultural management practices which specify compensation payments to farmers. Overall, economic instruments are used to increase the efficiency of using natural resources and can help to collect additional financial resources, being based on the polluter-pays principle.

Which instruments are currently in place and which innovations have been identified?

The most commonly used economic instrument for quantitative water management are tariffs for drinking water. Their level and structure is widely varying between countries and regions, leading to different effectiveness in providing incentives for sustainable water use and different levels of cost-recovery. Taxes and charges on water abstraction are also widely applied, their level being differentiated by water source (groundwater or surface water) and/or by the type of user depending on countries. Although not commonly used in the EU, tradable water rights systems constitute an example of an innovative economic instrument which is increasingly being discussed in various policy forums in Europe. However, the establishment of such a market is a rather complex undertaking which is not free from certain risks. Additional instruments include the allocation of subsidies for building alternative storage and reduce water abstraction

Water quality management, and the economic instruments developed for reducing polluting discharges, distinguish between point sources and diffuse sources. For handling point sources, tariffs for sewage and wastewater services as well as effluent charges are commonly applied. Wastewater tariffs are often based on the volume of drinking water used. In the Netherlands, however, wastewater tariffs are only based on the size of the household. In the case of Germany, the share of stormwater flowing into the sewer is increasingly considered when designing tariffs.

Diffuse pollution sources are more difficult to handle as polluters are often not easy to identify. Economic instruments applied include pesticide taxes (found in Scandinavian countries) with the tax level being based on retail prices or on the weight of the active ingredient in the product. Voluntary agreements constitute another form for limiting diffuse pollution from agriculture. They involve compensation payments for e.g. organic farming practices. Since very recently, tradable permits for polluting discharges into the aquatic environment are considered by some European countries, this instrument being already applied outside the EU.

Morphological issues and ecological restoration became of increasing interest in the water management sector due to the implementation of the Water Framework Directive. However, only little information about economic instruments applied for this issue is available. Economic instruments are applied as part of funding programmes for the nature conservation activities in Natura 2000 areas, or as part of schemes aimed at mitigating impacts of hydropower plants. Additional examples include the establishment of ecological accounts or schemes for managing financial compensations for biodiversity damage.

The last part of the study investigates economic instruments for managing excess water, an area where only few economic instruments are applied in Europe as most of the strategies in place are technical or regulatory. Examples include storm water taxes, subsidies for the creation of wetlands or for afforestation or income tax reduction for the installation of rainwater harvesting and reuse systems. In several countries, subsidy schemes for promoting green-roofs are also put in place to reduce storm water runoff.

Potential sources of inspiration for the Netherlands

The diversity of economic instruments that was investigated in the report shows that solutions exist and can be developed for many water related environmental issues. However, insufficient data and information is available for their evaluation in terms of effectiveness, efficiency/ impact (expected/actual) and

implementation constraints. Nevertheless, the report provides indications on transaction costs and acceptability issues for each of the instruments considered.

With regards to some of the main Dutch water management issues – flood management, water scarcity (current aestival and future) as well as diffuse pollution – the illustrations can clearly be used as source of inspiration. Regarding the management of excess water – in particular in urban areas – promoting green roofs and rainwater use could be a viable approach. Water scarcity – which is currently linked to summer months but which might aggravate in the future – could be counteracted for example through adaptations to domestic water tariffs (e.g. including block tariffs that account for both incentiveness and social affordability). In the agricultural sector, where water abstraction takes place mainly free of charge, tradable water markets could be considered in the medium term. However, this approach might have high transaction costs (in particular linked to the definition of initial water rights) and might face opposition from the farming community. The creation of tradable pollution permits is also an option for managing diffuse pollution. But European long-term experience is missing.

The report emphasises that economic instruments can be effective and efficient instruments for a diversity of water management issues. However, the decision to choose such instruments will clearly be taken based on a range of criteria including social affordability that needs to be taken into account when weighing alternatives and designing instruments.

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Chapter 1 - Setting the scene

The use of economic instruments in the field of environment and in particular water has been advocated by many as an effective means of promoting the protection of the environment - internalising environmental concerns and impacts into economic actors' decisions. The economic value of water, for example, was the key to the declarations of the Rio summit, recognising the role economic instruments could play in ensuring this value is taken into account in decisions.

In Europe, the European Treaty states the polluter pays principle (PPP) as a foundation of all European environmental policies (Article 174.2), economic instruments being considered as one way to implement this principle and providing the general framework for internalising environmental externalities – and thus being an effective means of achieving environmental policy objectives. The application of economic instruments has been further promoted in both the Fifth Environmental Action Programme of the European Commission and its current Sixth Environmental Action Plan.

In the field of water, the adoption of the EU Water Framework Directive[1] (WFD) in 2000 has marked a clear shift into the European debate on water and economic instruments. Indeed, in its Article 9, the Directive asks Member States to take account of the recovery of the costs of water services (including environmental and resource cost), assessed at the level of different sectors (disaggregated into agriculture, households and industry). It also requires that water pricing policies provide adequate incentives for users to use water efficiently, thus contributing to the environmental objectives of the WFD. References to other economic and fiscal instruments and voluntary agreements

[1] Directive 2000/60/EC of the European Parliament and of the Council of October 23rd 2000 establishing a framework for Community action in the field of water policy

are also made in the WFD in terms of the type of measures that might be proposed for achieving good water status.

There has been limited attention so far in Europe to revising existing economic instruments to comply with the requirements of Article 9 of the WFD[2]. However, the planning process put in place by Member States to develop river basin management plans is changing the context under which economic instruments can be, and are, discussed today. Indeed, programmes of measures have been developed for individual river basins and their costs estimated. The magnitude of these costs is bringing new challenges in terms of financing and of the capacity of countries or territories to mobilise sufficient financial resources to respond to the new challenges and ambitions of the EU WFD.

- On the **supply side**, financial resources traditionally available for supporting water-related investments, or the adoption of practices and processes that better account for the protection of the aquatic environment, are often fully mobilised;

- On the **demand side**, new measures have been proposed for reducing pressures for water users that were not commonly targeted by past water policy, and for tackling new environmental issues (e.g. river renaturation for reducing morphological pressures and restoring aquatic ecosystems).

Combined with the current economic and financial crisis that puts further pressure on available financial resources, this situation clearly calls for innovative thinking in terms of economic instruments for financing water management and water policy. Such instruments would need to: (1) mobilise sufficient financial resources for supporting the achievement of the environmental objectives of the WFD; (2) contribute to economic and allocative efficiency; (3) account for basic

[2] See the background document to the 2009 European Water Conference - http://www.ewc2009.eu/EWC2009-conferencedocument.pdf

economic principles (such as the *polluter pays principle* promoted by the WFD, but also the *user-pays principle* or the *beneficiary pays principle*); (4) take equity issues into account; and, (5) be in line with the requirements of Article 9 of the EU WFD, in particular in terms of the incentive they provide and their contribution to the application of the cost-recovery principle.

Chapter 2 - A review of economic instruments applied to water in Europe: what for?

In this context, the Dutch Ministry of Transport, Public Works and Water Management decided to launch a study to review the current application of economic instruments in the water sector in Europe. In particular, the study aims at:

- Presenting the **current state** in terms of the application of economic instruments in the water sector in Europe;

- Specifying the **main focus** of existing economic instruments in terms of **environmental issues** (quality, quantity, ecology…), **water users** and **economic sectors**, particular attention being given to morphological/ecological issues[3] and to the agriculture sector[4];

- Identifying possible ***innovative*** **economic instruments** applied today in the water sector in Europe, *innovative* being understood both in absolute term (i.e. an instrument that has been very recently implemented or considered in one or two Member States only) and in relative term (i.e. an instrument implemented elsewhere, in few or many Member States even for some years, and that could represent an interesting alternative for supporting water management in the Netherlands);

- Specifying (whenever possible) possible **constraints and pre-conditions** for the application of these innovative instruments;

[3] In line with the new attention given to the ecological dimension of water ecosystems.
[4] At the origin of significant pressures in many river basins in the Netherlands but also in Europe (see the background document to the 2009 European Water Conference - http://www.ewc2009.eu/EWC2009-conferencedocument.pdf)

- Summarising the ***pros*- and the *cons*-** of economic instruments that could be considered as alternative options **for the water sector in the Netherlands**.

The report presents the main results of this review structured as follows. Chapter 3 recalls the diversity of what is defined as economic instrument, stressing the multiple policy objectives instruments might have. Chapter 4 shortly presents the activities developed for collating existing information and for preparing individual short summaries of the actual implementation of selected economic instruments in individual Member States. The Chapters 5 to 8 presents the general overview and selected case studies on the application of economic instruments to target four key environmental issues, namely:

- Restoring the **quantitative water balance** and tackling water scarcity;
- **Water pollution** reduction and control,
- Restoring the **ecology** of aquatic ecosystems and reducing **hydro-morphological** pressures
- Managing **excess water** (including flood control).

Finally, Chapter 9 summarises the information collected, putting the elements of the review in the context of water management in the Netherlands. This chapter provides **first insights in the potential *pros* and *cons* of new economic instruments** that might be considered in this country.

By themselves, the elements of this review will not be sufficient to guide thinking on innovative approaches to water management that might be proposed to respond to today's challenges of water management in the Netherlands. They

will need to be combined with suggestions for innovations in the technical, legal and social (governance) fields to form the basis for robust forward thinking[5].

[5] The integration between technical, legal and economic options for future water management in the Netherlands will be the focus of the forthcoming conference co-organised in Utrecht in November 2009 by the Dutch Ministry of Transport, Public Works and Water management.

Chapter 3 - Economic instruments: what are they?

What are economic instruments?

A comprehensive definition of economic instruments remains a challenging task because of the diversity of policy measures this term encompasses. A distinction is generally made between **market-based** economic instruments and **non-market based** instruments (Strosser and Speck, 2004)- the common underlying rationale behind their application being to modify the behaviour and decisions of actors and individuals to enhance the protection of the environment, to secure an optimal level of pollution or to achieve optimum rates of resource use and depletion.

Market-based economic instruments comprise a rather broad group of policy instruments (see e.g. EEA 2005). Their common element is found in their reliance on market price mechanisms to internalise environmental costs and benefits and to provide financial incentives to economic actors. Because of their flexibility, these economic instruments are traditionally discussed in contrast to regulatory or "command-and-control" instruments (see e.g. Bernstein 1997). However, many examples of effective achievements of environmental policy targets illustrate the need for a combination and integration between regulatory and economic instruments. The most common economic instruments in use today in the field of water fall into one of the two categories:

- Instruments that **use existing markets**, modifying the market price of goods and services to account for existing environmental impacts (be it negative – leading to costs, or positive – leading to benefits) and to influence the decisions of actions and citizens. Policy interventions in this field include: (1) the application of, or changes in, tariffs for existing services ; (2) the application of environmental taxes and charges on the degradation (e.g. pollution or ecological degradation) and/or extraction

of natural resources; (3) the application of positive financial incentives (subsidies) on goods and services or good environmental practices that enhance the quality of the environment; and (4) the removal and/or reduction of existing subsidies on goods and services that negatively affect the environment (so called *perverse* incentives).

- Instruments that **create new markets** are a relatively new approach to solving environmental problems in particular in the field of water. These instruments are affecting prices not directly but by designing an institutional and regulatory framework addressing shortcomings and failures in environmental policy – by defining property rights, privatising and decentralizing, establishing tradable permits and rights, and creating international offsets. Such markets might be established for quality, quantity and ecology. Depending on their institutional framework, they might function by a direct confrontation between the demand and the supply of permits or rights (be it for quantity or for pollution). They can also involve intermediary structures facilitating financial transfers (e.g. such as it is the case for financial compensation for environmental services produced).

In addition to market-based instruments, **voluntary approaches** have increasingly been used[6]. There are many different types of voluntary approaches, with an equally wide range of terminology used to describe them. However, they can be usefully classified into the following four broad categories: (i) unilateral commitments where individual firms, or groups of firms set up environmental improvement programmes without any external involvement and communicate these to their stakeholders; (ii) voluntary agreements between two different economic actors that agree on a set of rules and practices and targets to the

[6] Examples of voluntary agreements include: (1) the voluntary agreement negotiated between the Government of the United Kingdom, pesticide producers and farmers to reduce pesticide use/pollution; (2) the agreement between drinking water supply companies and farmers for shifting land culativation in drinking water protected areas to least polluting activities.

benefits of both partners – such voluntary agreements might involve financial compensation for the loss in income which one partner might have in reaching the set target; (iii) public voluntary schemes where public bodies develop general schemes that define minimum standards of performance, and individual firms decide whether to join (eco-labelling is an example for this type of economic instrument); and (iv) voluntary or negotiated agreements where government interacts with firms (either individually or collectively) to agree on a performance target (or targets) and to define the commitments and/or obligations of both sides.

Why applying economic instruments?

Policy makers showed a growing interest in market-based instruments for environmental policy during the 1980s. An early indication of this change was the emphasis given to economic instruments in environmental policy by the report of the World Commission for Environment and Development in 1987. Furthermore, the Rio Declaration on Environment and Development (1992) discussed economic instruments. At European level, the advantages of their use are highlighted in a publication of the European Commission (European Commission 2000a):

> *The use of economic instruments, such as taxes, subsidies or other incentive payments, or tradable emission permits, will frequently offer a more effective means of achieving environmental policy objectives than traditional environmental policy instruments such as direct regulation of polluting activities.*

The practical reason for implementing market-based economic instruments is to send out a signal to economic operators or individuals on the indirect costs their decisions might impose on others by using a given resource - or on collective benefits to society one might obtain by changing behaviour and decisions. Thus, economic instruments internalise the external impact (cost or benefit) which are

not covered by the price paid for a product or a service as a result of *policy failure*[7] and/or market failure[8] (Strosser and Speck 2004, EEA 2005).

Overall, economic instruments are used to improve the economic and allocative efficiency in the use of natural resources and of the environment. Some economic instruments such as environmental taxes and charges can also help collect additional financial revenue in line with the application of the *Polluter-Pays Principle* (e.g. collecting financial resources from those that degrade the natural environment most). In the case of the charge, the revenue collected is then recycled in the water sector[9] (and not transferred to central government budgets as for taxes) mostly to promote practices and actions that enhance the quality of the environment. The following table summarises the main economic instruments that can be considered in the field of water management and policy.

[7] Existing policies generate perverse incentives leading to the overuse of environmental goods. In some cases, policy failure can result from existing subsidies put in place to enhance the competitiveness of specific products, processes, economic sectors or regions and that together with the prevailing taxation regime (unintentionally) discriminate against sound environmental practices.

[8] Market failure refers to the lack of actual markets for certain environmental goods or services and/or the failure of conventional markets to consider the environmental impacts of man-made goods and services or of the exploitation of natural resources. Prices in actual markets do not reflect the 'true' or 'full' cost (benefit) of producing the goods and services, leading to overexploitation of natural resources, excessive amounts of waste and other pollution or inadequate deliver of environmental improvements. The environmental impacts, be it positive or negative, are external to the market mechanism and are then referred to as "environmental externalities".

[9] Following the principle behind the French system of water agencies of "*l'eau paye l'eau*" (water pays for water).

Table 1. Economic instruments in the water sector at a glance

Type of instrument		Function/main purpose	Examples	Policy issues
Taxes and charges	Water tariffs	To collect financial resources for the functioning of a given water service	Tariffs for drinking water and sewage, tariffs for irrigation water	Does not account for environmental impacts resulting from the use of the service, social issues
	Environmental tax	To internalise negative environmental impacts and influence behaviour, to collect financial resources for the central budget	Tax on pollution discharge or abstraction, tax on polluting input (e.g. tax on pesticide use)	Tax levels are often too low to provide incentives effectively, thus limiting their role to revenue collection
	Environmental charge	To internalise negative environmental impacts and influence behaviour, to collect financial resources that are allocated to support environmentally friendly practices and projects	Charge on pollution discharge or abstraction, charge on polluting input (e.g. charge on pesticide use)	Charge levels are often too low to provide incentives effectively, thus limiting their role to revenue collection
Subsidies	Subsidies on products	To increase the attractiveness of "green" products and production factors that have limited negative environmental impact/footprint	Subsidies for biological agricultural products	Possible negative side-effects in other markets (additional policy failure)
	Subsidies on practices	To promote the application of practices and production processes that limit negative impacts on water resources or produce positive environmental externalities	Subsidies for agri-environment measures in the field of agriculture	Level of subsidy to ensure attractiveness by private operators, indirect economic implications
Market for environmental goods	Tradable permit for pollution	To ensure an optimum allocation of pollution among sectors	Market for pollution permits among polluters of a given river basin	Definition of permits, initial allocation of permits
	Tradable permit for abstraction	To ensure an optimum allocation of water quantity among sectors (including the natural environment)	Informal water markets in irrigation schemes Temporary/permanent transfers of water from agriculture to urban areas	Definition of permits, initial allocation of permits, how to account for environmental externalities from reallocation
	Compensation mechanisms	To establish mechanisms where environmental degradation leads to financial payment that is allocated to alternative actions to compensate for the degradation	Compensation to ecological degradation in the aquatic ecosystem	To establish the equivalence between the degradation that is caused and the environmental improvement that is put in place as compensation
Voluntary agreement		To establish contractual agreement between two parties (public/private) to promote good practices that reduce pressures on water resources	Agreements between water companies and farmers to promote good agricultural practices in drinking water protection zones Agreements between municipalities and farmers to change practices in rivers' mobility space	Effectiveness of the agreement When financial compensation takes place, question of consistency with EU rules in terms of state/public aid

Chapter 4 - How has information been collected for this review?

Information and data on existing economic instruments applied to the water sectors in EU Member States were collected via three mechanisms:

- The extraction of data and information on water-related economic instruments from the database on economic instruments developed and managed jointly by the European Environment Agency (EEA) and the OECD[10];

- The review of articles, reports, grey literature, web sites… dealing with economic instruments;

- Interactions (emails, phone and face-to-face interviews) with experts (economists and experts involved in water policy making at state level, including the implementation of the WFD and of its Article 9) from different Member States.

Overall, this short review study mobilises secondary information. No attempt was made to develop additional surveys for collecting primary information. As a result, there might be gaps in information in this report – in particular on specific mechanisms and economic instruments that might be applied at local levels (e.g. municipality) but not uniformly within a given country. While information on water tariffs for drinking water and sewage, and environmental taxes and charges applied in the water sector, can be rather easily obtained (partly as a result of the assessments performed to respond to the requirements of the WFD), information on financing for ecological improvements or reducing

[10] http://www2.oecd.org/ecoinst/queries/index.htm

morphological alteration is scarce[11]. Furthermore, as many financing instruments that are illustrated in this report are rather new, only limited data is often available on their importance in terms of total financial flows or effectiveness.

[11] It sould be noted, however, that it is not always easy to compare information on water tariffs between Member States. Indeed, the term "water tariffs" cover a diversity of elements in different Member States that are not always reported in a transparent manner – including in Member States reporting obligations to the EC.

Chapter 5 - Water quantity and water scarcity

The most common economic instrument applied in the majority of Member States[12] to manage water quantity issues are *water tariffs* or water service charges (be it for drinking water, raw water for industrial uses or irrigation water). In many cases, charges or taxes on water abstraction are also levied. In a few cases, also more specific instruments such as water markets or tradable water (use) rights are applied for water quantity management.

Water tariffs

When providing the right incentives, water pricing policies can be an effective tool for water management, by not only promoting a sustainable use of water, but also by raising funds to support water management programmes (Bernstein 1997, European Commission 2000b). A large diversity of drinking water tariffs can be found in Europe in terms of price structure and price level, distinguishing in general between different types of users: households, industry and agriculture) (EEA 2001). The most simple water tariff system is a flat rate system based on a constant fee, independent of consumption. When water metering is in place, volume-based water tariffs can be used. The following figure illustrates the four most common volumetric tariff structures found in Europe.

[12] Apart for Ireland that finances water services via the general government budget.

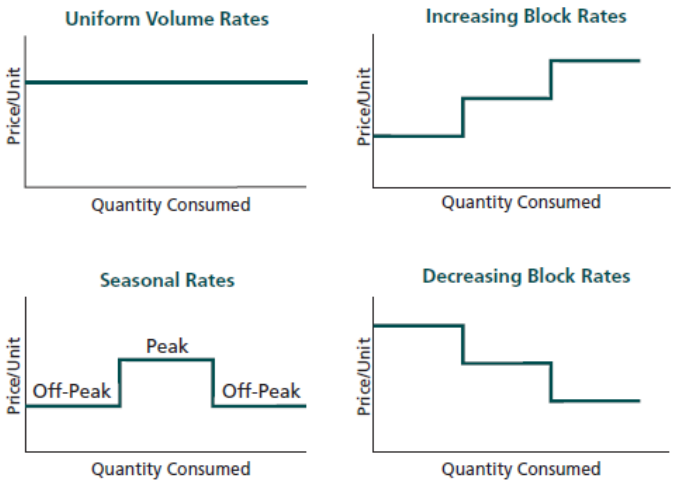


Figure 1. Different water rates in volume-based systems

Source: Chesnutt et al. (1999) found in PRI (2004)

Whereas drinking water supplied to households and connected economic sectors is most often charged on a volumetric basis[13], irrigation water is in many cases paid on a per hectare basis, independent of the quantity of water applied to crops (Dworak et al. 2007, Johansson 2000, European Commission 2000b). It is interesting to note that in many countries, water tariffs combine service charges for both drinking water and sewage/wastewater treatment (see illustration box below), thus providing a higher incentive to save water and reduce water demand.

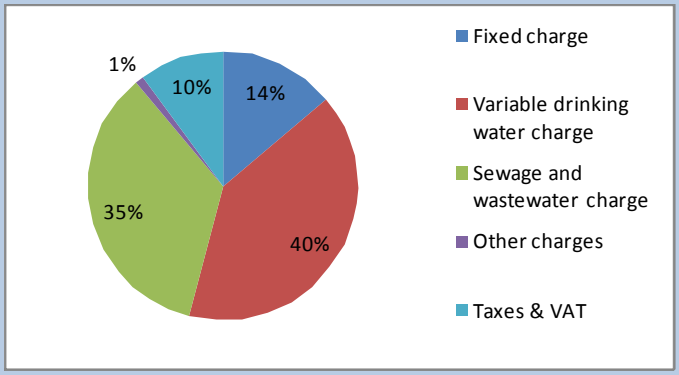
[13] In England an Wales, less than one-third of all households were metered in 2007, hindering the broad application of volumetric charges in the domestic sector (Herrington 2007).

Water pricing for European households

Water prices paid by European households consist often of four components:

- a fixed charge per year – independent of the level of consumption,
- a variable charge for the distribution and purification of drinking water per m^3,
- a charge for sewerage and wastewater treatment and
- VAT and taxes.

The share of the mentioned components in the composition of the water price is given in the figure below. It is showing that the variable drinking water charge as well as the charge for wastewater treatment constitute by far the biggest share of the total water price.



Average composition of water prices (own calculations based on IWA 2006)

Most of those components are the result of local decisions (municipal level), except mainly for VAT and national taxes. This might be one reason why water prices can differ greatly even within shorter distances in one country (EEA 2001). In the North of France, price differences up to 2 Euro/m^3 have been found even within the same river basin (Artois Picardie). Several factors can explain such a variability, for example geographical particularities, current investments, the standard of delivered services or the seasonal demand of water (Courtecuisse 2007).

What is the situation in the Netherlands?

In the Netherlands, drinking water, sewerage and wastewater treatment services are provided by three different authorities, being initially charged through three different bills. In a recent study carried out by the Waterdienst it was suggested to combine and integrate these three bills in order to develop more incentives to save drinking water (Jantzen 2008). This practice is now becoming more and more common (van der Veeren, p.c.).

As indicated above tariffs for drinking water can vary widely. This is shown for different Member States in Table 2. Ireland plays a particular role, as charges for domestic water consumers have been abolished in 1996 (Scott 2003).

Table 2. Average drinking water tariffs in selected Member States

Country	Average variable drinking water charge (€/m^3)	Country	Average variable drinking water charge (€/m^3)
Austria	0.99	Italy	0.52
Belgium	1.17	Ireland	0.00
Cyprus	0.45	Latvia	0.42
Czech Republic	0.53	Lithuania	0.48
Denmark	1.00	Portugal	0.72
France	1.05	Slovakia	0.35
Germany	1.86	Spain	0.47
Greece	0.75		

Sources: IWA 2006, adapted; Morris & Kis 2004; Diernhofer et al. 2003; BDEW 2008; Semeniene (p.c.) 2009; Berbel 2008; Scott 2003

The variation of water prices can be explained by different factors. This includes for example environmental conditions (costly treatment due to pollution), the quality of the drinking water provided, the state of the infrastructure or the level of cost recovery, - and complicates any attempt to thoroughly compare prices (e.g. Kraemer & Piotrowski 1998, Schmitz 2002).

What is the situation in the Netherlands?

Currently, the average price for drinking water in the Netherlands varies between 1 and 2 €/m^3, excluding the costs for piping, which are mostly billed as a fixed fee in addition to the m^3 price for the water used (Jantzen 2008). Compared to the water prices shown in the table above, tariffs in the Netherlands are relatively high. This is explicable by various factors. Whereas for example in Spain and Italy water tariffs are subject to considerable subsidies, the Netherlands (and Germany) have a high degree of cost-recovery. Furthermore, quite expensive measures to purify water of nitrates and pesticides are necessary in the Dutch context due to a high pollution pressure. Thirdly, the elevated prices reflect also the good state of the water infrastructure, showing only very low leakages (Kraemer & Piotrowski 1998)

However, large differences between costs for drinking water exist also within the Netherlands. In some parts, very old pumping stations are used to pump groundwater – with no need for recovering investment costs. This makes drinking water e.g. in the eastern part of Groningen relatively cheap. This contrasts for example with Rotterdam, where water from the Meuse is taken and purified using expensive purification processes (van der Veeren, p.c.).

As water prices are of particular social interest, several countries have specific price structures which take social aspects into account. However, a weighting

between social issues and the incentiveness of prices is necessary in this case (European Commission 2000b). In the Walloon region in Belgium, for example, a water tariff structure for domestic users driven by social considerations tarification has been applied since 2005, setting prices based on different tariff brackets (see table below) differentiating between different levels of demand/use (Salvetti 2005).

Table 3. Tariff brackets in the Walloon region (2005)

	Volume Bracket (m^3)	**Tariff (€)**
Vital bracket	From 0 to 15	0.80
Social bracket	From 15 to 30	1.39
Normal bracket	From 30 to 60	2.06
Comfort bracket	Over 60	3.06

Source: Salvetti 2005

In the given Walloon example, the two first brackets are dedicated to "social use" and the two following ones are expected to have an incentive effect as the volumetric water price is raised by 32% and 54%, respectively (Salvetti 2005).

In the case of agriculture, there is a larger diversity of charging schemes for irrigation water. In many irrigation schemes (in particular large public financed irrigation systems with gravity irrigation), irrigators pay a fixed charge depending on the total irrigated area. In irrigation systems managed by small associations of irrigators, charging systems can combine a fixed flat rate per unit area or per farm and a volumetric rate depending on the volumes of water effectively used. In some cases, different rates can be applied to different crops; a system being usually based on differences in crop water requirements. Water pricing is often also coupled with other water management instruments, e.g. quotas like in Italy, France, Spain and the UK (OECD 1999, Dworak et al. 2007, EEA 2001, see also Johansson 2000).

What is the situation in the Netherlands?

With respect to agriculture, one of the objectives of regional water quantity management as executed by regional water boards concerns irrigation and drainage of rural areas. This is also the historic start of regional waterboards: a couple of farmers sitting together, thinking of ways to deal with water in order to manage excess water in wet periods, but secure water supply in dry ones. These farmers implemented measures (e.g. dykes and pumping), which were primarily performed and paid for by the agricultural sector. This principle is still in place, although nowadays nature conservationists and households also want to have a say in regional water management. As a result, they contribute financially to regional water management. Therefore, not all costs are paid by farmers although they still pay an share of the costs based on the total land area they own (van der Veeren, p.c.).

Concerning public water supplied to industries, special tariff arrangements partly justified by economies of scale are rather common (e.g. Germany and France). However, there is a clear lack of public information on the structure of industrial water tariffs, as the terms of the contracts are usually not made public. In some Member States like Belgium and France, lower prices are granted to large users, this being contradictory to the need for water prices to play an incentive role to reach environmental objectives (Roth 2001).

Abstraction charges and taxes

Abstraction taxes and charges are in place in most European countries. They target in particular households and industry, and only to a lesser extent agriculture, that may sometimes benefit from lower rates (ECOTEC 2001). These instruments are even more widely used in Central and Eastern European (CEE) countries which have recently joined the EU. They are mainly using abstraction charges that are earmarked to environmental funds and water protection (Strosser and Speck 2004).

The structure of the abstraction charges is volumetric in most cases, with the user paying a unitary rate per cubic meter abstracted. However, different systems can be found. In the United Kingdom, for instance, the system is based on licenses and charges on abstractions made above the permitted volume. A

volume-based system implies metering. For non-metered agricultural abstraction, fixed charges per hectare can be used, as for example in the Seine-Normandy river basin district (France). In addition to the abstraction charge, the Seine-Normandy water agency also applies a consumption charge to the user. For industries which consumptions are unknown, a specific coefficient to each type of industry is applied for transforming abstraction into consumption (Strosser and Speck, 2004).

What is the situation in the Netherlands?

Similar to the UK, a system of licences for groundwater extraction exists in the Netherlands, with different tariffs being applied in the different provinces. When only limited amounts of groundwater are extracted, no licence is needed and no charges have to be paid (van der Veeren, p.c.).

Water abstraction charges or taxes can be modulated according to the user but also to the source, giving a signal to water users on which resources to tap in priority and which resources to protect. Baltic countries for example have developed such a system (see case study below, Speck et al. 2006). Other examples of water abstraction charges that account for the environmental sensitivity of the water body and differentiate between surface water and groundwater is the water charge of the Seine-Normandy water agency in France (Strosser and Speck, 2004).

Exemptions to abstraction taxes and charges are not rare. They are applied in regions or water bodies where the water balance is largely positive. Also small water abstractors are often exempted, as the costs of collecting revenue might outweigh potential financial revenues from the abstraction charge/tax. In some cases, the exemption for small water abstractors might be a 'de facto' exemption for specific uses or economic sectors (e.g. the exemption given to small abstractors in the Netherlands is an indirect exemption to agriculture and domestic water abstractors).

Water charges are often levied by the government or water agencies. In Sweden and Finland, however, the charges are levied at municipal level, leading to a great variability between different cities (Hiltunen 2004, Speck et al. 2006).

Table 4. Illustrating individual abstraction charges in selected EU countries

Country	Source of water	Unitary rate
Denmark	All sources of water	0.67 €/m3 for domestic users only
Finland	All sources of water	1.34 €/m3 in average but depending on the municipality
France (Seine Normandy – basic rate)	Surface water On volume abstracted On volume consumed Groundwater On volume abstracted On volume consumed	 0.00071 €/m3 0.04 €/m3 0.024 €/m3 0.04 €/m3
Hungary	All sources of water	0.007 to 0.02 €/m3 depending on the use
The Netherlands	Groundwater Drinking water	Charge depends on the province (varying between 0.81 and 2.54 cent/m^3 in 2003)

What is the situation in the Netherlands?

In the Netherlands, there is no specific levy today for surface water abstraction, although this issue is regularly debated at policy level, in particular in periods of water shortage. The situation is rather different for groundwater: in addition to a groundwater levy, which is going to the provinces and which is earmarked for anti-dehydration studies, a groundwater tax has been established wich revenues flow into the general state budget. Also a drinking water tax exists.

All these taxes and levies are aimed at reducing (mainly ground-) water use that represents 2/3 of the Dutch drinking water source. However, price elasticity of drinking water is relatively low. The drinking water tariff combined with these additional taxes does not give a real incentive for water saving (Jantzen 2008).

Other economic instruments for managing water quantity

Other economic instruments for water quantity management include for example agri-environmental subsidies which can be granted famers who stop irrigation on plots located in water scarce regions. This measure is used for instance in the Marais Poitevin region (France) which is suffering from a high water stress. However, only a limited number of contracts have been signed so far. Investigations of farmers showed that the level of the subsidy was not sufficient. In addition, there is high uncertainty on the time period the subsidy will be available.

As for the managing of excess water (see chapter below), the use of a National Environmental fund is reported in some countries (Bulgaria, Czech Republic, Lithuania, Slovenia). In Slovakia, subsidies from the State budget on water quantity monitoring are used (EEA 2006).

What is the situation in the Netherlands?

In case of water shortages, water is allocated following an agreed prioritisation among water users. The hierarchy among water users helps the Dutch government to point out water users who will have the priority in receiving scarce water resources (Jolink 2009).

Tradable water rights systems are not commonly used in the EU. However, they are operational as informal water trading systems in many local irrigation systems in most Mediterranean countries. Tradable water rights are, for example, in place in Catalonia (Spain) where farmers can temporarily or permanently sell their water right(s) to other farmers or to water supply companies (see case study below, Tarrech 1999). Informal trading is also reported in other irrigation schemes in most Mediterranean Member States.

Water markets

In theory, water markets allow for an efficient reallocation of the water resource between users, with supply and demand being automatically adjusted to each other through the "invisible hand" of Adam Smith. Furthermore, water users are encouraged not to waste water as they have the opportunity to sell it. For a water market to be successful, some conditions have to be fulfilled (Holden and Thobani 1996, see also Panayotou 2007):

- Ensuring stakeholder participation in designing and implementing the new legislation
- Deciding on rules for the initial allocation of rights and on how new rights would be allocated
- Establishing a public registry and block titling
- Setting up or strengthening water user associations
- Protecting against the development of potential monopolies
- Ensuring that trades do not infringe the water rights of existing users
- Establishing appropriate environmental laws.

In practice, few empirical studies have assessed the impacts of water markets on society and the environment (Bauer 2004). Existing evaluations suggest that markets seem to work best when accompanied by other instruments (e.g. regulations, education) to ensure that equity and environmental goals are met. An important political barrier to implement markets is the fear that water markets will lead to water being treated as a *commodity* and loose its value as an essential and social good: indeed, markets allow whoever can pay to access water, irrespective of other social and environmental goals.

Looking outside of the EU

As shown for the case of Europe, there is a broad variety of tariff structures for drinking water supply services. Indeed, water tariffs are often a matter of local policy set at municipal scale.

In Canada, 43% of domestic water was not metered in 1999 and therefore charged at a flat rate[14]. Generalized deployment of metering was judged to be costly and requiring a cost-benefit analysis that is often beyond the capacity of smaller municipalities. The metered consumption was mainly charged with a uniform volumetric rate (68% of metered consumption) and the remaining with increasing or decreasing block tariffs. Water prices in Canada are variable, but generally lower than in other OECD Countries. Municipalities get subsidies in the form of capital grants from provincial and federal governments for their water infrastructure, and most of them subsidize both the consumption of water and the extension of their pipe networks into new developments. This can have the effect of reducing the price to all consumers irrespective of water use or income, and may be seen as a signal that governments view water as an essential service rather than an economic good (Environment Canada 2001).

Most industries abstract water directly from water bodies. The price of water in this sector is therefore often the cost of self-supply plus any fees or taxes (usually minimal) imposed by governments. Taxing industrial water use may give the industry the incentive to reduce consumption or to increase efficiency through recycling and treating wastewater. However, this is not widely spread in Canada.

Metering is not common in the agricultural sector; hence irrigation charges are often based on the number of hectares irrigated rather than on the amount of water used (Tate 1990). Additionally, many agricultural subsidies promote increased irrigation and irrigation-dependent crops.

[14] Constant fee regardless of water consumption.

Water markets are more widely used outside of Europe. Each market is specific to its own local and institutional conditions and therefore, each experience is different. The main examples are the following (found in Environment Canada 2001):

- The most widely cited reference to water markets is water markets in Chile. Indeed, water markets are formally recognised and embedded into the water law (revised in 1981). Recent analysis suggest that a number of issues still have to be resolved, including externalities and better definition of the water rights. Trading is still limited in many regions of the country and the markets did not have the effect of increasing agricultural water use efficiency, which was initially anticipated (see also Bauer 2004 and de la Luz Domper 2009).

- In the Rio Grande water market (New Mexico), annual and permanent water rights are leased and traded, usually within the same sector. Although it has led to an efficient allocation, the Rio Grande market resulted in little investment in efficient technologies, and total water use has actually increased. Issues of fairness were also raised, as smaller and poorer user organizations and municipalities are disadvantaged.

- In the water market in Texas, only stakeholders who make economic gain can use water. With a negative consequence for the environment, NGOs were not allowed to buy water rights for ecosystem preservation.

- California's case is different in the way that the trades occur between a small number of water agencies rather than a large number of direct users. Only 3 to 6% of the total annual water use is traded but the market is expanding.

- When markets were first introduced in Australia, legislation was not adequately designed, resulting in many environmental, economic, and social damages. Many reforms are currently discussed such as the

dissociation of the entitlement and allocation system, the implementation of a bank-like system, etc. The positive effects of the Australian water market on the environment are so far more linked to a strong regulation. For instance, farmers who want to be involved in trading have to adopt water efficiency practices (see also frontier economics 2008).

Investigating inspiring solutions and options

Several options applied by Member States have been investigated in more details and are presented below. The economic instruments illustrated include:

- *Water abstraction charge in the Baltic countries*. The water abstraction charge in these countries is based on the source (surface water, groundwater, mineral water) and the region in which water is withdrawn. This system provides better signals to water users on the value of water.

- *Financing substitution reservoirs the farmers to access good quality water in the Boutonne river basin (France).* The development of intensive agriculture in this region of France has led to severe problems in terms of water quantity and water quality. To ensure its supply, a drinking water supply company decided to finance water reservoirs for farmers in exchange of using their boreholes in a (high quality) water aquifer.

- *Tradable water rights – the Siurana-Riudecanyes District water market (Catalonia, Spain).* Water markets are used in different countries outside of Europe but more rarely found within the EU. In this water scarce region of Spain, the trading of water use rights leads to an efficient allocation of water within farmer associations as well as between farmers and municipalities. The magnitude of the market varies between years according to the annual availability of water resources.

Water abstraction charge in the Baltic countries

Objective:

In addition to the charge paid by the consumer, a water abstraction charge was introduced in the Baltic countries. This charge depends on the source of the water (groundwater, surface water, mineral water) and the region. The charge structure allows getting closer to the polluter-pays-principle, generates revenues and encourages the efficient use of water.

Description:

In Estonia, the charge for the abstraction of water ranged between 0.0016 and 0.42 €/m3 in 2005, as shown below:

Source of water	Type of extraction/area	Charge in €/m3
Underground water	Most upper ground level	0.028
	Lowest ground level	0.042
	Extracted from mines and quarries	0.0045
Surface water	From Tallinn catchment area	0.021
	From Tallinn catch. Area for cooling	0.0032
	From other area	0.013
	From other area for cooling (Narva Power Plant)	0.0016

This charge is not applied to all uses. Irrigation, water used for fishing ponds and energy generation activities based on water are for instance not charged.

Latvia and Lithuania use the same type of water abstraction charge system. Surface water is charged 0.003€/m3 in Latvia[15] and 0.0003€/m3 in Lithuania[16]. Groundwater charges range in the same amounts for both countries (0.01 and 0.014 €/m^3). Mineral water is charged with a much higher price in Lithuania (1.2 €/m^3) than in Latvia (0.29 €/m^3).

As for Estonia, the fee is not applied to all users in Latvia. Hydroelectric power stations, fish ponds and the reuse of water in industry are free of charge. In Latvia, agriculture is not exempted. In Lithuania, only land users using water on their own land for domestic purposes are exempted.

Stakeholders involved:

In Estonia, the charge on water abstraction was introduced by the Water Law. The charge levels are set by governmental regulations, in particular by the Ministry of Environment. The charge was introduced in Latvia through the Law on Natural Resources in 1996. For Lithuania, the principles of a charge on water abstraction are established in the Law on the State Natural Resource Tax. Charge rates are indexed quarterly according to the consumer price index.
The revenues from the charge are divided equally between the state (Ministry of Finance) and the respective local municipalities

Relative importance:

The abstraction charge generates revenues close to 3 million € for the Lithuanian budget. Around 90% of this stream is generated by surface water abstraction for energy production (cooling of the Ignalina nuclear power station).
In general, the abstraction charge gave good results in the Baltic countries. For example, it stimulated the reduction of the large leakages identified in the Latvian water supply companies' networks in the 1990s.

Source: Speck et al. 2006

[15] Charge level in 2004
[16] Charge level in 2002

Financing substitution reservoirs for farmers to access good quality water in the Boutonne river basin (France)

Objective:

The Boutonne river basin in France suffers from important water shortages combined with water quality problems affecting drinking water companies. In the Northern part of the basin, a drinking water company has been acquiring boreholes from farmers to access very good quality groundwater in exchange of financing reservoirs for irrigation.

Description:

A monitoring programme of farmers' boreholes pumping water from the deep groundwater aquifer of the upper Boutonne revealed an excellent water quality. At the same time, the local water supply company of the sector, Syndicat 4B, was facing increasing water quality problems. A project was launched to finance reservoirs for irrigation as a substitute to boreholes that were then transferred to the drinking water company. Fifteen boreholes were concerned by this project. Syndicat 4B plans to abstract between 1 and 1.2 million m^3 of water per year, which is slightly more than what was abstracted by the farmers. However, abstraction by the water company will be spread over the year, resulting in a significant reduction in pressures on water resources during the summer period (by almost half). The capacity of the 15 boreholes represents today 40% of the Syndicat 4B water production. Reservoirs are built with a total capacity equivalent to the volumes that were previously abstracted from the deep groundwater aquifer.

Stakeholders involved:

The project was managed by the Syndicat 4B, with the contracting authority being CAEDS (Compagnie d'Aménagement des Eaux des Deux Sèvres). The stakeholders benefiting from the reservoirs are ten farmers that were previously borehole owners. Subsidies for financing the reservoirs are also provided by the French government, the Loire-Bretagne Water Agency and the "Département". The project is not finalised yet. The terms of reference for building the reservoirs have been published and the project manager for these reservoirs has now been appointed (April 2009).

Relative importance:

The volume of water at stake is around 1 million m^3 per year. The total cost of the reservoirs project is 6 million €, of which 4 million € (66%) are paid by public subsidies, with 2 M€ being paid by the Syndicat 4B. Projects for building reservoirs for agricultural irrigation in the region are very common. Water is scarce and important quantitative imbalances are present in different water bodies and catchments. However, the above described case study is unique in the institutional and financing mechanisms put in place.

Source: CAEDS, Individual farmer (phone calls, April 2009)

Tradable water rights – the Siurana-Riudecanyes District water market (Catalonia, Spain)

Objective:

The aim of the water market is to make an effective allocation, utilization and management of the water resource in regions suffering from water scarcity. The owners of water rights are allowed to temporarily or permanently sell their rights to other members of the association. In a region of Spain, such a market of water rights is established between farmers and municipalities.

Description:

Located in the region of Catalonia, the Siurana-Riudecanyes district has a hydraulic structure consisting of two dams and a network of pipes and canals. The Riudecanyes dam was build in the beginning of the 20th century with 50% contribution of the State, 40% as a loan to be repaid after twenty years by the users and 10% of immediate contribution by the users. The Siurana-Riudecanyes Irrigation Subscribers Association was created at that time and was run as a private corporation[17]. As part of the concession agreement[18], 2/3 of the water was to be used for irrigation and the remaining 1/3 for municipal water use (mainly the city of Reus). The water to be utilised by famers was allocated through titles by the Association. The titles were sold to the members of the association at an initial fixed price. Each title gives the owner the right to use 1/13275[19] of the water available each year. Water titles are tradable, permanently or temporarily. The price varies according to the supply-demand rule. For example, the title price was US$ 3.8/m^3 (2.67[20] €/m^3) in 1980. It increased to US$ 9.5/m^3 (6.68 €/m^3) in 1986, due to general water scarcity in the region and the high price of the hazelnut (principal production of the area). The title price dropped to US$ 6.6/m^3 (4.64 €/m^3) in 1990 and to US$ 4.3/m^3 (3.02 €/m^3) in 1993.

Stakeholders involved:

Initially, informal transactions with little legal or financial structure characterized the market. The stock Market of Reus later served as a meeting point for transactions. In the 1980s, an official exchange administered by the The Siurana-Riudecanyes irrigation subscribers Association was formed. The Association represents the farmers and negotiates the transfers with the water companies that supply the municipalities. This power equilibrium and the information symmetry about water supply and water demand allow “fair” transfer prices. Large groups of titles were owned by a small number of individuals at the beginning. The market led to the breakup of these “pockets” and ownership is now spread among 3 000 families.

Relative importance and implementation constraints:

The Siurana-Riudecanyes district water market system is one of the rare examples of tradable water right markets found in Europe. However, other examples can be found e.g. in Chile, in the United States or in Australia (see main text).

The successful features of this system include: the active participation of the water users, the structure of the managing institutions, the good definition of the water rights, the transparency

[17] A Directive Council (the “board”) is elected. It names a Regional Administrator (the “executive director”)

[18] In Spain, water resources belong to the nation but the right to use it may be obtained through a government concession

[19] The total number of titles is now 13 275. 3 275 titles belong to the city of Reus as part of the original agreement.

[20] Today’s conversion rate has been used to calculated prices in €: US$ 1 = 0.70 €

of the management (accounts, water availability) and the small size of the market. Another important feature of the system is the allocation of water rights at the time of the creation of the resource. A more challenging scenario for policy makers is distributing water rights when private users have historic claims on these rights.

Source: Panayotou 2007; Tarrech 1999

Chapter 6 – Water quality

Water quality refers to the chemical quality of water bodies. Different pollutants are important in this regard, including for example nitrates, phosphorous, organic pollutants or metals. Pollution sources are generally divided into point and diffuse pollution sources. Whereas good instruments are available for controlling point sources, this is more difficult for diffuse sources, as technical constraints exist for public authorities to monitor actual emission levels (OECD 2007; see also Pearce & Koundouri 2003).

Different European Directives influence significantly the handling of water quality. The EU Nitrates Directive regulates for example the application of nutrients at farm level, whereas the Drinking Water Directive sets upper limits on the concentration of nitrate in drinking water. The Water Framework Directive aims at reaching "good status" of all water bodies by 2015. Finally, the Common Agriculture Policy (CAP) has to be mentioned, which includes large subsidies with strong impacts on agricultural activities, as well as several Directives regulating pesticides use (OECD 2007, Roth 2001). In the following, some information on economic instruments applied for point and non-point sources control will be described.

Point source pollution

The most common economic instruments used for point source pollution control are tariffs for sewage and wastewater (see Chapter 5 for more information on water prices). In most countries they are charged to households and industry together with the water bill, depending on the volume of drinking water used (EEA 2001). In the EEA-OECD database[21], they are mentioned for 16 European countries. The rate of the wastewater charges in selected European countries is shown in the table below.

[21] http://www2.oecd.org/ecoinst/queries/index.htm

Table 5. Average wastewater treatment and sewerage charges in selected Member States

Country	Average wastewater treatment and sewerage charges (in €/m^3)
Austria	1.69
Belgium	0.89
Cyprus	1.38
Czech Republic	0.45
Denmark	1.45
France	0.97
Germany	2.14
Greece	0.64
Italy	0.42
Latvia	0.51
Lithuania	0.68
Portugal	0.26
Slovakia	0.22
Spain	0.49

Sources: IWA 2006, adapted; Morris & Kis 2004; Diernhofer et al. 2003; BMU 2006; Semeniene (p.c.) 2009; Berbel 2008

In Germany, however, two different ways of charging for sewage services exist, being based either on the freshwater scale or on a split scale (see box below).

Wastewater fees in Germany

In Germany, charges for wastewater collection and treatment are either based on a split fee scale or on the freshwater scale. The split scale is composed of a sewage charge based on the amount of freshwater consumed and of a separate rainwater (stormwater) charge, based on the area of drained land. Under the freshwater scale, only drinking water is used for the calculation. The costs for stormwater management are included on a pro-rata basis. A trend can be observed towards the use of a split scale. This allows a more equitable fee structure. About 60% of the connected households are charged this way. The average wastewater fees in 2003 are given in the table below (BMU 2006).

Split scale		Freshwater scale
Sewage	Storm water	
(€/m3)	(€/m3)	(€/m3)
1.97	0.82	2.14

Average wastewater fees in Germany 2003

In order to cover the fixed costs of wastewater treatment which represent around 75-85% of the total costs, an additional standard basic charge is levied in some regions. Currently, 11% of all inhabitants pay a fixed annual amount. In other regions, costs are only covered by volumetric tariffs (BMU 2006).

What is the situation in the Netherlands?

Sewerage is often paid for as a fixed price (independent from water consumption). Households pay for wastewater treatment depending on the size of the household, considering 1 or 3 persons (thus 2-person-households subsidize larger households). By combining the entire water chain costs (including drinking water supply), and calculating them per m^3 the water price would amount to 4 €/m^3 (Jantzen 2008). Industrial sources that discharge their wastewater over public wastewater treatment plants pay according to the number of population equivalents (based on the BOD and/or COD content) (van der Veeren, p.c.).

Another common instrument used in the EU Member States is the water effluent or pollution charge. In 2000, seven of the 15 EU countries were already using this instrument and a further five considered the possibility to introduce it (EEA 2005). The amount of the charge is usually calculated based on the quantity of different pollutants in the effluent. This includes in general the chemical and biological oxygen demand (BOD), heavy metals, suspended solids, nutrients (nitrogen and phosphorus) and the total volume. The liability depends usually on a small number of characteristics; in Denmark for example only on biological oxygen demand, nitrogen and phosphorus (Speck et al. 2006). Whereas some water effluent charge schemes cover only direct discharges to surface water (Denmark, Germany, Spain and the United Kingdom), others include indirect discharges (Belgium, France and the Netherlands). The German charge is even designed to provide incentives for reducing water abstraction. Levies implemented in Belgium, France and the Netherlands have a dual function; they shall cover the general costs of wastewater collection and treatment services, but also provide funding sources for water-related investments (EEA 2005).

In central and eastern European countries, water pollution charge schemes form often part of complex systems of pollution charges levied on a large number of pollutants (EEA 2005, Speck et al. 2006). In Romania for example, “the number of chargeable pollutants increased from two to more than 30 different pollutants between 1991 and 2002”. Furthermore, when the pollution concentration exceeds permitted levels, also non-compliance fees have to be paid for discharges in several countries, e.g. Bulgaria, Estonia, Poland and Slovakia. In Lithuania for example, these non-compliance fees can amount to up to 300 times

the base rate in specific cases, depending on the hazardousness of the pollutant (EEA 2005).

In central and eastern European countries, earmarking water pollution charges for environmental investments is common. Former 'extra-budgetary' units which existed under the Soviet regime with the task to manage those earmarked revenues were often transformed into environmental funds which ensure the utilisation of the money for environmental measures. During recent years, some of the environmental funds have been dissolved, others have been transformed into a foundation (e.g. the Environmental Investment Center Foundation in Estonia) or into a special line in the annual budget of the Ministry of Environment (e.g. Hungary) (different sources, in EEA 2005). Changes are expected to continue. Whereas environmental funds in Belgium, France or Germany have clearly defined, sector-specific objectives, they provide financial means for a broad range of environmental needs in central and eastern European countries (EEA 2005).

Concerning the financing of water supply and wastewater treatment infrastructure in certain European countries, e.g. Greece, Spain, Portugal and Ireland, also the Cohesion Fund can be named as a major source (EEA 2006).

Diffuse pollution

The OECD (2007) carried out a survey on policy instruments addressing non-point sources of water pollution. For both nutrients run-off and pesticide use, regulatory instruments turned out to be the most common. For nutrients, economic instruments are largely dominated by subsidies. For pesticides, information instruments are still more common than economic instruments. Taxes and charges currently play only a small role in addressing non-point sources of water pollution in agriculture.

Taxes on pesticides exist for example in Denmark, Norway, Finland, Sweden, France and Belgium. Whereas the tax applied on pesticides in Norway is based on

the recommended area doses of the different products, it depends in Denmark on the price of each product. In Sweden, France and Belgium the tax rate relates to the weight of the active ingredient. In Belgium however, all agricultural uses of pesticides are exempted (OECD 2007; see also Peace & Koundouri 2003).

Table 6. Summary of pesticide taxes in four Nordic countries

Country	Year of introduction and adaptation	Reference base of the current tax	Objective
Denmark	1986, 1996, 1998	Based on the maximum retail price[22], differentiated between different pesticides	Influences the use of pesticides by farmers and reduces total consumption
Finland	1988, 1998	Added value fee levied on pesticide dealers, set at 3 % of the previous year's turnover	Finances the control and registration costs associated with the use of pesticides
Norway	1988, 1999	Changed from a value added tax levied on wholesalers of pesticides to a tax per normal dose	Originally to finance selected environmental projects; reduction of pesticide use
Sweden	1984, 1995	Based on the weight of the active ingredient and imposed on pesticide manufacturers and pesticide importers, being SEK 20/kg (in 2001)	Reducing environmental risk and health risks associated with the use of pesticides

Source: Söderholm 2004, Schou & Streibig (*after* 1999); own compilation

Reductions in pesticide use have been noticed after the introduction of the taxes. Nevertheless, a large part of the observed reductions might be due to a transition to low-dose agents, having the same impact while using smaller quantities of pesticides. Observed volume reductions do therefore not necessarily correspond to reductions in health and environmental impacts (Söderholm 2004). Also Pearce and Koundouri (2003) state that – although countries which have introduced taxes on pesticides (and nutrients) experienced reductions in their use – price elasticity estimates are low. This leads to the assumption that the taxes result in comparably low reductions in quantity, unless they are set very high compared to the price. The redirection of the corresponding revenues to research and information might have had a higher environmental effectiveness (see also Sjöberg 2005).

[22] For a small number of products it is based on the wholesale price.

Another instrument for limiting diffuse pollution coming from agriculture is the establishment of voluntary agreements between drinking water suppliers and farmers, involving compensation payments e.g. for organic farming practices. Examples can be found in different countries (e.g. Germany, the Netherlands). Those collaborations of stakeholders are in particular important concerning diffuse pollution, as it is not easily traced or monitored (Hoffman 2008).

What is the situation in the Netherlands?

Systems of voluntary agreements between farmers and drinking water producers are quite common in the Netherlands, especially in groundwater protection zones. The contents of these agreements include pesticides and/or nutrients (van der Veeren, p.c.).

In the UK for example, where nutrient surpluses per area are relatively modest (compared to the Netherlands), the system relies mostly on regulations which are setting limits for nitrogen application and pesticide use, on training and information provided to the farmers, on a general requirement to comply with the relevant Directives in order for the farmers to qualify for income support under the CAP and on some subsidies to facilitate compliance. In Denmark, however, where agriculture is rather intensive, relatively strict instruments are needed to limit the environmental impact. Quotas for nitrogen application per area unit are calculated for each farm. This takes soil and weather conditions as well as current and past crop choices etc. into account. The quotas are set 10% below the agronomically optimal level, in order to reduce nitrogen run-off. Very significant fines are set for farmers exceeding their quotas. Furthermore, different subsidies exist to encourage farmers to transform sensitive farmland into wetlands or forests. In 2005, also a tax on mineral phosphorus added to animal feed was introduced. Taxes on pesticides – linked to the price of the different products – are in place for a few years (OECD 2007).

Additional economic instruments

Nordic countries (Denmark, Norway and Sweden) have recently initiated activities on tradable permits for polluting discharges in the aquatic environment.

At this stage, these are not yet operational: Sweden, however, has launched a pilot project for testing the operational aspects of implementing such a tradable permit schemes.

A recent study on behalf of the OECD (Trémolet & Scatasta 2009) analysed innovative financing mechanisms in the water sector. One illustrative example is presented in the box below on financing of water and sanitation services in the UK.

Financial innovation in the water sector in England and Wales

In the fully privatised water sector in England and Wales, securing access to finance is critical in order to comply with the water quality improvement targets of the European Union through adequate investment programmes. As a consequence, considerable financial innovations took place in the last ten years. One financing structure that combines several innovations is the artesian loan facility, which was created to allow England's smaller water only companies (WoCs) access to bond finance, as this is usually cheaper than commercial bank finance. Most WoCs are not large enough to issue bonds individually on commercially viable terms. The Artesian Loan facility provides an "umbrella" under which the WoCs can group together to issue debt at cheaper conditions. The credit quality of the combined bond issue is guaranteed by a so-called "monoline insurer", which guarantees the bondholders' demands in the case of failure of one of the firms in the loan structure. Investor security is further enhanced by disclosure agreements and isolating water revenues from other interests in the company. This combination of measures enhancing credit quality allowed small companies with large capital expenditure programmes to raise the required financing at very preferential terms (Trémolet & Scatasta 2009).

What is the situation in the Netherlands?

"The Dutch water sector has its own financing institution, the Nederlandse Waterschapsbank (Waterboards Bank). It was created in 1954 by the water boards, and is effectively their house bank. It has a triple A credit rating and makes long-term loans to water boards, municipalities, and other public institutions. In 2002 it had a loan portfolio of nearly €20bn. It finances its activities on the international money and capital markets. Given the legal structure and requirement to maintain a balanced budget, the water boards have a credit risk rating of 0, which saves the bank having to employ credit analysts or project assessors."

Extracted from: de la Motte 2004

Looking outside of the EU

Other examples of economic instruments applied outside of the EU regarding water quality management are presented below:

- Watershed collaborations as a means of water quality control in the USA: For addressing problems of non-point pollution, collaborations have become increasingly common in the USA. They are managed by thousands of "Watershed organisations", being mainly purely voluntary organisations, "which seek community commitment to and assistance in resource protection through the collaborative process" (several sources, in Hoffman 2008).

- Effluent charges and sewer discharge fees have been introduced in British Columbia. Effluent charges not only provide an incentive to reduce pollution, but since most of the effluent water was intake water, they can also reduce water use. Their use is still limited in Canada, but international experiences suggest that they can be effective as part of a package that includes strong stakeholder buy-in and the use of revenue to fund other instruments, such as education and technological improvements (Andersen 1999 & Green 2003, in: PRI 2004).

- In New South Wales, Australia, a load-based licensing scheme is in place. It sets limits on the pollutant loads emitted by the state's larger, potentially most polluting industries which hold environment protection licenses, while linking licence fees to pollutant emissions. The instrument also provides the administrative infrastructure for emission trading schemes. These enable emissions to be controlled from groups of licensees as well as from individual premises by allowing licensees to buy and sell credits for reducing emissions (NSW 2009a). Licensees have also the possibility to agree upon load reduction agreements. These are voluntary contracts which provide immediate fee reductions for

companies willing to commit to future reductions of pollutants. As it often takes time to implement new technologies to reduce pollution, the agreements allow saving fees during this period in order to invest in improved environmental performance (NSW 2009b).

- In Japan, the amendment of the Sewerage Law in 2005 opened a new framework for market based instruments, in particular the Tradable Load Reduction Assignment (LRA) for nitrogen and phosphorus in the basin of enclosed water bodies (Otsuka 2008). The transferable LRA is somewhat similar to transferable permits in the water quality trading employment in the USA, but only applies to the advanced treatment of wastewater treatment plants in order to improve sewage treatment in inner bay basins (Jujiki *after 2005*).

An interesting example of soil salinity management and its impact on water is described in the box below.

Salinity permits, Australia

The replacement of native vegetation with crops and agricultural systems in Australia has substantially increased the amount of water entering ground water systems, leading to massively rising water tables. This results in a mobilisation of salt, formerly stored in the landscape. Higher stream and soil salinity reduces the productive capacity of agricultural resources, can adversely affect infrastructure such as roads and cause considerable water supply problems. Furthermore, rising river salinity threatens the biodiversity of wetlands and river ecosystems.

The Murray-Darling basin has adopted an interesting solution for salinity management on a regional level. States within the basin have to meet electrical conductivity (EC) levels at the end of their river valleys, in order to maintain a favourable water quality in the entire downstream river. In order to reach this goal, a system of salt credits and debits is used. Credits are obtained for the implementation of any works that reduce the salinity in shared rivers. Debits are incurred based on the estimated shortfall in protecting shared rivers. The balance of credits and debits is registered for each state, and, as a general principle, each state must be in credit. The credits and debits are converted to EC impact at a location in the downstream area of the basin. This method allows states and catchment management authorities to decide on the most cost-effective options for their area whilst contributing to the overall basin-wide river salinity management plan.

Sources: Murray-Darling Basin Ministerial Council, 2001 in FAO 2002; Heaney & Levantis 2001; "Basin Salinity Management Strategy 2001 – 2015" [5]

Investigating inspiring solutions and options

Several options applied by EU Member States have been investigated in more detail. The economic instruments illustrated in the following include:

- *Charges on water pollutants in the Baltic countries.* In addition to the tax paid by the consumer, a charge on water pollutants and permits to emit pollutants was introduced in the Baltic countries. The water pollution tax is calculated using complex formulas which integrate the presence of specific chemicals in the discharge (BOD7, Nitrogen, Phosphorus, etc.).

- *The pesticide tax in Denmark*: A tax based on the maximum retail price is applied on pesticide products in Denmark in order to give incentives to reduce their total consumption. The tax is accompanying the Danish authorisation system for pesticides, which is keeping the most harmful products from the market.

- *England Catchment Sensitive Farming (CSF) – Capital Grant Scheme 2009/10*: The CSF Scheme is providing grant aid towards the improvement or installation of facilities that benefit water quality by reducing diffuse pollution. Grants are limited to a maximum of about 9 000 € per holding and are available for defined items – with a minimum lifetime of at least 10 to 20 years.

- *Voluntary agreements between water suppliers and farmers in Germany*: The instrument provides a flexible framework for offering incentives for adequate agricultural practices which are allowing for good drinking water quality. Agreements are either based on remunerations of individual measures or depending on the resulting content of mineralized nitrogen in the soil.

- The *native woodland scheme in Ireland*: In order to – amongst others – improve water quality through native riparian woodland development,

landowners are provided with financial support in the form of grants and annual premiums for relevant projects.

- *Tradable permit schemes in Sweden*: A system of markets for pollution rights and compensatory measures has recently been created in Sweden in order to reduce nitrogen and phosphorous loads from Swedish sources to the Baltic Sea in a cost-effective manner.

Charges on water pollutants in the Baltic countries

Objective:

In addition to the tax paid by the consumer, a charge on water pollutants was introduced in the Baltic countries. Although for example Latvia does not face problems of water shortages, water quality problems are important, in particular eutrophication and pollution with hazardous substances. The idea was to charge polluters for the damage caused to the environment. However, current charge rates are not based on the mitigation costs of water pollution.

Description:

The water pollution charge is calculated using complex formulas which integrate the presence of specific chemicals in the discharge (BOD7, Nitrogen, Phosphorus, etc). The rates and the pollutants charged differ between the three Baltic countries. The opposite table illustrates these differences.

€/ton	Estonia - 2005	Latvia - 2004	Lithuania- 2005/2009
BOD7	360	4.3	222
Nitrogen	340	42.9	174
Phosphorus	543	42.9	869
Suspended solids	182	14.3	89.5
Sulphates	2.6		0.58
Monophydric phenols	2 416		
Oil products	575		
Chlorides			2.6
Hazardous (Zn, Cu, Ni)		11 429	
Especially hazardous (Pb, mercury)		71 429	
Group I			2 519 827
Group II			229 585
Group III			37 433
Group IV			8 483
Group V			832

In Estonia, special arrangements are in place allowing the rates to be increased further in certain cases. For instance, the rate is increased by a factor of 1.2 if the substances are discharged into soil with unprotected groundwater, by 1.5 if the substances are discharged to waters of cities, towns or beaches used for swimming.

In Latvia, the non-compliance fee paid for discharges exceeding the permitted level is three times the basic rate for the given pollutants. For illegal and unreported discharges, the fee is twelve times as high. In Latvia, polluters can be granted an allowance to finance projects that aim at decreasing water pollution.

In Lithuania, only 6 pollutants have an individual fixed charge, the remaining substances are categorized based on their degree of hazardousness into 5 groups (see table above). As in Latvia, the fee for discharges above permitted levels is a multiplication of the basic rate (between 1.5 and 100). However, exceptions are granted for the period in which the pollution reduction measure is implemented (maximum 3 years).

Stakeholders involved:

In Estonia, the Ministry of Environment sets the rates, giving consideration to a multi-year planning period. These rates have increased by almost 20% each year from 1999 to 2005.

Latvian pollutant charges have not evolved since 1996, which reduces their effectiveness[23]. The Latvian Ministry of Environment is in charge of dealing with the pollution charge and of granting allowances to industries that invest in projects to reduce water pollution.

In Lithuania, the principles of a tax on water pollutants are established in the Law on the State Natural Resource Tax. The rates have increased between 2000 and 2004 but have been fixed in 2004 until 2009.

Relative importance:

The pollutants charge generates around 3 million € per year in the case of Lithuania. In average, an additional 0.6 million € are collected from the fees for discharges exceeding the permit limits.

Source: Speck 2006

[23] The weight of the charges in the production costs reduces due to inflation

The pesticide tax in Denmark

Objective:

Pesticide taxes have been introduced in Denmark in order to influence their use by farmers and to reduce the total consumption. The taxes help furthermore responding to public concerns related to the use of pesticides.

Description:

The Danish tax on pesticides has been first introduced in 1986. It is a relatively "crude" type of tax, being based on the maximum retail price of the product. Each pesticide product sold in Denmark has therefore to carry a label indicating its maximum legal price. This is then used as a basis for the tax calculation. The levy is imposed on domestic manufacturers and on importers in case the product is sold for use in agriculture. It does not apply for exports. The revenues generated by the tax are channelled to the agricultural sector. They are used to reduce the tax on the value of land, to feed special funds administered by farmer's organisations, and to finance R&D related organic farming.

The tax is accompanied by the Danish authorisation system for pesticides, which keeps the most harmful products off the market. Furthermore, a phasing out of the pesticides use on public areas by 2003 took place.

Pesticides category	Tax rate
Insecticides and soil disinfectants	54% of retail price, excluding tax
Herbicides, fungicides and growth regulators	33% of retail price, excluding tax
Wood preservatives, algaecides, rat poisons and microbiological agents, etc.	3% of wholesale value, including tax

Tax rates of the Danish pesticide tax (OECD 2007)

Stakeholders involved and institutional issues

In Denmark, the Ministry of Taxation is the responsible authority for managing the tax. The charges have to be paid by the manufacturers, but the majority of the price increase has been passed on to farmers. The system based on prices of the products is relatively cumbersome to handle for the producers and importers of pesticides but facilitates significantly the administrative tasks of the tax authorities. Although more fine-tuned ways to calculate the tax exist, which can give farmers an incentive to choose the least environmentally harmful pesticide products, the described system can be defended by reduced demand of administrative efforts and the fact that the most harmful products are anyway kept off the market.

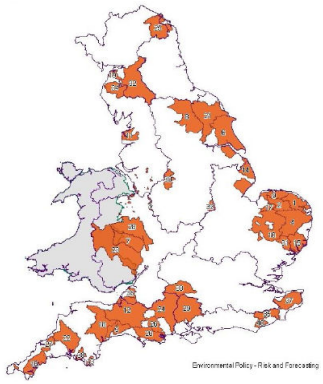
Relative importance:

The annual revenues from the pesticide tax in Denmark varied between 40 and 60 million € over the period 1996-2002. Potatoes, sugar beets and fruits are the most affected products by the pesticides tax, due to their high treatment frequency and pesticide dependency.

The Danish tax rates are said to have helped to reduce overall consumption by 15-20 %, with the largest decrease for herbicides. However, since many factors affect the use of pesticides and the tax was introduced in a moment when the level of consumption already was falling, it is difficult to determine the real, isolated impact of the tax.

Source: OECD 2007, Söderholm 2004, Sjöberg 2005

England Catchment Sensitive Farming (CSF) – Capital Grant Scheme 2009/10



Catchments falling under CSF (in red) (Froment 2007)

Objective:

The Catchment Sensitive Farming (CSF) Scheme aims at raising awareness for diffuse water pollution from agriculture and at encouraging early voluntary action by land managers to face it.

Description:

The England CSF Initiative has been launched in 2006. As part of it, a first CSF Capital Grant Scheme started for one year in April 2007. It supported land managers in 40 priority catchments in England by providing grant aid towards the improvement or installation of facilities that benefit water quality by reducing diffuse pollution. Due to its success it has been repeated in 2008/09 and will run again in 2009/10. The grants are limited to a maximum of 8 950 €[24] per holding. They are available for defined items, endowed with fixed payment rates. The minimum design life is – depending on the item – at least 10 or 20 years. Another condition of the scheme is that each grant aided capital item remains in the agricultural use for which it was installed until 2015.

Capital item	Payment per unit (€)
Fencing for buffer strips, wet grassland, ponds etc. – high tensile	€ 1.40/m
Sediment ponds and traps	€ 6.71/m²
Rainwater storage tanks - underground	€ 391
Relocation of sheep dips including pens	€ 3 913 per unit
Roofs for silage and slurry stores	€ 56 per m²

Examples of capital items eligible for grants (Natural England 2009)

The items eligible for grants can be grouped in different categories: fences and gates; water provision for grazing livestock; management of run-off/drainage water, dirty water and sediments; sheep dips and others. Grants are only available for small or medium-sized enterprises, employing less than 250 people with an annual turnover of less than 50 million €.

Stakeholders involved and institutional issues

CSF has been introduced by the Department for Environment, Food and Rural Affairs (Defra), in partnership with Natural England[25] and the Environment Agency. Catchment steering groups as well as farmer liaison groups have been established, covering all catchments. The Initiative is carried out through a network of Catchment Sensitive Farming Officers (CSFOs), each of them being responsible for an individual catchment. The CSFOs are engaging farmers through workshops and farm demonstrations; they coordinate the Catchment Steering Group activities and assist farmers with CSF Capital Grant applications.

Relative importance:

The catchments falling under the CSF scheme cover 35% of England, comprising 50 000 farmers. The most frequently financed items in the first phase were amongst others farm access tracks, roofing of yards and stores as well as watercourse fencing. Sheep pen relocation and floating covers at the other hand have not been applied for.

Source: Froment 2007, Natural England 2009

[24] The following conversion rate has been used for this case study: 1 £ = 1.118 €

[25] Natural England is an independent public body whose purpose is to protect England's environment.

Voluntary agreements between water suppliers and farmers in Germany

Objective:

Voluntary agreements between drinking water companies and farmers provide wide opportunities to ensure and ameliorate drinking water quality in the long-term. They are in particular useful in areas with nitrate surplus.

Description:

In Germany, the national water law ("Wasserhaushaltsgesetz") provides the framework for the agricultural practices allowed in (ground) water protection areas. Compensation payments to farmers are foreseen for the losses implied through legal obligations. The different federal states in Germany have implemented different models to deal with those payments. In Baden-Württemberg for example, the compensations for the mandatory measures are paid centrally by the regional government and financed by a surplus to the water price ("Wasserpfennig"). In Bavaria, however, a decentralised model exists where farmers are directly compensated by water supply companies. In the latter case, the Bavarian law includes also the possibility to establish rules and agricultural practices for water protection which go beyond the legal ones. This is done through voluntary cooperation under private law, between the water suppliers and the farmers working in the respective drinking water catchments. Two different approaches can be distinguished in the agreements. Whereas one is remunerating individual measures (see box), the level of the premium paid in the other approach is depending on the results of an analysis of the soil on the content of mineralized nitrogen. The compensation payments are often accompanied by advice services for the farmers.

Examples of measures included in the voluntary agreements

- Limiting the use of liquid manure, e.g. defining a calendar for the use of liquid manure adapted to the local conditions
- Cultivating certain crops, e.g. ban on crops like maize or bonuses on perennial clover.
- Encouraging soil cover through intertillage:
- In most of the agreements the cultivation of nitrate bounding catch crops is promoted.
- Prohibiting the change of currently used grassland into arable land.
- Pesticides: Interdiction of certain pesticide products

Stakeholders involved:

The agreements are established directly between water supply companies and farmers. In Bavaria, an official notice has been published in 1997 by the Ministry of Environment and Agriculture to gives hints for the reasonable level of compensation payments [26].

Relative importance:

Only in Bavaria, more than 200 voluntary agreements between water supply companies and farmers working in their catchment zones have been established. As for the level of compensations paid, the water supply company of the city Freising for example is paying about 90 000 € per year for 460 ha of agricultural land which is subject to voluntary agreements. In the area, about 3 million m^3 of water are extracted for drinking water provision every year.

Source: Flaig et al. 2002, LFU Bayern 2009

[26] « Ausgleich für Landwirte und Waldbesitzer in Wasser- und Heilquellenschutzgebieten »

The native woodland scheme in Ireland

Objective:

The main objective of the Native Woodland scheme is to promote opportunities to protect and expand Ireland's native woodland resources. The Scheme aims furthermore at the improvement of water quality through native riparian woodland development. However, there are other objectives such as the conservation of native genetic biodiversity or to encourage wood and non-wood production where they are compatible with native woodland biodiversity.

Description:

The Scheme provides financial support for landowners under two separate elements: (1) protection and enhancement of existing native woodlands and the conversion, where appropriate, of existing non-native forests to native woodlands; (2) support to the establishment of new native woodlands on greenfield sites. Grants and annual premiums are available under both elements for projects that are compliant with national legislation, operational and environmental guidelines.

Different grants and periods apply depending on the element considered (protection or establishment of new native woodland) and the status of the land owner (annual premium for establishment of native woodland ranging from 211 €/ha/year for the non-farmer rate to 545-575 €/ha/year for the farmer rate depending on the total are converted). Grants for protection apply for a 7 year period, while grants for the reestablishment of native woodlands apply for a 15 (non-farmer rate) to 20 year (farmer rate) period.

The initial grant ranges from 5 000 €/ha (conservation) to 6 470 €/ha (establishment). The grant is paid in two instalments (75% of total costs, then 25% of total costs). Additional allowance exist for fencing up to a maximum of 450 €/ha (or 1,800 €/ha in the case of deer/rabbit fencing) – with fencing claims being capped at 50,000 € on all plantations.

All proposed woodlands greater than 2.5 hectares are notified by the Forest Service to the public through a notice in an appropriate provincial newspaper. An Environmental Impact Assessment must accompany applications for the planting of areas of 50 hectares or more.

Stakeholders involved:

The Department of Agriculture, Fisheries and Food administers the scheme, with the Exchequer funding the scheme. Land owners fill in forms and apply to the scheme for financial support.

Relative importance:

There is no available information on the relative importance of this scheme.

Sources: Government of Ireland (n/a)

Tradable permit schemes in Sweden

Objective:

The main objective of the tradable permit scheme is to reduce nitrogen and phosphorous loads from Swedish sources (both point source and diffuse pollution) to the Baltic Sea. This is seen as a dynamic approach to achieve the environmental objectives of the Baltic Sea Action Plan in a cost-effective manner – as opposed to the current sector-driven or even measure-driven approach that limits the possibilities to implement low cost measures first.

Description:

The system is structured around three interconnected markets

- Pollution limits or caps are imposed on (regulated) point source discharges on the *charge market,* so that the total allowed load is coherent with environmental standards. For any amount of a nutrient that exceeds this limit, the polluter can choose between implementing measures to meet the limit or paying a specific charge. The charge gives the polluter the right to emit a given load during a specific time period.
- The second market is the *measures market*. The charges paid are used to finance compensatory measures that counterbalance the amount of load that exceeds the sum of individual caps. These measures are put in place by regulated or unregulated activities that do not generate emissions (e.g. mussel farming and wetlands). It is expected that these measures are more cost-effective than those that could have been chosen by polluters paying the charges. Discussions are under way on how compensatory measures are selected, including on the possibility to use reverse auctioning (allocating financial resources to those with the lowest implementation costs).
- When these two first markets are established, a *second-hand-market* is created where rights to emit can be directly traded between different stakeholders. The purpose of this third market is to enhance cost-effectiveness and flexibility in nutrient load reduction. The load credit acquired through the charge by the regulating authority can be sold on this market. Buyers on this market are mainly regulated sources that need to pay a charge for their load. However, buyers also include environmental organizations who wish permitted discharges to decrease.

Supervision is carried out on the *charge market* to check that the sources do not exceed their discharge caps or that polluters buy load credits via the charge or *second-hand markets*. A check is also required on compensatory measures to ensure compliance with the terms of the contract. Costs of supervision may also be included in the charge because this is the only source of revenue in the charging scheme and has to cover all costs. Alternatively a "membership fee" can be imposed on those sources that wish to have the option of paying a charge instead of carrying out their own measures.

There are still questions on the scale at which the different markets will operate, from all catchments discharging into the Baltic Sea to individual river basin districts or lower units. It is not necessary that all markets operate at the same scale.

Stakeholders involved:

The central actor is the regulating authority that is active on both the *charge market* and the *measures market*. Polluters on the charge market who exceed their loads pay the charge to the regulating authority. These financial receipts are then used to finance measures on the *measures market* (ensuring measures implemented are cost-effective in reducing pollution load). As such, the regulating authority plays the role of a broker and is expected to reduce

transaction costs that are seen as obstacles of traditional permit markets in particular when diffuse pollution is at stake. The different monitoring roles described above for ensuring the market players comply with the rules (load limits, payment of charge, implementation of measures…) are fulfilled by authorities that are already working on similar (monitoring/supervision) tasks.

Relative importance:

The proposed tradable permit fee scheme is still under testing. Thus, it is not possible to assess how important the functioning of the different markets will be in terms of total charges, loads, compensatory measures…

Sources: Swedish Environmental Protection Agency 2009 (forthcoming)

Chapter 7 – Morphology and ecological restoration

Limited information on economic instruments applied to water-related morphological issues and ecological restoration is available in the literature. Some examples identified are presented in the following paragraphs.

River and wetland restoration

The EEA-OECD database on economic instruments in the environment contains only a few direct references to river and wetland restoration. A programme for revitalisation of river systems exists for example in the Czech-Republic. Furthermore, grants for wetland restoration, subsidies for stream restoration (both Denmark) and subsidies for wetlands (Sweden, UK) are reported.

What is the situation in the Netherlands?

In the Netherlands, pre-treated water from the Lake Ijssel is pumped into the dunes for a final natural treatment before it becomes drinking water for (e.g.) Amsterdam. The costs of nature conservation of these dunes is partly included in the price of drinking water and partly paid for by the visitors of this dune nature reserve area (van der Veeren, p.c.).

Ecological restoration of wetlands and water ecosystems is basically part of nature conservation activities, and for example relevant for NATURA 2000 sites. Different instruments for financing activities in NATURA 2000 sites exist at European level. The most important ones are given in the box below.

The most important financial instruments for Natura 2000

- The Structural Funds (European Social Funds, ESF; European Regional Development Fund, ERDF)
- The Cohesion Fund
- The Fund for Rural Development (EAFRD)
- The European Fishery Fund (EFF)
- The Financial Instrument for the Environment (LIFE +)
- The 7th Research Framework Programme

Source: Suske 2007

Hydropower plants

Revenues of hydropower plants come usually from specific purchase contracts signed with electric utilities. Depending on national legislation, electric utilities are usually obliged to buy the electricity generated from renewable energy resources and to give them priority. In some countries, specific incentives are given for investments in renewable energy facilities. In those special schemes, renewable energy projects can apply for special loans with low or even zero interest rates, or receive other types of investment subsidies (ESHA after 2006).

Among European countries, prices paid to small hydropower plants vary considerably. Different components can be found in the tariff structure, depending on the country. This includes market prices, avoided carbon prices or green certificate prices. The development of small hydropower plants can be greatly affected by the respective support scheme. As market-based schemes can sometimes reveal themselves too uncertain and therefore unattractive to developers, a fixed feed-in tariff reduces uncertainty and guarantees cash flow for a determined duration (ESHA after 2006).

Table 7. Examples of tariff systems for hydropower plants

Country	Tariff structure
Germany	Average feed-in tariff is 6.65 € cents/kWh (66.5 €/MWh). It depends on the capacity of the plant. Maximum can reach up to 8 €cents/kWh (80 €/MWh). Scheme valid for 20 years.
Italy	Average 75 €/MWh (for selling electricity) + 125.2 €/MWh (Green certificates). The grid authority fixes a cap (upper) price for green certificates every year. Certificates are issued only for the first 12 years of operation.
Slovenia	Feed-in = 61.45 €/MWh (in 2003) (premium = 28.12 €/MWh - included). Small hydropower plants > 1 MW: Feed-in = 59.29 €/MWh (premium = 25.96 €/MWh – included).

Source: ESHA *after 2006*

In Germany, the level of the price paid for hydro-energy is depending on the compliance with certain ecological criteria, giving incentives for mitigating negative impacts of hydropower facilities. In Latvia, hydropower plants pay contributions to the so-called Latvian fish fund, which is financing measures for the restoration of fish populations (see case studies below).

What is the situation in the Netherlands?
Hydropower is not significant in the Netherlands. There are plants connected to some large sluices in the Rhine and Meuse, but with the primary use for water quantity management (shipping, flood defence, water allocation). All large sluices are provided with fish passages (van der Veeren, p.c.).

Dredging

No innovative economic instruments could be identified for dredging activities in the EU (Dirks 2009).

The situation in the Netherlands
In 2008, an innovative programme has started in the Netherlands which is focussing at developing new technologies at the interface of Ecology and Marine Infrastructure (including dredging). The programme has a budget of 27.5 million and is jointly financed by the industry, knowledge institutes and the Dutch Government (Ministry of Transport, Public Works and Water Management). The government funds are from the national budget for innovation. The programme is run by the foundation EcoShape and is called "Building with Nature" (Dirks 2009).

Looking outside of the EU

An inspiring example from Japan on the financing of water protection projects has been identified. The Forest and Water Source Environment Tax has been introduced in Japan by 29 prefectures (among 47 in total) by 2008. In most of the prefectures the tax focuses on forests. In Kanagawa, however, it focuses on water sources in river basins (Otsuka 2008). The tax imposes an additional residence tax, with its revenues to be used exclusively for promoting water-source protection projects. In order to ensure that revenues are only used for conservation and restoration of the water source environments, the tax is accompanied by the creation of a special account and a fund [4].

What is the situation in the Netherlands?
In the Netherlands, some experiments (e.g. Binnenveld fonds) are underway where funds have been created for landscape conservation, filled by a (voluntary) 'tax', based on the value of the property. If the landscape, despite the fund, would be distorted, the fund will reimburse its members (van der Veeren, p.c.).

Investigating inspiring solutions and options

Several options applied by Member States have been investigated in more details and are illustrated below.

- *Compensating for "Damage to fish"- the Fish Compensation Fund in Latvia*: In order to internalise environmental costs caused by morphological pressures, municipalities, hydropower plants and other economic sectors are paying compensation payments to the so-called "Fish Fund". The revenues are used to re-establish damaged fish resources.

- *Ecological accounts ("Ökokontos") in Germany*[27]: Ecological accounts allow for a flexible handling of ecological compensation areas foreseen in German law. Compensation obligations as well as suitable areas are pooled and can be activated when it seems the most pertinent.

- *Support to ecologically friendly hydropower plants through favourable electricity tariffs*: A bonus in the form of a higher price paid per kWh is guaranteed to hydropower plants in Germany which are complying with certain environmental conditions. The criteria involve incentives for increased continuity, minimum water flows, areas of shallow water, etc.

- *Financial compensation for biodiversity damage in France*: Financial resources from economic actors and municipalities who cause damages to the environment (including aquatic) are collected by an independent operator. He controls the effective use of the funds by redirecting them to actors involved in nature conservation and restoration activities for implementing compensation measures.

[27] A similar approach might be applied in the Dutch "Landschapsfondsen".

- *Purchase of agricultural land to improve the river morphology in France :* To restore the morphology of the Allier River where rock rip-rap was made by farmers, a French environmental NGO, the CEPA, launched a project to purchase private land that will be “given back” to the river for divagation.

- *Financial compensation for environmental services in France.* Ecological flow support by dams during the summer period remains a costly option, including in terms of losses in hydropower production. To finance this service, a financial compensation fee is charged to water abstractors downstream of dams. This compensation fee is calculated each year to account for changing climate and water scarcity conditions.

Compensating for "Damage to fish"- the Fish Compensation Fund in Latvia

Objective:

The aim of the instrument is to internalise environmental costs caused by morphological pressures stemming from municipalities, hydropower plants or other economic sectors as well as to re-establish damaged fish resources.

Description:

A regulation adopted in 2001 in Latvia is dealing with the losses of fish resources due to economic activities and with corresponding compensations. It classifies different types of losses of fish resources and defines formulas to estimate their value. This is done in accordance with the methods recommended by the International Council for the Exploration of the Sea and the FAO European Inland Fisheries Advisory Commission. Compensation payments have to be made by the following economic activities and structures: Construction and operation of hydro-technical installations, water reservoirs (in rivers and lakes), ports, shipping route or canal deepening, explosion works in water bodies, ground excavation and water table regulation.

The level of the contribution to the fund depends on the estimated damage that the morphological change imposes on the river ecosystem, in particular to its fish population. The money is mainly used to restore fish populations which are commercially exploitable, in particular salmon.

The regulation on compensation payments is accompanied by another law specifying parts of rivers on which it is forbidden to construct or rehabilitate hydropower dams or to install any mechanical barriers in order to protect fish resources. It is in force since January 2002.

The compensations are paid into a so-called "Fish Fund". This is a special-purpose state fund which sub-allocates the resources into the budgets of the seven existing fish-growing companies as well as in financing research.

Stakeholders involved and institutional issues

The "Fish Fund" has been created by the Latvian Ministry of Agriculture. In 2004, the Latvian Fish Resources Agency (LATFRA) has been established based on the Latvian Fisheries Research Institute. It is the responsible state management institution, which is subordinated to the Latvian Ministry of Agriculture. In the hydropower sector, so far, only the three big Latvian hydropower plants are paying to the "damage to fish"-fund. The extension to small hydropower plants is being considered.

Relative importance:

About 0.7 million € are paid from each of the three big hydropower plants every year. The total annual losses caused to fisheries by the existence and operation of those plants in the Daugava river are estimated to be about 396 tons or 866 232 €. It is estimated that the necessary reproduction of fish resources would cost around 586 900 €/year (Ecorys 2004).

Source: ECORYS 2004, LATFRA 2009, LEGMA 2008 (p.c.)

Ecological accounts ("Ökokontos") in Germany

Objective:

The instrument aims at improving the effectiveness of compensations of structural interventions which affect nature and landscape. It enables measures to be flexible in time and space and to integrate them into an overall spatial concept.

Description:

According to the German impact regulation under nature conservation law, interventions which impact on nature and landscape have to be compensated by the initiator of the activity in order to avoid a degradation of the local environment. Compensations take place by establishing new, lasting habitats. This includes for example measures around water bodies and or improving the permeability of the soil.

In the past, compensations had to be made once the intervention took place. This led to problems as suitable areas for the compensation measures were not always available and less useful measures have been carried out instead. The amendment of the German federal building code in 1998 introduced more flexibility, as the possibility to establish a pool of suitable areas ("Flächenpool") and an ecological account ("Ökokonto") has been allowed for[28].

In the pool of areas, potential public and private areas are regularly checked for their suitability and availability for compensation measures. Furthermore, a grouping of areas to bigger complexes of measures – for example related to a floodplain of a river – takes place. The basis of the pool of areas is the active stocking of areas in the municipality – through buying, exchanging or contractual agreements.

The ecological account allows managing the described areas pool. Municipalities can carry out nature conservation measures beforehand and register them on the account ("deposit"). The responsible nature conservation authority has to accept the measure and to keep records of its value in the compensation land register ("Kompensationsflächenkataster"). Once a structural intervention takes place – which legally requires compensation – the measure can be assigned to the initiator of the intervention. According to the polluter-pays-principle, the latter compensates the costs which have been caused ("debit").

Stakeholders involved and institutional issues

The ecological account (and the areas pool) is usually managed by the municipalities, but also for example private foundations can fulfil this function. The initiator of the intervention can be a private or a public entity, depending on the intervention. A comprehensive landscape planning instrument provides the basis for the ecological accounts, in order to decide on the extent, location and eligibility of the compensation measures. In the federal state of Baden-Württemberg, a project has been started in 2002 which is promoting the exchange of experiences between different municipalities in order to support the introduction of ecological accounts.

Relative importance

The ecological account is applied in a large number of cities and municipalities. The amount of the "bookings" depends on the interventions and differs from case to case.

Source: BDLA 1999, LUBW 2006, NABU after 2002

[28] Although the national legal basis has been built in 1998, some federal states transposed it into regional legislation only in 2008.

Support to ecologically friendly hydropower plants through favourable electricity tariffs

Objective:

The instrument aims at promoting the new building and the extension of hydropower plants in Germany, taking environmental and nature conservation objectives into account.

Description:

The measure is based on the German Renewable Energy Sources Act (EEG) from 2000 (amended in 2004 and 2008) and fixes certain remuneration for energy produced through hydropower plants complying with certain conditions. In accordance with the terms of the Water Framework Directive, a good ecological status has to be reached after the building or the modernization of the plant. Alternatively, the ecological status must have – compared to the previous status – significantly improved. The criteria applied relate for example to biological continuity, the presence of areas with shallow water and to guaranteed low water flows. The plants have to comply also with certain conditions concerning their location: New plants must be built in a spatial relation to fully or partly existing barrages or weirs.

Part of production	New plants (cents/kWh)	Modernized plants (cents/kWh)
Until 500 kW	12.67	11.67
500 kW to 2 MW	8.65	8.65
2 MW to 5 MW	7.65	8.65

Remuneration for plants up to and including 5 MW

Augmentation of production	Expanded plants (cents/kWh)
Until 500 kW	7.29
Until 10 MW	6.32
Until 20 MW	5.8
Until 50 MW	4.34
Over 50 MW	3.5

Remuneration for increased power production for plants > 5 MW

The remuneration paid depends on the energy output of the plant. A difference is made between plants generating up to and including 5 MW and plants generating more than 5 MW as well as between modernized and new plants.
The remuneration is paid for 20 years. Smaller plants are paid higher remunerations per kWh than bigger plants to ensure their profitability. Plants producing more than 5 MW are – after their modernization – only paid for the increased part of production. The rates decrease every year for 1%.

Stakeholders involved and institutional issues:

The electricity operators in Germany are obliged to connect facilities which produce renewable energy to their net and to remunerate them according to the EEG. As the costs are allocated to the consumers, no government funds are involved. Since the law has been adopted, regular reports have been elaborated which led to further amendments.

Relative importance:

In 2007, the predominant part of the hydropower produced in Germany stemmed from plants which were not remunerated according to the EEG. In order to increase incentives, the rates for small hydropower plants have been augmented in 2008. In 2006, the electricity consumer paid in average 0.5 cent/kWh for the promotion of renewable energies.

Sources: BMU 2005, BMU 2008a, BMU 2008b, GP 2007

Financial compensation for biodiversity damage in France

Objective:

The mechanism aims at supporting compensation for biodiversity damage. It builds on the collection of financial resources from economic actors and municipalities who impose damages on the environment (including aquatic) by expanding and developing their activities. These financial resources are then mobilised in an efficient manner to support nature protection and renaturation activities that are of equivalent value to the damage created. As such, it contributes to the "no biodiversity loss" principle promoted by EU and French legislation.

Description:

A specific independent operator has been put in place to accompany and support the implementation of compensation measures. It plays the role of an intermediary between economic operators and municipalities who engage in development activities that are damaging the natural environment and biodiversity, and actors involved in nature protection and restoration.

The intermediary operator collects financial resources from economic actors and municipalities responsible for the damage. It then redistributes these resources to actors engaged in nature protection and restoration activities to support compensation. It ensures that the compensation is effectively put in place – and complies with regulatory, administrative and scientific requirements. Thus, the definition and implementation of compensation measures are integrated into a wider ecological strategy in terms of ecological values and equivalences, validation of selected choices, specification of the technical implementation of the compensation measure, reporting, monitoring….

On behalf of the economic actors and municipalities, CDC Biodiversité: identifies the site for compensation; secures land (in some cases by purchasing land on its own name); establishes contractual arrangements with local actors managing natural sites (environmental NGOs, land managers, etc) – the duration of these arrangements being up to 30 years; implements the compensation measure (taking care of all technical and financial issues); monitors compensation measures; reports to the economic operator and the municipality; accompanies economic actors and municipalities in communicating on the positive impacts of compensation actions….

Stakeholders involved:

The Caisse des Dépôts et Consignations (CDC) has launched CDC Biodiversité to play the role of the intermediary operator. Building on a multi-disciplinary staff of ecologists, agriculture engineers, forestry engineers and financial specialists, CDC Biodiversity provides support services to municipalities and economic operators. Its activities are supervised by a scientific committee combining ecology and economic disciplines. It has developed key partnerships with the major environmental NGOs and with government services in charge of the implementation of environmental legislation.

Relative importance:

Because of its relative novelty, it is difficult to assess the importance of CDC Biodiversité in supporting restoration measures in the aquatic environment. A first project to expand wetlands is under way in the Crau valley (South of France) – but it is too early to draw conclusions. Overall, CDC Biodiversité has a capital asset of 15 Million Euros.

Sources: CDC Biodiversité 2008, Centre d'Analyse Stratégique 2009

Purchase of agricultural land to improve the river morphology (France)

Objective:

In order to protect their lands from erosion, farmers have often been using rock rip-rap to limit the river's natural dynamics. However, such morphological alteration causes several problems: incisions of river beds, changes in sediment transport and river flow. To restore the morphology of the Allier River where rock rip-rap has been widely applied, or to compensate farmers who are losing parts of their land because of erosion, the Conservatoire des Espaces et Paysages d'Auvergne (CEPA) decided to purchase private land that is "given" back to the river. This measure was part of a large scale project: *Loire Nature*.

Description:

The Allier river is 420 km long. It is therefore not feasible to purchase the totality of the corridor concerned by erosion. Therefore, priority spots were defined according to their position, the probability they have to be eroded in the short or medium-term, their ecologic interest, their restoration interest and the presence of human pressures. Twenty four zones were defined, representing a total area of 1 057 ha. On a river stretch going from Varennes to Moulins, 170 ha were bought, 92% being located in the "mobility space" of the river. This surface represents only 10% of the erosion corridor of the river on this stretch but 41% of the land (5.6 hectares in total) that were concerned by erosion between 2000 and 2005[29]. The average purchase costs were 3 220€/ha. These costs include also the legal charges (for the change of land ownership) and the SAFER[30] charge. This cost is to be compared to the rock rip-rap for one hectare ranging from 15 000 to 30 000 €.

Stakeholders involved:

Many stakeholders are involved in this measure:

- Financing: French Government, European Union, regions, Départements and municipalities.
- SAFER[2] facilitated land purchase and gave priority to the CEPA to buy agricultural land.
- Land management is carried out by NGO such as the LPO (Bird Protection association) and CSA (Conservatoire of River Allier's remarkable sites)
- The farmers from whom the lands is bought

Relative importance:

Today, CEPA owns 41% of the private land (=10% of the total land) in the erosion corridor of the Allier river. Its actions were initiated in 1993 as the Loire Nature LIFE project. Most of the land was purchased at the end of this first phase that lasted until 1999. More land was purchased between 2000 and 2006. Today, funds are not available anymore but CEPA continues its activity of land management and awareness raising for farmers in terms of agricultural practices.
Some limits and difficulties encountered during the project include: limited budget, political interference in the use of public funds, impacts on the land market price, lack of willingness by some owners to sell their plot, high number of land owners (increase of transaction cost[31]).

Source: CEPA 2009

[29] In total, 54 ha were eroded but 49 ha were part of the public domain.
[30] French institution in charge of land market management
[31] For some plots, the notarial costs were higher than the land cost itself

Financial compensation for environmental services, France

Objective:

The French Water Act of 2006, which translates the Water Framework Directive into French law, contains an article (article 82) that allows a River Management Organisation to implement compensations for environmental services, that would work as a charge (i.e. revenues are earmarked). A compensation for environmental services was implemented by the EPTB[32] Loire to ensure an adequate contribution by water users to the financing of the costs linked to the ecological river flow support by dams. The compensation is levied according to the water consumption, but with different levels depending on the water use sector and its location along the river.

Description:

The charge was implemented in 2006 through a decree, following a public survey that highlighted the general interest to use and maintain the two large dams of Naussac and Villerest to support the ecological flow of two rivers, the Allier and the Loire river. Water abstractors which are targeted by this charge include: farmers, drinking water companies and industry. By definition of an earmarked instrument, the revenue collected equals the costs linked to the change in dam operation. Therefore, the unitary compensation is calculated every year and adjusted with an "annual rate". The following formula is used to calculate the compensation owed by each water user:

Compensation = volume * annual rate * user rate * seasonal rate * geographical rate

With: *Volume:* maximum volume abstracted within the past 3 years
Annual rate: fixed every year according to the foreseen expenses
User rate: Drinking water=1; Industry=0.8; Agriculture=0.4
Seasonal rate: Agriculture=1; Drinking water and Industry=0.5
Geographical rate: depends on the location of the withdrawal (ranges between 0.5 and 1)

The compensations are part of EPTB Loire budget. For 2007, a provisional budget of 4 million Euros (VAT excluded) coming from the compensation was estimated.

Relative importance:

Such an instrument is not yet widely used in France (only one additional example could be identified[33]). However, the idea of using a similar instrument is widely discussed today, especially at the scale of local river catchment organisations.

Stakeholders involved:

The EPTB Loire collects the financial compensation from water users. A few hundred users are concerned. State's Departments are not involved.

Sources: Etablissement Public Loire (2007); [8]

[32] Etablissement Public Territorial de Bassin

[33] The SAGE Nappes Profondes de Gironde implemented a very similar compensation system.

Chapter 8 - Managing excess water

Managing excess water is an issue for which a poor variety of economic instruments is implemented in Europe as compared to other issues. Measures taken to reduce floods risk are often technical or regulatory: restoration of flood plains or wetlands, definition of flood hazard maps where no new buildings are allowed, etc. Nonetheless, a few economic instruments are applied in EU Member States.

One of the most important economic instruments is the use of a National Environmental Fund to finance flood prevention measures. This has been reported for example for Bulgaria, the Czech Republic, Poland and Slovenia (EEA 2005).

A stormwater tax was introduced in a number of Northern EU Member States. In some cases it targets owners of impervious surfaces, in other cases it is linked to the sewage tax. For the most part, subsidies or tax reductions are granted owners who invest in source control techniques (see case study below).

Another instrument applied in the field of managing excess water is the use of subsidies coming from the Rural Development Programmes. Subsidies are granted for different measures reducing flood risk. One of them concerns production investments on agricultural land (measure code 216). This measure can be found in the Rural Development Plan of ten, mainly "old" Member States (including the Netherlands, France, Germany, Belgium ...). In Finland, for example, investment support is used to establish wetlands on arable areas

What is the situation in the Netherlands?

For managing excess water, the Dutch Delta Committee - which is giving advise on water policy - proposed in 2008 the implementation of a "Delta Fund". This fund would be used to finance flood protection measures. In the draft National Water plan the Dutch government took up this idea and proposed to implement it (Deltacommissie 2008, Stumpe 2008).

Furthermore, with regards to the management of stormwater, the Dutch national policy aimed at reducing by 50% the combined sewer overflow in terms of phosphorous and nitrates from 1995 to 2005. In this context, some municipalities chose to implement the disconnection of the stormwater from the sewer network and provide financial help to house owners who want to disconnect (e.g. 5 €/m² of disconnected surface for the municipality of Nÿmegen) (Chouli et al. 2007).

susceptible to flooding (see case study below). In Flanders (Belgium) support is granted for investments that will help to conserve temporarily water in the upstream areas. In the Po Delta (Italy), the code 216 measure is used to protect biodiversity, e.g. by the creating wetlands. Another measure concerns afforestation. The Rural Development Code differentiates between two situations: first afforestation of agricultural land (code 221) and first afforestation of non-agricultural land (code 222). Whereas the former is applied by a large majority of the Member States (18 out of 27), the latter is less used (eleven, mainly "new" Member States). A good example is Lower Saxony (Germany) where both measures are combined (Dworak et al. 2009).

Examples of subsidies to promote afforestation were also found in other countries or regions (Poland[34], Flanders (Belgium)[35]). But in these cases, the target of the incentive policy was either the production of wood or the building of ecosystems. If flood prevention was mentioned, it was not investigated and considered only as a positive side effect.

Other economic instruments are more specific to one or two countries. Denmark, for example, provides subsidies for pilot demonstration projects. Support for municipal environmental infrastructure is granted in Slovenia. Several German cities provide economic support for the building of green roofs on houses (see case study below). Also in Germany, a tax is levied from the owners of impervious surfaces, proportional to the area. Tax deductions for environmental investments are also granted in Spain (EEA 2005).

Stormwater management has received little attention compared to wastewater management or water resources management. Traditional stormwater systems aim at rapidly evacuate stormwater from urban centers.
But stormwater management does not only consist in flood control. Indeed, several studies have proved that urban stormwater is heavily polluted[36],

[34] Dzikowska et al. (2006)
[35] Moons and Rousseau (2007)
[36] Saget A. et al. (1995)

comparable to the level of wastewater pollution. This gives stormwater management a double objective (Chouli et al., 2007).

Investigating inspiring solutions and options

Several options applied by EU Member States have been investigated in more detail and are presented below. The economic instruments illustrated include:

- *Support for the building of green-roofs to reduce storm water runoff*. The use of green-roofs to prevent and reduce the effects of heavy storms was found to be efficient in countries such as Germany. It is now widely developed in some German cities, driven by a system of subsidies or a storm-tax rebate.

- *Income tax reduction for rainwater collection and reuse in France.* French inhabitants that invest in rainwater collection and reuse systems can benefit from an income tax reduction. This measure aims at reducing stormwater flowing off of streets and in the sewage system but also at encouraging reuse of rainwater and therefore the reduction of drinking water consumption.

- *Economic mechanisms for storm water management – a review of European experiences.* Different instruments were developed in Europe to develop flood management. An economic instrument based on the implementation of a storm tax that could be returned to the owners if he invests in flood control techniques was developed in different ways in some North European countries

- *Creation of multi-functional wetlands in Finland.* This case study gives the example of the implementation of a Rural Development subsidy that participates in flood prevention in Finland. Subsidies are granted land owners for the creation of multi-functional wetlands, of which one of the benefits is the retention of water in upstream catchments during flood episodes.

Support for the building of green-roofs to reduce storm water runoff

Objective:

Heavy storms can overload sewage systems and lead to sewage overflows to local waterways. Green roofs can reduce storm water runoff by retaining up to 75%[37] of the rainwater. Water is gradually turned back into the atmosphere, while pollutants are retained in the soil. In some European cities, the installation of green-roofs is financially supported.

Description:

A green-roof is a roof of a building covered by vegetation and soil (or growing medium) and planted over a waterproof membrane. Green-roofs are used for several reasons (reduction of heating, fruit growing, pollutant filtration, wildlife habitats, etc). One of the main purposes is the reduction of storm water run-off. Created in Northern Scandinavia centuries ago, green roofs were further developed in Germany in the 1960s and have since spread to many countries (particularly to the United States). In 2002, 15% of all flat roofs in Germany were "green". Switzerland also has a strong "green-roof" policy: in 2005, 20% of the flat roofs of Basel were green-roofs. Also London recently decided to promote them.

Stakeholders involved:

In Germany, the financial support is provided by the cities. 43% of Germany's cities offer financial incentives for roof greening. Different types of support are granted:

- 29 large cities (including Berlin) give direct financial support to roof greening ranging from €5 - €50/m^2, or between 25 – 100% of the installation cost[38]. The subsidies are based on estimates of avoided costs associated with infrastructure maintenance and replacement.
- Indirect aid for green roofs is provided by 17% of German cities by offering reduced sewage disposal charges for buildings with green roofs.
- Another thirteen German cities allow for a reduction between 50% and 80% of the utility surcharge fee or "rain tax"[39] for using a green roof. Over a 36-year period (estimated life-time of a green roof); the reduction in the usage fee alone can compensate the building owner for as much as 50% of the additional capital cost.

Relative importance:

The Federal Nature Conservation Act requires mitigation for the ecological impact of construction activities. This means that green roofs are often required by conditions attached to construction permits. In 1989, 27 German cities had established districts that require green roofs to be installed on flat roofs. In Stuttgart, such a requirement was included into its Law on Buildings for industrial building. In 1984, Munich included green roofs in its building ordinance.

Sources: [1], [2], [3], English Nature 2003

[37] In summer, depending on the plants and depth of growing medium, green roofs retain 70-90% of the precipitation that falls on them; in winter they retain between 25-40%. For example, a grass roof with a 4-20 cm layer of growing medium can hold 10-15 cm of water.

[38] Only investment is subsidised. Maintenance is limited to the removal of unwanted seedling that requires around 0.1 minute/m^2 every year (according to German research).

[39] In Germany, a rain tax is collected for the area of impervious surface on a property that generates runoff directed to the local storm water sewer.

Income tax reduction for rainwater collection and reuse in France

Objective:

The proposed reduction in income tax resulting from investments in rainwater collection and reuse has a dual objective. First, it aims at reducing stormwater going on streets and in the sewage system, reducing investment needs for dual systems. Second, it aims at encouraging the reuse of rainwater (for outdoor uses and for a limited number of indoor uses) to reduce drinking water consumption. This income tax reduction is specified in the 2006 water law that extends an older income tax reduction scheme limited to rainwater collection only.

Description:

Inhabitants that invest in rainwater collection and reuse systems benefit from an income tax reduction equal to 25% of the total expenses of the rainwater collection and reuse system. For a given residence, the total expenses that can be claimed for income tax reduction cannot exceed, for the period between January 1, 2007 and December 31, 2012, 8 000 € per single person or 16 000 € for a couple (plus 400 € for each child). The government decree that introduces the system indicates the technical specification of the equipment that can be installed. Visual signalling for distinguishing between the regular drinking water system and the grey water system has to be put in place (e.g. pipes with different colours). And signs specifying "non potable water" have to be put at taps and outlets where rainwater can be tapped. In addition to the regular maintenance of the system, the inhabitant will need to regularly fill in a « health notebook » (*carnet sanitaire*) that includes: the name of the company/person in charge of maintenance; a map/drawing of the rainwater collection and reuse system; the certificate of the installer/seller; the dates of check-ups and the details of maintenance activities; the monthly indoor use of rainwater. This type of equipment also needs to be reported to the municipality, along with the clear identification of the building where the equipment is in place and an assessment of the volumes of reused rainwater. The decree stresses that the tax reduction only applies to reuse of rainwater for (1) outdoor uses (gardening, irrigation of green public spaces – outside of periods with high attendance, car washing…) and (2) for limited indoor uses (toilet flushing, cleaning of floors). Some tests are under way to decide whether laundry can be included in the list of permitted uses. The provision does not apply to health buildings and to so-called social buildings used for example for childcare or elderly people.

Stakeholders involved:

There are a very limited number of stakeholders involved in this income tax reduction scheme. Inhabitants install the equipment themselves or call for a private operator to do the installation. They then send the bill or certificate provided by the seller of the equipment or the building company to the tax authorities at the same time as their income tax papers. Income tax services might verify the validity of the bill (and the fact that the system has effectively been put in place) occasionally. But these checks are the regular random checks of income tax services, independent of the fact that rainwater collection systems have been installed or not.

Relative importance:

Because of the recent application of the instrument, data on the relative importance of the instrument in terms of number of inhabitants, volumes of water, costs … is not yet available.

Sources:

[6], [7], Guide sur l'utilisation et la récupération d'eaux de pluie

Economic mechanisms for storm water management – a review of European experiences

Objective:

Flood control can be managed through different techniques (see below). To finance the implementation of these techniques, different strategies are developed in the Member States. This case study proposes to review the economic mechanisms and instruments used in six member states to deal with flood management.

Description:

Managers dispose of two methods for stormwater control: (i) conventional drainage systems with end-op-pipe treatment installations and (ii) source control methods[40] . If end-of-pipe installations were broadly used before, institutions in charge of storm water management in Europe are now developing more source control methods.

A similar system is in place in Sweden, Denmark and Germany. In Sweden and in Germany, a fee per m^2 of impervious surface is charged to the property owners (the Drainage fee in Denmark and the Storm water fee in Sweden). In Denmark, the storm water fee is part of the drainage fee[41], charged accordingly to the water consumption. In Denmark and Sweden, the property owner who implements source control techniques pays a smaller fee (Sweden) or gets a refund up to 40% of the fee (Denmark). The situation is different in Germany. For example, in Dresden where the stormwater fee amounts to 1.04 €/m^2/year, the money collected is used to finance collective projects such as the reusing of rainwater for municipal use or the organisation of promotional campaigns for the use of source control techniques. In those countries, private and public owners are targeted (the latter is taxed for roads).

The situation is different in France. Special permits have to be issued for all important projects concerning rainwater discharge, artificial infiltration and creation of impervious areas of more than 5 hectares. No tax is charged to all property owners of impervious surfaces. Flood control is rather managed at municipality level with multifunctional installations (e.g. the Seine St Denis County who uses sport facilities or green spaces that can be flooded in case of rain) or the creation of wetlands upstream the city (e.g. the urban municipalities of Limoges agglomeration co-funded the construction of wetlands in the upstream rural municipalities). A stormwater fee is under discussion.

The existing national policy in the UK consists in funding only reduction of flood vulnerability and not flood protection. A fee is charged when pollutions are emitted in flood zones. The fees are reduced if the developer follows the Environmental Agency's technical guidance. Municipalities can then assign stricter obligations to the developers.

[40] Non-structural measures such as street cleaning, education, etc. or structural techniques such as filter drains, porous asphalt, etc.

[41] The Danish drainage fee is split into one part allocated to wastewater management (60%) and a second to stormwater management (40%)

	Pilot projects	Regulation restrictions	Discharge control	Discharge fees/penalties	Stormwater fees	Tax brakes/ fees reductions	Public subsidies	Information campaigns
Sweden	+	+	+		+	+		+
Denmark	+	+	+		+	+		+
Germany	+	+	+	+	+		+	+
France	+	+	+	+		+	+	+
UK	+	+	+	+	+	+		+

Methods applied in the countries to promote source control techniques (methods can be different between the cities)

Stakeholders involved:

In Sweden and Denmark, a public company is responsible for water management (drinking water, sewage, flood control, etc.) at municipality level. National departments (Sewage Department, Drainage Department, Street Department...) are also involved in stormwater management. In Germany, the federal system allows every Land to choose its own policy. The important stakeholders involved in stormwater management include the Water Authorities (who collect fees for every discharge to the water bodies) the Verbände (river managers who offer technical guidance) and the municipality (that implements the source control techniques in public areas and promote them in private sectors). In France, large scale coordinators such as Water Agencies, Counties and Regions often sponsor source control techniques. In the United Kingdom, most of the urban projects are managed by private companies.

Source: E. Chouli et al. 2007

The creation of multi-functional wetlands in Finland

Objective:

http://www.christophedoucet.org/?category/Actu

Creation of multifunctional wetlands is designed to promote water conservation in watercourses and coastal areas with a heavy environmental load from agriculture; improves the living conditions for birds; reclaims habitats that were lost when arable areas were drained and improves the conditions of brooks that organisms use as passages. Furthermore, wetland areas reduce harmful flooding downstream and increase low flows.

A measure was designed in the Rural Development regulation to give incentives for non-productive investments (code 216). The Ministry of Agriculture and Forestry (MMM) in Finland has seized the opportunity to include a measure that provides financial help to famers for the creation of wetlands.

Description:

The investment support in Finland is used to establish wetlands and wetland-like flooded areas in places in which they would occur naturally, on arable areas susceptible to flooding and on terraced drainage areas. The measures must be implemented in accordance with a specific plan, and measures must not have an adverse impact on the drainage situation of arable land cultivated outside the area covered by the measure. The area of a wetland must be at least 0.5–1.0% of the area of the upstream catchment area. The measure may be implemented only in areas in which arable areas account for more than 20% of the catchment area of the watercourse or main ditch. The investment support can be granted if a special contract for wetland management is concluded for 5 or 10 years after the wetland is completed. Payments can also be granted to beneficiaries other than farmers through the Leader approach[42]. The payment application is then delivered to the local action group for processing and issuing a statement.

The payment level for the establishment of multifunctional wetlands is up to 4000 € per hectare of wetland. If the contract is not renewed because of the transfer of the contract area, the beneficiary shall reimburse the special payments granted for the contract area during the year of the transfer and the preceding years.

Relative importance:

The measure was not integrated in the Finnish Rural Development Program which has to be implemented in the whole country, but only in the catchment areas of rivers running into the Gulf of Finland, the Archipelago and the Bothnian Sea and in the catchment areas for which the measure is relevant. Measure code 216-incentives for non-productive investments, includes the creation of multifunctional wetlands and initial clearing and enclosing of valuable traditional biotopes. The budget foreseen for both sub-measures for the period 2007-2013 amounts to 14.6 Million Euros (support given to 2200 farms).

Sources: MMM 2007

[42] The Leader approach provides registered associations with the opportunity to establish wetlands that individual farmers are not able to establish.

Chapter 9 - In conclusion

A first evaluation of the instruments

The diversity of economic instruments that was investigated in the report shows that solutions often exist or can be developed for many water related environmental issues. Furthermore, the study has shown that any given instrument could be applied in different manners according to the national context and decision makers' preferences (as illustrated, for example, by existing taxes on pesticides or charges on water abstraction).

To reflect on the potential relevance of existing instruments to the Dutch situation, different aspects can be considered: the efficiency and effectiveness of the instrument, the difficulties of its implementation and of course the priorities and policy demands in the Netherlands. With regards to effectiveness, however, the knowledge base is scarce and only a very limited number of references assessing impacts of instruments are available. Furthermore, instruments are often implemented in combination, making it difficult to assess the marginal impact of individual ones. Keeping this in mind, an attempt is made in the following table to compare the economic instruments identified. This table reflects also on potential transaction costs, implementation constraints and expected acceptability.

Instrument	Summary of the case study			Criteria for evaluation			
	Objective(s)	Type of instrument	Sector targeted	Relevance for the Netherlands	Transaction costs & implementation constraints	Acceptability	Comments
Water quantity and water scarcity							
Water abstraction charges in the Baltic countries	To modulate abstraction according to the value of the water abstracted, i.e. in relation to the quality and scarcity of the water from a given source in a given region. To apply the polluter-pays principle more firmly. As for most charges, to collect financial resources.	Charge on water abstraction	All water abstractors in principle (depending on possible exemptions)	Unclear	Applying a charge based on the volume abstracted requires the installation of meters, which has proven to be costly, especially in rural areas. In areas where meters are already installed, this instrument reduces transaction costs significantly.	Different rates can be proposed to users accounting for their capacity to pay. However, some users are often exempted (based on a mixture of objective justification and political choice). They do not get the economic incentive to regulate their consumption and do not contribute financially. Depending on the design of the charge, it is not necessarily totally earmarked. A Ministry of Finance can keep part of the financial receipts from the charge.	In the Netherlands, a water abstraction charge already exists which depends on the province. However, it is unclear whether it is correlated with the value (quality, scarcity) of the water abstracted.
Financing substitution reservoirs for farmers to access good quality water in the Boutonne river basin (France)	To ensure a sufficient, good quality and more reliable supply, a drinking water company finances storage reservoirs for farmers in exchange of their boreholes and groundwater abstraction rights.	Subsidies for investments	Farmers having boreholes abstracting water from deep good quality aquifer	Yes - in some specific cases	The reservoir projects involve public subsidies (in France, up to 70%). Because of the political sensitivity of building new reservoirs in this region of France (numerous protests from environmental NGOs), the requests take time to be accepted, involving long juridical decisions and therefore higher transaction costs.	The projects are usually fully accepted by farmers involved. In case where reservoirs lead to better drinking water supply, there is usually better acceptance from Environmental NGOs because of a recognised public utility (drinking water is involved).	
Tradable water rights – the Siurana-Riudecanyes District water market (Catalonia, Spain)	Ensuring an efficient allocation of water within farmer associations and between farmers and municipalities, according to its annual availability.	Tradable permits for abstraction	Farmers, municipalities	Yes	The water markets have been in operation for many years. It has been adjusted several times during its history for better efficiency. The Association of farmers plays a crucial role as intermediary. It allows reducing significantly the number of stakeholders involved in negotiations between farmers and municipalities. In general, the creation of new markets of tradable permits involves very high transaction costs. New institutions have to be built, property rights have to be set and the market has to be carefully monitored and eventually adjusted in its first phase.	Large groups of titles were owned by a small number of individuals at the beginning, leading to the problem of access to water for "new" farmers. The market activities led to the breakup of these "pockets" and ownership is now spread among 3 000 families. However, the introduction of markets can be confronted with opposition from those which currently use the resource free of charge and/or in high quantities.	As shown in the report, every water market has its specific features, weaknesses and strengths. In the Spanish case, successful features include: active participation of water users, structure of the managing institutions, good definition of water rights, transparency of management (accounts, available water) and small market size. Another important feature of the system is the allocation of water rights at the time of the creation of the resource. A more challenging scenario for policy makers is distributing water rights when private users have historic claims on these rights.

Instrument	Summary of the case study			Criteria for evaluation			
	Objective(s)	**Type of instrument**	**Sector targeted**	**Relevance for the Netherlands**	**Transaction costs & implementation constraints**	**Acceptability**	**Comments**
Water quality							
Charges on water pollutants in the Baltic countries	The charge introduced in the Baltic countries on pollutants in water is combined with a system of emission permits. Polluters who exceed their permit have to pay a fee, the financial receipts from these fees being used to subsidise less polluting practices for other users.	Pollution charges and emission permits	Point source pollutant sources: industries, sewage treatment companies, individual polluters	Yes	The implementation of a charge on point and non-point pollution sources requires monitoring and control which could represent important transaction costs. To avoid those costs, one possibility is to trust polluters on their declarations. To be efficient in influencing polluters' behaviour to reduce their pollution, the rates have to be increased on a regular basis. Otherwise, the incentive effect to invest in more environmentally-friendly technologies is gradually reduced.	The idea of a charge on pollution is usually well accepted by the public. However, as for taxes on pesticides for instance, there is a chance that the additional costs would be transferred to consumer (through the bill for sewage companies or through the price of the product for industries). In that case, the financial burden is born by the consumer with questions on the effectiveness of the instrument.	
The pesticide tax in Denmark	Reducing the total consumption of pesticides in the agricultural sector. Responding to public concerns on the use of pesticides.	Tax based on the maximum retail price	Domestic producers and importers of pesticide products; Agricultural sector	Yes	Transaction costs depend on the design of the pesticide tax. Whereas taxes designed as a share of the price of the product might be easy to implement from an administrative point of view, it is more difficult to introduce a tax system based on the toxicity of substances. However, the latter is assumed to be more effective, as prices of pesticides might fall due to technological progresses; this would lead to smaller taxes and therefore smaller incentives in the first option, although environmental costs remain the same.	The general public might welcome taxes on pesticides due to related health issues. However, if financial costs are passed on to farmers and then to consumers, acceptability might decrease. Objections might also come from the fact that pesticide taxes are known to have low price elasticities, resulting only in limited reductions in terms of quantity of pesticides used. The effectiveness (and therefore the acceptability) of the whole instrument can be significantly increased by redirecting the generated income into research, information campaigns and support to better practices.	The remarks made for pesticide taxes can also be applied to taxes on fertilizers. For further reading: see e.g. Pearce & Koundouri 2003

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England Catchment Sensitive Farming (CSF) - Capital Grant Scheme 2009/10	Raising awareness for diffuse water pollution from agriculture and encouraging land managers to take action.	Grants for specific items	Agricultural sector - small and medium sized farmers in priority catchments	Yes	Some work is needed beforehand for defining eligible items of the grant scheme. Also a network of catchment steering groups and responsible Catchment Sensitive Farming Officers has to be built to accompany the implementation of the instrument. Furthermore, financial resources have to be provided for the grants. However, as in the UK, defining maximum amounts per holding and restricting the measures to priority areas allow limiting the necessary financial resources and focussing on targeted areas.	Experiences in the UK show that some time is needed to build farmers' trust and to establish cooperation. Minimum running times of several years of the financed items are necessary for the sustainability of the instrument. However, farmers might see this as a restriction of their freedom and conflicts might appear during controls and potential demands for repayment. Catchment Sensitive Farming Officers can play an important role in facing and avoiding such difficulties.	Some of the measures promoted in the English case might form part of the Good Agricultural Practices in the Netherlands, which are not subsidized. However, such a grant scheme would then be interesting for additional measures.
Voluntary agreements between water suppliers and farmers in Germany	Ensuring and improving drinking water quality in the long term.	Voluntary agreement	Agricultural sector - farmers in drinking water catchments	No (see comments)			Voluntary agreements between agriculture and drinking water producers exist also in the Netherlands. In general, such cooperation can complement regulations of protected areas in an individual and flexible way, with agreements being beneficial for both sides. However, measures have to be checked for effectiveness and acceptance before selecting them for the agreements. For further reading: see e.g. LFU 2009
The native woodland scheme in Ireland	Protecting and expanding native woodland resources, including the improvement of water quality through native riparian woodland development	Grants and annual premiums	Landowners	Yes	Preparatory work is needed for establishing the design of the scheme, including criteria for application. During the implementation of the scheme, field visits are necessary for compliance checking. As some of the grants relate to long time periods, a long-term supervision programme has to be implemented.	Some problems might be related to the grants which are given for longer periods (15-20 years) if compliance after a certain time is put into question.	In its current design, the instrument aims only secondarily at water quality protection. However, the establishment of priority areas next to watercourses or higher grants for riparian woodland are conceivable.
Tradable permit schemes in Sweden	Reducing phosphorous and nitrogen loads in a cost-effective manner	Tradable	All emitters of nitrogen and phosphorous	Yes	The establishment of a tradable permit scheme is linked to considerable transaction costs. Its introduction requires besides a legal basis a sound knowledge of the amounts of pollutants emitted from each source as well as an elaborated monitoring scheme. Furthermore, pollution caps have to be carefully chosen, in order to fulfil the final	In order for the scheme to be effective, pollution limits have to be set at a lower level than the currently existing emissions. This will have financial implications for several actors, which will provoke opposition to the scheme. Problems of acceptability might also arise from potential exemptions or the controls which are necessary in order to	After a costly launching and testing period, the tradable permit scheme promises to be a cost-effective and fair pollution reduction tool.

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					environmental objective. The same applies to the measures which are supposed to reduce concrete amounts of pollutants.	supervise the system.	
Morphology and ecological restoration							
Compensating for "Damage to fish" - the Fish Compensation Fund in Latvia	Internalising environmental costs caused by morphological pressures and re-establishing damaged fish resources.	Compensation payments	Initiators of morphological alterations: Municipalities, hydropower plants, other economic sectors	Yes	The attempt to internalise environmental costs implies that efforts have to be undertaken to calculate them for the different actors concerned. Furthermore, different sectors will be affected by the instrument, making probably negotiations with stakeholder groups necessary. An institution which is managing the fund, which is collecting the money from the respective sectors and redistributing it for compensation measures, might need to be created.	No broad opposition should come from the general public, as the impact of the economic sectors on the morphological environment - and in particular fish populations - is obvious. The opposition from the side of the concerned sectors will depend on the amount of the compensation they have to pay. The political acceptability of the instrument might also be hindered by the difficulties to determine sound values for the environmental costs to be compensated. In Latvia, the money collected is so far only used for the introduction of commercial fish species. A shift of a part of the resources for the ecological improvement and the support of a diversity of native species could increase the acceptability of the measure as well as strengthen its ecological justification.	The instrument is relevant as it is one of the few which aims at mitigating morphological alterations (which are one of the main "new" pressures to be taken into account in the context of the Water Framework Directive).

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Ecological accounts (Ökokontos) in Germany	Improving the efficiency of compensations for interventions affecting nature and landscape.	Accounting system	All sectors carrying out interventions which affect nature and landscape	Unclear	Some administrative effort is necessary to establish and manage the accounts. However, once a list of criteria for corresponding compensation areas has been determined, the operational work is limited to the maintenance of the database and eventually field controls.	Ecological accounts offer a wide set of advantages: - Helping to accelerate planning processes. - Facilitating the use of ecologically reasonable compensation areas. - Managing compensation areas in advance permits to use cheap areas as speculations on land prices can be avoided. - Increasing transparency of the processes and therefore acceptance of the local nature conservation policy. Acceptability problems might occur if interventions are balanced with compensations that took place beforehand, when the link is not necessarily obvious.	With the landscape fund, a similar instrument might already exist in the Netherlands.
Support to ecologically friendly hydropower plants through favourable electricity tariffs	Promoting the new building and extension of hydropower plants which are complying with environmental (ecological) criteria	Bonus/premium on end-product	Hydropower sector	No (hydropower only of minor importance in NL)	Once criteria for receiving the bonus have been set, the administrative effort to implement the measure is limited. All hydropower plants have to be controlled on site, but once this is done a next visit is only necessary after a longer time span.	The political acceptability can assumed to be high. Electricity consumers which are purchasing renewable energy can be expected to have a certain environmental affinity and probably approve the environmental efforts around the hydropower plants, although this entails a certain increase in the price. The acceptability from the part of the operators of the hydropower plants will depend on the time period for which higher prices (bonus) will be paid. Indeed, this will make them able to calculate long term profitability of ecological improvement measures.	Although hydropower plays only a small role in the Netherlands, the concept of the instrument - a bonus on a water related product for a water environment friendly production process - could possibly be transferred to another sector. Imaginable would be for example higher prices for freight of ships in harbours which comply with certain environmental criteria. However, the system works only in "markets" where prices are fixed.
Financial compensation for biodiversity damage in France	Supporting compensation for biodiversity damage	Establishment of an intermediary operator	Economic operators, municipalities	Unclear	See annotation for ecological accounts in Germany. In the French case, a private operator takes the initiative for providing the service of pondering damages and compensation measures, reducing costs for administrations to initial and then occasional controls of the activities.	The fact that an intermediary operator manages the system might evoke some scepticism on the part of the environmental organisations which are carrying out the compensation measures, as part of the money will go into the administration of the system. Transparency of the accounts can avoid this.	With the landscape fund, a similar instrument might already exist in the Netherlands.

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Purchase of agricultural land to improve river morphology (France)	To purchase agricultural land in the erosion corridor of the Allier river. Indeed, some agricultural plots are protected against erosion using rocks, which have a negative impact on the river morphology.	Compensation payments	The land owners located in strategic spots in the erosion corridor of the river	Unclear	Despite its success, the instrument had relatively high transaction costs, mainly due to the number of stakeholders (land owners) involved : important communication activities were needed (requiring significant human and financial resources), each land transaction involved important notarial costs, some owners were unwilling to sell their land, etc.	Although the French NGO in charge of the project still works on the erosion corridor of the Allier river, funds are not granted anymore for land purchasing. Several politicians thought it as an inefficient allocation of public funds as land purchased would eventually be eroded…	It is unclear whether such an instrument already exists in the Netherlands. The principle of land purchase for environmental objectives can be used for other issues. For example, a public purchase of land could be imagined in sensitive areas for drinking water abstraction. Then the land would be leased to farmers who accept to use it with good practices that will be defined by the new public owner of the land (organic farming for example).
Financial compensation for environmental services (France)	Making water abstractors participate to the costs of ecological flow support by dams.	Compensation working as a charge	Water abstractors downstream the river (agriculture, industries & drinking water companies)	Yes	Water is nowadays metered in most places in France and a charge is levied by the water Agencies. Therefore, water consumptions are known with relatively high precision and the implementation of this new charge was not too complicated.	Different rates are used to calculate the compensation owed by a user, including a rate that adjusts the compensation according to the annual cost of ecological flow support (mostly depending on the climate). The users are made aware of the use of the funds collected. Indeed, without ecological flow support, the situation of water quantity in the two rivers would not be as acceptable as it is today with the enhanced operation of the dams.	Financial compensations are widely discussed in France at local level. It is thought to be a way to make recreational users contributing to river restoration for example. The problem is that the charge is linked to water abstraction and recreational users are not abstracting water. The charge could then be proposed for other services (entry fee to a recreational spot, charge on hotel and camping nights, etc).
Managing excess water							
Support for the building of green-roofs to reduce storm water runoff	Promoting the construction of green-roofs as a technique to reduce storm water run-off.	Subsidy or tax/charge rebate for investment	Owners of impervious surfaces	Yes	No high transaction cost can be expected for the support of green roofs. However, this depends on the design of the support. Some effort is required for control of roofs.	The instrument is well accepted as it is a way to redistribute revenues collected through the storm water charge.	The architecture of the building has to be suited for the creation of a green roof. In the medium term, this requires partnership of architect and urban designers so green-roofing can spread.
Income tax reduction for rainwater collection and reuse in France	Reducing stormwater runoff and encouraging rainwater reuse	Income tax reduction	Houseowners	Yes	The instrument needs to be based on regulation and guidance documents established. However, once the basis provided, minimal additional work is required as controls take place in the context of already existing regular controls.	No direct problems of acceptability should appear, aside from general discussions about tax exemptions and their impact on the state budget.	

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Economic mechanisms for storm water management – a review of European experiences	This instrument aims at collecting financial resources by charging owners of impervious surfaces. Then, the money collected can be (fully or partly) used to financially help owners willing to invest in flood control techniques.	Tax or charge + subsidy or tax/charge reduction	Owners of impervious surfaces	Yes	The creation of a new charge ("storm water charge") can lead to transaction costs (calculating impervious surfaces, etc). One way to avoid this cost is to link the storm water tax to the sewage charge as it is done in some countries. The tax reduction for investments that would improve flood control is then calculated based on the sewage charge.	Part of the financial receipts is redistributed to those who invest in techniques to control flood sources. This enhances acceptability of the instrument.	The Netherlands have chosen another approach to storm water management. Some municipalities grant subsidies to owners who accept to disconnect stormwater collection from the sewer network. However, both instruments are not incompatible.
Creation of multi-functional wetlands in Finland.	To finance the creation of wetlands as a way to improve flood management, among other things.	Subsidies on practices	Land owners	Yes. Although different financial schemes exist in the NL, the Ministry emphasises the insufficient interest by land owners.	This economic instrument can be implemented as a Rural Development measure supported by European funds. Transaction costs could come from the management of the administrative applications from potential candidate.	The willingness of farmers to accept this instrument is influenced by many factors (see de Groot, forthcoming). Financial support is not the only driver to farmer's decision.	

The table above stresses that most instruments investigated within the case studies are potentially relevant to the Netherlands. More specific assessments, combined with stakeholder consultation, would however be needed to further assess the suitability of individual instruments to the Dutch context. These could also further investigate practical implementation conditions.

In which direction to proceed? Food for thoughts

As reflected in the course of this report, several water management issues are of importance in the Netherlands. The diversity of economic instruments developed in different EU countries would favour the optimistic view that each issue can be tackled by some sort of economic instruments if adequately designed and adapted to the local situations. The report also showed that the Netherlands already applies a large set of different, including innovative, economic instruments (e.g. voluntary agreements between farmers and drinking water companies) even though partly still at a more local scale (e.g. *Binnenveld fonds*).

Future actions on new economic instruments to be applied in the Dutch situation could include the following:

- **Flood management:** The management of excess water is one of the most important water management issues in the Netherlands. Being very flat, more than half of the country is prone to sea or river floods or to water logging (Mostert 2006). Currently, flood protection is paid by people based on the value of their property (van der Veeren, p.c.). One approach for storm water management by reducing runoff could include the promotion of green roofs as described in the report. Whereas direct subsidies are one way to facilitate their development, other possibilities such as reductions in wastewater charges could also be envisaged as incentive. The promotion of areas open to percolation goes into the same direction. 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.

- **Water scarcity**: The Netherlands have to face also water scarcity situations mainly during summer months. However, water shortage problems are expected to become more important in the next future due to climate change (Mostert 2006). The increased use of alternative water supply sources, e.g. rainwater, can be one issue contributing to both problems of water scarcity and mitigating stormwater runoff. Its promotion in the form of an income tax reduction like in France is one alternative with minimal transaction costs. The costs at the expense of the state budget, depending on the level of contribution to investments, could be counterbalanced with lower storm water management costs combined with reduced pressures on drinking water resources. As the absolute water price level in the Netherlands is already quite high (as compared to other European countries), the introduction of a system of block tariffs for drinking water services could represent an alternative worth considering that would give incentives for reducing water consumption of large water consumers without hindering access to water for economically vulnerable families. In the agricultural sector, water consumption is mainly free of charge (vander Veeren, p.c.), the existing groundwater charge affecting only a small percentage (1-2%) of farmers (Hellegers & van Ierland after 1999). The progressive introduction of a system of tradable water abstraction rights could be considered as an alternative manner to reorganize (quantitative) water management in the Dutch agricultural sector. This would however require changes in the overall institutional set-up and new allocations of property rights which might face some resistance because of the tradition of free extraction licences granted by provinces that can be considered as historical extraction rights ("grandfathering rules") (Hellegers & van Ierland after 1999).

- **Diffuse pollution** – with nitrates and phosphate from agricultural sources being the main pollutants – is another predominating challenge in the Dutch water management sector (Mostert 2006, Ligtvoet et al. 2008). Also here, tradable permit systems could be an interesting solution. However, as mentioned before, transaction costs are considerable and, furthermore, European long-term experiences are still missing. It could nevertheless be considered in long-term strategies against diffuse pollution. One specific type of tradable permits could be salinity permits, which are currently applied in Australia and which seem to achieve good results. However, the system design would have to be adapted to the Dutch situation, as – in contrast to the Australian situation – salinity problems do not result from the increased liberation of soil salinity.

In conclusion, economic instruments can – in theory – be effective and efficient instruments for a diversity of water managing issues. However, it has to be kept in mind that they are not always the best choice (e.g. EEA 2005, Anderson & Farooqi 2003). From the beginning, the application or new development of economic instruments should in particular take social implications into account. Furthermore, and as demonstrated at several occasions in the report, they need to be designed in combination with other (technical, regulatory) instruments for an effective and sustainable management of water resources.

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