



The role of water pricing and water allocation in agriculture in delivering sustainable water use in Europe – FINAL REPORT

European Commission

Project number 11589 | February 2012



Client	European Commission DG ENV – D1 Protection of Water DG ENV.SRD.2 (BU-5 00/122) B-1049 Brussels +32 2 296 91 05
--------	--

The role of water pricing and water allocation in agriculture in delivering sustainable water use in Europe

Client	ARCADIS Belgium nv/sa Main Office Koningsstraat 80 B-1000 Brussels
--------	--

Contact	Sarah Bogaert
Telephone	+32 2 505 75 21
Telefax	+32 2 505 75 01
E-mail	s.bogaert@arcadisbelgium.be
Website	www.arcadisbelgium.be

Revision		
Version	Date	Remarks
1	20 December 2011	Final report
2	February 2012	Final report adapted to comments
Drawn up by		
Arcadis Belgium NV	Sarah Bogaert	
Arcadis Belgium NV	Dieter Vandenbroucke	
Fresh Thoughts Consulting	Thomas Dworak	
Fresh Thoughts Consulting	Maria Berglund	
InterSus	Eduard Interwies	
InterSus	Stefan Görlitz	
TYPSA	Guido Schmidt	
TYPSA	Manuel Herrero Álvaro	
With contributions from		
Ecologic	Manuel Lago	
Ecologic	Jennifer Moeller-Gulland	
Verification		
Department	Function	Name
ARCADIS Belgium	Project leader	Sarah Bogaert

Table of content

Executive summary	I
1 Background and introduction to the study	1
2 Definition of the theory behind water pricing and water allocation policy and its implications for the agricultural sector	3
2.1 Introduction	3
2.2 Explanation of main Concepts	6
2.3 Water Allocation	10
2.3.1 Water Allocation Mechanisms	11
2.3.2 Water Allocation in Agriculture	15
2.4 Water Pricing	16
2.4.1 Variations and Objectives of Pricing Schemes	16
2.4.2 Options in Tariff Design and Price Level	17
2.4.3 Water Pricing in Agriculture	19
2.4.4 Possible Impacts of Water Pricing on the Agricultural Sector	23
2.4.5 Conclusions	25
2.5 Legal Framework for Agricultural Water Pricing in Europe	26
2.5.1 WFD – Overview of Provisions regarding Water Pricing	26
2.5.2 Other Policy Fields	29
2.6 Conclusions	31
3 Current use of water pricing policies & water allocation policies in the EU and for the agricultural sector	33
3.1 Introduction	33
3.2 Current baseline in the EU: summary of water pricing and allocation policies in agriculture	34
3.2.1 Water allocation	34
3.2.2 Water pricing	37
3.3 Conclusion	44
4 Analysis of case studies	47
4.1 Aim of the case studies	47
4.2 Selection of case studies	47
4.3 Case study methodology	50
4.4 CASE STUDY: MURRAY-DARLING BASIN IN AUSTRALIA	53
4.4.1 Characterisation	53
4.4.2 Water allocation policy in the agricultural sector	53
4.4.3 Water pricing policy in the agricultural sector	54
4.4.4 Conclusions	55
4.5 CASE STUDY: CYPRUS	55
4.5.1 Characterisation	55
4.5.2 Water Pricing in the agricultural sector	55
4.5.3 Conclusions	56

4.6	CASE STUDY: FRANCE – ADOUR-GARONNE	58
4.6.1	Characterisation	58
4.6.2	Water allocation.....	58
4.6.3	Water pricing.....	59
4.6.4	Conclusion	60
4.7	CASE STUDY: MEXICO.....	61
4.7.1	Characterisation	61
4.7.2	Water allocation policy in the agricultural sector	62
4.7.3	Water pricing policy in the agricultural sector	63
4.8	CASE STUDY: NETHERLANDS	64
4.8.1	Characterisation	64
4.8.2	Water allocation.....	64
4.8.3	Water pricing.....	65
4.8.4	Conclusions.....	66
4.9	CASE STUDY: ROMANIA - BAZAU-IALOMITA	67
4.9.1	Characterisation	67
4.9.2	Water allocation.....	68
4.9.3	Water pricing.....	68
4.9.4	Conclusions.....	69
4.10	CASE STUDY: SPAIN – GUADALQUIVIR.....	70
4.10.1	Characterisation	70
4.10.2	Water allocation.....	71
4.10.3	Water pricing.....	71
4.10.4	Conclusions.....	73
5	EU-level conclusions from case study analysis	75
5.1	Results from the Case Studies.....	75
5.1.1	Comparison of the Case Studies	75
5.2	Actions at EU level	89
5.2.1	Introduction	89
5.2.2	Methodology.....	89
5.2.3	EU policies linked to Water Pricing and Water use	90
5.2.4	Beyond the case studies - EU policies with the potential to affect Water Pricing	95
5.3	Identified links to EU level policies	102
5.4	Conclusions.....	105
6	Conclusions.....	109
7	Recommendations to EU river basins for establishing agricultural water pricing.....	113
References	121	

List of diagrams

Diagram 1 : Water Abstractions in Europe and Turkey.....	3
Diagram 2: Water abstracted for Irrigation in 1990 and 1997-2005.	4
Diagram 3: Price-Demand Curve.....	22
Diagram 4: Incentive pricing, cost recovery and polluter pays principle	28
Diagram 5: Member States where exemptions from water abstraction taxes are granted for agriculture (red marking) or irrigation (orange marking). (Source: own compilation of different information sources)	39
Diagram 6 : Case study methodology and link with policy recommendations	50
Diagram 7 : Link between screening of EU policies and the project	90

List of tables

Table 1: Attributes of Water Use Rights.....	6
Table 2: Interpretation Issues in WFD regarding agricultural water pricing	29
Table 3 : Water prices in the agriculture sector	68
Table 4 : Key characteristics of the Case Studies	75
Table 5 Water allocation policies in agriculture	76
Table 6 Main aim of water pricing policy (according to MS Expert representatives)	80
Table 7 Water price by sector.....	82
Table 8 Indirect effects of water pricing and allocation policies	86
Table 9 Links between Cohesion policy and the WFD	101

Abbreviations

CAP	Common Agricultural Policy
CIS	Common Implementation Strategy
EC	European Commission
EEA	European Environment Agency
ERC	Environmental and Resource Costs
FAO	Food and Agriculture Organisation
GDP	Gross Development Product
GVA	Gross Value Added
GWP	Governmental Water Projects
GWW	Governmental Water Works
ICWE	International Conference on Water and Environment
IWUA	Irrigation Water User Association
MCM	million cubic metres
MoE	Ministry of Environment
OECD	Organisation for Economic Co-operation and Development
O&M	Operation & Maintenance
POM	Programme of Measures
RBA	River Basin Authority
RBD	River Basin District
RBMP	River Basin Management Plan
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WBCSD	World Business Council for Sustainable Development
WFD	Water Framework Directive
WWF	World Wildlife Fund for Nature
WSD	Water Scarcity and Droughts
WDD	Water Development Department

Executive summary

Out of all economic sectors worldwide, agriculture uses the greatest amount of water and in Europe rates second to energy. Agricultural water use across Europe has increased over the last two decades, accounting now for a rather stable share of around 24% of total water abstraction, mainly due to irrigation practices. In some parts of southern Europe, where crop irrigation has been practiced for centuries and is the basis of economic and social activity, this figure can reach up to 80% or even higher. Future demand for energy crops and higher water stress pressures resulting from climate change and drought events are expected to increase agricultural water use.

In recent years, a growing concern has been expressed throughout the EU regarding water scarcity problems and the significant impacts on water resources by agricultural activities. Managing water use in agriculture has been identified as one of the key themes relating to water scarcity and drought. The present study explores what role water pricing and allocation plays or could play to promote a more sustainable use of water in agriculture in Europe. The overall objective of the study is to provide a general overview of the use of water pricing and water allocation policies in agriculture, to assess the impacts of policies implemented in order to identify good practices and to draw EU-level conclusions of practical implementation.

Aim and approach of the study

The study starts with a theoretical part on the different concepts behind water pricing and water allocation policies and what these imply for the agricultural sector. Then, an overview is given of the baseline situation across the EU, clearly showing the broad diversity regarding water allocation and water pricing policies towards the agricultural sector. The overview has been compiled from various publicly available literature sources. Member States had the opportunity to validate the draft presentation of collected information. The key tendencies and principles in water pricing and allocation in agriculture across the EU have been presented at the Water pricing conference in Warsaw mid September 2011. A second consultation round has been organised and some further modifications were done.

In close cooperation with the EC and after consultation of the CIS Expert Group on WFD & agriculture a set of seven case studies within the EU as well as in third countries has been selected for in-depth analysis. The chosen set of EU case studies offers a balance between new and old Member States, as well as between northern and southern Member States. The following case studies (river basins) have been analysed in detail: Cyprus, France (Adour-Garonne), Netherlands (Scheldt), Romania (Buzau Ialomita), Spain (Guadalquivir), Australia (Murray-Darling) and Mexico (Lerma Chapala). The highly diverse case studies undertaken highlight the successes and pitfalls of agricultural water allocation and pricing policies. From the case studies, conclusions have been drawn, making comparisons among the countries to determine what factors help or hamper the goals of water pricing and allocation policies in the given countries by comparing the main impacts of the presented policies. Further, the link is analysed on an EU level between water pricing and other EU policies in order to investigate whether any conflicts or synergies exist. The study

concludes with the development of recommendations for Member States and river basin management authorities with regard to water pricing and allocation policies.

Water allocation policies

Historically, water allocation mechanisms have been in place in most areas to guarantee water availability for basic needs, sanitation and the production of food. Most of these allocation mechanisms were not based on a formal law but rather on tradition and custom. The subsequent intensification of agriculture led to growing investments in water supply schemes, mostly reservoirs and irrigation canal networks largely financed with public budgets. Today, pressure on global water resources is heavier than ever before, and it is assumed to rise steadily. This necessitates the need to find better mechanisms to allocate scarce resources between various competing sectors of society. Although the potential efficiency gains by applying economic criteria to water allocation cannot be neglected, the issue is complex as water is a commodity with attributes and values that distinguish it clearly from other economically treated goods.

The high water consumption by agriculture and the connected potentially detrimental effects on local and regional water supply on the one hand and on the other hand the importance in providing food security and other important social and environmental services, underline the special attention needed when analysing water allocation mechanisms in agriculture or policy instruments to control agricultural water use.

Findings from baseline overview and case study analysis

From the case study analysis and baseline overview it is seen that generally, the **right to abstract or use water** is initially issued by a public authority through the granting of authorisations, licenses or permits. Water allocation to individual farmers and/or plots is carried out by different actors at different administrative levels. The rationale behind the initial allocation can consider the availability of water resources, the aim of the abstraction (use), environmental needs and other uses and the water source. Authorisation procedures and formalisation differ according to the quantity of water abstracted (in some MS licences are only needed above a certain threshold) or the pumping capacity. Time periods or duration of permits or authorisations can differ significantly between Member States.

In times of water scarcity or droughts, the practice to **restrict water use** is included in all of the water allocation policies found in the case study areas. In some Member States, restrictions are determined according to the hierarchy of water users (e.g. Netherlands, Cyprus, Spain and France). This can take the form of prioritising only according to sectors (e.g. prioritising domestic supply above agriculture) or, as is the case in the Netherlands and Cyprus, also within sectors (e.g. prioritising higher value crops). In some cases the environment is included as a separate sector.

Abstraction rules can be more stringent in areas qualified as suffering from chronic water shortage e.g. in France. Some interesting mechanisms have been identified, such as the innovative 'organismes uniques' in France or the strict rationing procedure in Cyprus. These restrictions have been found to significantly impact farmer incomes. As highlighted by the French example, there is a need to notify farmers as early as possible regarding these restrictions, in order to enable them to change their cropping patterns/behaviour.

The Romanian, French and Australian cases have managed to incorporate the concept of **minimum ecological flow** in their water allocation designations. This has especially shown to be useful in order to limit abstractions and to control allocations in the designated water stressed areas in the Adour-Garonne RB (France).

Australia, Spain and (to a lesser extent) Mexico have turned towards using **water markets** to trade water entitlements and allocations. The system is the most developed in Australia where water trading has helped individual irrigators (buyers and sellers) manage and respond to external drivers (including seasonal water availability, changes in commodity prices and input costs, government water policies and social trends) by allowing more flexible production decisions. However, in both Australia and Spain the pressure on the ecosystems has risen, due to problems with over-allocation of water rights.

Based on the Australian experiences in water trading, key elements for a successful water trading scheme could be identified, such as the unbundling of water access entitlements, installation of metering to allow control, the putting aside of sufficient environmental allocations, the application of a unit share structure instead of volumetric entitlements and the obligation of license registers.

Recommendations regarding water allocation policies

Particularly in water-scarce basins, water allocation is a driving factor for the economy as it prioritises water use according to a hierarchy of sectors or uses within sectors. Over-allocation of water permits poses significant threats to the ecosystem health of a catchment area. It is important that the allocation is **controlled** and the final water use at farm level is regularly **monitored**.

It is generally advisable for RB authorities to relate authorisations or permits to the local circumstances and impact of the water abstraction. Abstraction rules can be more stringent in areas qualified as suffering from (chronic) water shortage; however, it is important that these water use restrictions are communicated before farmers have made decisions on the use of (water intensive) crops to be effective.

The pitfalls of inefficient water allocation policies should be avoided by taking the following potential actions within each RB and at EU level:

- Set up an allocation system that is based on **environmental flows and sustainable groundwater use**. This allocation system should be governed under the competent authorities set up under Art 3 of the WFD. **Guidance** is needed at EU level for calculating and implementing meaningful flow regimes at river basin level but also more locally. Further guidance might be needed on how to organise a process that identifies priorities and balances out regional shortages. This work should be organised within the above recommended CIS working group on environmental flows.
- Improve the understanding of the **value of water** for the economy of the area (and outside the RBD) across the full production and consumption chain, e.g. by combining methods calculating total water use, such as the life cycle analysis (LCA) or water footprint assessments (WFA), with economic valuation methods (taking also opportunity costs into account).
- Over-allocation should be avoided through a comprehensive permitting system that is not burdensome in terms of **administration costs** and that provides a clear overview of water abstraction. Allocation should

be based on a current precipitation and runoff rate and not be based on historical averages. To avoid non-authorised abstraction, this permitting system should not only be regularly checked internally through the **enforcement** system, but also through an **external auditing** process that can check and “certify” the performance of the system.

- The allocation system should include a water use **hierarchy**. This hierarchy should be differentiated among the different sectors (e.g. households before agriculture and tourism) but also within the sector, where it could be based on economic motivation (e.g. high value crops first). The environment should be included as a user to ensure sustainable water use in the basin. Such an allocation hierarchy has to follow a comprehensive and transparent approach which allows all stakeholders to gain the same picture of issues of concern. During both scarce and non-scarce times, allocation systems should be based on a water balance and water quantities assigned to each use, including environmental flows. Besides an overall allocation hierarchy, there is also the need for specific, transparent “emergency allocations” for different potential scarcity situations/years. Both hierarchies need to be established on the sub-basin level but in many cases also on the transboundary level in order to ensure that up and downstream countries are served in an equal way.
- The allocation system should allow **short to medium term adjustments** (every year to three years). An allocation system that remains stable for several years might have the effect that the restriction on water use could become too low and the reductions in abstraction would not be sufficient to meet good status. In other cases, a long term fixed quota might result in water savings above the needs defined by the good status. This would lead to additional costs (in general or for a specific sector), as such restrictions would either limit production (e.g. agriculture, industry) or trigger expensive technical water saving measures with no additional environmental benefit.
- **Online monitoring** could be used to adjust the predefined allocation rights to real conditions, ensuring that flows are guaranteed. This could potentially also enable quicker notifications of water use restrictions to enable farmers to adjust their cropping decisions.
- Since Member States already have water allocation systems in place, it is important to analyse the **existing governance structures** for strengths and weaknesses. In general, administrative or information gaps between water abstractions, water consumption and allocated water should be identified to lead to a better understanding of overall water abstraction pressures on water bodies.

Water pricing policies

The Water Framework Directive 2000/60/EC establishes an integrated approach to water management based on the functional boundaries of river basins and relies to some degree on economic instruments to reach its target of “good ecological status” in both qualitative and quantitative terms by 2015. Several provisions in the WFD relate to water pricing:

1. According to Article 11, water pricing should be considered as a potentially cost-effective measure for the implementation of the Directive’s objectives and more specifically the Program of Measures (POM) for each River Basin District (RBD).
2. Article 9 introduces the concepts of incentive pricing, cost recovery and the polluter-pays-principle. Member States are required to set up a water pricing policy which provides adequate incentives to use water resources efficiently and thereby contribute to the environmental objectives of the Directive. Water pricing policies should ensure an adequate cost recovery of

water services, taking account of the polluter pays principle. The three concepts can be regarded as guidelines or criteria for establishing water pricing schemes:

- Cost recovery is about the amount of money that is being paid for water services. The principle, however, extends not only to the financial costs for the provision of a water service, but it also covers the costs of associated negative environmental effects (environmental costs) as well as forgone opportunities of alternative water uses (resource costs). Relevant for calculating cost recovery rates in the agricultural sector is that it generally has high financial costs involved in setting up irrigation schemes, a high level of water consumption and potential detrimental environmental effects.
- The polluter-pays-principle looks at the adequacy of contributions from the different water uses towards the total cost based on their role in causing these costs, i.e. it addresses the question who pays for water. Relevant issues in the agricultural sector are e.g. the unclear groundwater use rights for irrigation, leading to difficulties in pricing and groundwater abstraction without being registered or monitored by any water authority. To a much lesser degree, non-authorised water abstraction is found in surface water extraction.
- Incentive pricing deals with the way water users pay for their use and whether the right price signals are transmitted, i.e. it addresses the question how is water being paid for and how the water price affects the behaviour of water users. In certain local and regional agricultural circumstances (e.g. in case of a low share of water costs in overall production costs) price elasticity of water demand can be low, especially in the short term. In these cases, a higher price for water may not lead to significant reductions in water use.

Findings from baseline overview and case study analysis

With respect to the objectives of Article 9, the baseline overview and the case study analysis indicate that there is still a considerable lack of **cost recovery**, both financially and with respect to environmental and resource costs (ERC). The level of cost recovery reflected in the water tariffs across the EU is highly different. Non-water stressed MS typically report the highest level of financial cost recovery. For at least 30% of the MS, O&M costs for the provision of water are only partly recovered. Capital costs (investments) are even more often (at least partly) subsidised by the state/regions. Central water management facilities and new constructions for dams and reservoirs, for example, are still subsidised by the State and thus represent a form of indirect support for irrigation activities. ERC do not yet form a central element in pricing policies. Generally, it is clear from the case studies that guidance on cost recovery, especially methodologies to include externalities, would be highly useful.

It is difficult to make overall conclusions on water pricing policies, considering the **large variability in both tariff design as well as price level**, not only between MS but also inter- and intra-RBDs. Generally, the incentive in the water pricing mechanism to manage water sustainably is weak; however, a number of good practices could be identified.

Volumetric tariffs, which have the greatest potential to fulfil cost recovery and incentive functions, are generally used for self-supply and increasingly for water provision throughout the EU. However, **tariff levels**

are **low to very low** (often below 0.01 €/m³ and - where prices were available - much lower compared to other sectors). Moreover, an **important share of water abstractions** for agriculture in the EU, even in water stressed areas, is **not priced yet**. Specifically, more than one third of the Member States has no tariff system for individual abstractions of farmers (or irrigators) and in this way does not recover any ERC for these abstractions.

A number of MS take the **scarcity** of the water resource and/or the volumes abstracted into consideration for their pricing scheme. Some MS **penalise** quantities abstracted above certain quota by charging a much higher price, or on the contrary, **favour** the use of alternative water sources by charging cheaper tariffs for treated effluent. In some MS, **area based** pricing systems can lead to an unfavourable situation where water intensive crops pay less compared to other crops.

One of the most important factors influencing the ability of water pricing and allocation policies to lead to sustainable water use is **metering**. The case study analysis showed that Cyprus, France and Romania have wide-spread metering, which is a pre-condition for volumetric pricing as well as for monitoring and controlling water allocation permits. Several examples indicated that insufficient or non-existent metering makes water pricing and allocation difficult to enforce and control. A lack of monitoring capabilities does not allow for proper control of agriculture areas to prevent construction of illegal boreholes (e.g. Mexico). Several MS pointed to a lack of necessary resources to effectively execute control activities.

Reasons behind the lack of incentive pricing are various. The conditions set up in Article 9 itself might play a role. Given that Member States are able to adjust incentive pricing for local conditions, the extent to which water pricing levels are actually able to induce sustainable water use has not been proven. The **low share** of water prices **in overall production costs**, highlighted by the case studies of Cyprus, France, Romania and Spain, indicate that current water pricing policies are not geared towards incentive pricing. Rather, the cases of Romania and Spain highlight the more significant role electricity prices play in water use. Both Member States - but especially Romania - saw decreases in water use due to marked increases in electricity prices.

In addition, higher prices, whether they are a result from the price of water or electricity, do not necessarily result in water savings but rather a **shift in crop production** to higher value crops; this is to ensure that margins remain the same. A shift towards higher value crops or profit losses is more dependent on the geographic and socio-economic situation of the river basins than on water prices themselves; poorer farmers are not as easily able to change production and not all high value crops can be grown in a region.

Closely linked to this issue, another key result of the case study analysis is that programmes targeting technological improvements have had mixed results. **Water use efficiency programmes** have a high potential to complement water allocation and pricing policies but they need to be set up carefully. For example, in Spain efficiency programmes have led to increases in irrigation area and to an intensification of land and water use. The water savings criteria found in Romania, where 10% water savings must be achieved if using rural development funding to modernise irrigation systems, could serve as a standard for all Member States. Such an approach is currently proposed within the latest CAP proposal. This criterion enables MS to unlock the potential of efficiency programmes and achieve water saving goals, thus avoiding rebound effects.

Recommendations regarding water pricing policies

Cost recovery

As shown in several case studies, the recovery of operational and maintenance costs for irrigation systems is often achieved and farmers bear these costs. However, capital costs (investments) are often (at least partly) subsidised by the state/regions (e.g. by using cohesion, rural development or national funds for modernisation purposes). Such subsidies reduce the level of costs borne by farmers, but this might be justified by the social and economic situation of a region. Furthermore, it should be noted that public funding only covers part of the investment (e.g. 40% in the case of rural development). Bigger investments, such as reservoirs, are still substantially subsidised through government budgets. There is no doubt that such investments have often multiple purposes and do not only serve farmers' irrigation needs. However, it often remains unclear which share of investment costs can be allocated to the different users.

Environmental and resource costs (ERC) do not yet form a central element in pricing policies in EU Member States. This can be explained by the fact that the internal/external environmental costs and resource costs of water supply networks are still not fully understood and practical implementation rules are lacking.

The following recommendations can be made to achieve adequate cost recovery, including taking into account ERC:

- **Financial costs** of the water supply network need to be calculated and **spread across water using sectors**, including irrigation, to ensure adequate financial cost recovery.
- An **enhanced coherence** between relevant policies should be implemented, requiring that EU and national funding for the modernisation of irrigation is a) coupled to gains in water saved and b) these gains are returned to the environment and not used to extend the irrigated area/water volumes used by change of crops. While the first issue might be easy to implement (e.g. inclusion of an efficiency percentage in the funding rules¹), the second issue is more difficult to achieve as funding is often linked to specific areas or projects. Environmental flows are a prerequisite for ensuring that modernisation of irrigation systems does not inadvertently increase/maintain pressures on water resources. This aspect is of particular importance within the next financial perspective of the EU as RD provides the possibility to financially support farmers seeking to invest in irrigation.
- Subsidies for improving irrigation should be linked to mandatory cost-benefit and climate impact assessments in order to ensure that only those investments are made which are sustainable. Thereby benefits should not only be considered from an income point of view, but also from an environmental perspective.
- Research activities should be expanded into methodologies and approaches regarding the environmental and resource costs of water infrastructure. The CIS process should consider advising MS on such methodologies and approaches they can use to calculate cost recovery including E&R costs in accordance with Art 9 WFD. This would also increase transparency and comparability within the issue.

¹ This is included in the proposed future rural development regulation (see article 46(3) http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/com627/627_en.pdf)

Incentive pricing

The primary aim of water pricing is to stimulate a more efficient use of water, by making users aware that water is a resource that can be scarce and that protecting water quality and ensuring water availability goes with a cost. However, incentive pricing also can avoid new water use when coordinated with allocation policy and in basins that are still not over-allocated. As shown in a number of case studies of Chapter 4, but also as set out as in many other studies (see I-adapt, FAO, 2004b; Dworak et al., 2010), incentive pricing as provided in the WFD does not work yet. Because the share of water prices in the total irrigation costs is low, other factors have a higher influence on water use behaviour, such as fertiliser or energy costs.

For a pricing scheme to deliver the optimal level of cost recovery and to ensure a sustainable use of water resources through incentives and investments in water saving technologies, the water pricing design options such as the **tariff structure and price level** are crucial success factors.

Volumetric pricing has to be considered as one of the most effective tariff structures with regard to actually providing incentives for water saving. Well designed volumetric tariffs have the greatest potential to fulfil cost recovery and incentive functions, but possibly have the greatest negative impacts on farm income or food prices compared with other tariff structures.

For volumetric pricing, **metering** devices are necessary, which are complex to install and monitor. Metering could be made mandatory as it is a prerequisite for a) proper monitoring to fully know how much water is abstracted, and b) proper controlling of the abstractor. Metering can face rejection by farmers because of additional costs and additional controls which are not accepted. A shift to metered systems may be difficult, especially in specific situations with area-based systems, or no history of metering (as water has simply been available for agriculture), or other circumstances. Several options are possible to increase the level of metering, e.g. confirming it as mandatory through the WFD implementation (then cross compliance could build on this WFD requirement as it has been experienced in the different French river basins since 2006). However, metering might not be easy in all cases, e.g. in situations where there is abundant water availability instead of abstractions, gravity-fed systems (quantity to individual farmers?) or from a cost-perspective (difficulty of approximation of quantities for groups of farmers in certain situations).

Second, a volumetric tariff reflecting the **true value of water** on a unit base would increase water prices for farmers and in cases where water use is already highly efficient, rising water prices on a volumetric basis could have negative economic impacts.

It is important that all elements of the water pricing policy are **balanced**. If a particular water source is under high stress, it may be advisable to set a relatively high price compared to other water sources. However, it is important that the prices for all water sources integrate an incentive to use water sustainably and at the same time **prevent illegal use** (primarily from groundwater abstraction) by allocating sufficient resources to monitoring and control. In order to address illegal water usage properly, it is important to ensure an adequate capacity of the River Basin Authorities (RBA) to deal with the control of illegal water usage, improve the control with technology, and to install an adequate size of penalty being higher than the benefit of the farmer by irrigation with non-authorised abstracted water. Illegal abstraction should be addressed through **surveys**

of existing boreholes and strict **monitoring** to avoid the emergence of new, non-authorised self-abstraction. Penalise non-authorised water usage by applying fines coherent with the potential economic benefits from the non-authorised water abstraction. Start with those farms that abstract greater water volume, and therefore contribute more to the depletion of the resources, or with major environmental impact. It is also necessary to seal or remove non-authorised water intakes and monitor that the farmer is not using other non-authorised sources. Additionally, it would be advisable to publicise the penalties and the closing of wells so that the example will caution potential offenders. The costs of monitoring and enforcement can be expensive – one approach found in the Member States (RO) is to pay for monitoring activities through the money gained from wastewater charges. In this context it might be worth to prove if there are other bodies having higher penalty power. If so a coordination and cooperation of efforts should be envisaged.

Increasing water prices at a level where they set incentives is necessary. This should be introduced **gradually** over several years, so as to give time to farmers to adapt. Further, such price increases are mostly not accepted by any water user and might result in social problems, with improvements in the environment therefore being highly uncertain (see OECD, 2006b). Too high water prices could contribute to driving farmers out of business, leading to agricultural land abandonment. This in turn could result in the loss of cultural landscapes (which should be taken into account in land use planning and which potentially decreases the amenity value and other cultural services delivered to human population) and negative environmental rebound effects (e.g. increased soil erosion, loss of biodiversity, or decrease in landscape maintenance).

In order to avoid these potentially negative effects and to deliver ecosystem services, **payments for ecosystem services** (PES) could be considered as a complement to incentive pricing. Such payments should be seen as payments for a certain set of ecosystems services such as carbon storage, creation of places to improve biodiversity, the creation of wetlands, or for cultural heritage. In other words payments for ecosystem services programmes are an effort to “get the incentives right” by sending accurate signals to both providers and users that reflect the real social, environmental and economic benefits that environmental services deliver. Furthermore, PES allows achieving environmental objectives that go beyond the threshold of the polluter-pays-principle (e.g. as set out under the environmental legislation and cross compliance) to provide environmental services (i.e. the provider-gets-principle).

In the context of the TEEB (The Economics of Ecosystems and Biodiversity)² study two types of PES can be seen:

- Agri-environmental payments as set out under the RD regulation where farmers are compensated for the income forgone and/or additional costs. The effectiveness of the existing system could be enhanced in two ways: a) the additional costs and loss of income could be compensated at the level of 100% in as many cases as possible (currently not the case); b) Member States should avail more of the possibility to use transaction costs when implementing agri-environmental measures.

² <http://www.teebweb.org/LinkClick.aspx?fileticket=vYOqLxi7aOg%3d&tabid=1019&language=en-US>

- The creation of new markets for ecosystem services. There is no doubt that in the creation of such a market the key challenge is in creating a mechanism for valuing (or at least measuring) a service where none currently exists (e.g. a market for biodiversity).

Both approaches can be seen as complementary to each other and to the polluter-pays-principle and water pricing. More generally only one tool will not solve all problems and we should definitely rely on a combination of different tools to achieve our objectives. Further Agri-environmental measures should be accompanied by training and provision of information (see article 29(4) of proposed rural development regulation for 2014-2020³).

As there is quite a knowledge gap on how all these mechanisms (PES, PPP and incentive pricing) can be combined in an optimal way, it is highly recommended that these approaches are further detailed and discussed in the context of a specific research project that brings together economic and legal aspects related to such a new PES scheme.

Overall concluding recommendations

First, it should be noted that allocation and pricing schemes alone will not be able to reach the target of sustainable water use, especially due to issues related to the low price elasticity of demand: the impact on the change in water use is expected to be limited resulting from a marginal price increase. A **well-balanced mix** of command and control, social and economic policy measures is needed, also with regard to regulations in related policy fields such as the CAP and EU Cohesion Policy to promote the sustainable use and conservation of water resources. Further, in many areas a more systemic change - often called a paradigm shift - is needed. The driving forces for water scarcity are the evolution of demand for the goods and services provided by land. Such a paradigm shift has to focus on these aspects, strengthening sustainable production and consumption patterns.

The current role of economic instruments such as water pricing is clearly underdeveloped. Implementation gaps, differences in the legal systems, lack of guidance and methodological gaps are the main reasons (see also results from the CIS workshop in on WFD-economics in Liege 2010)⁴. The **CIS process** could close the implementation gaps by providing more guidance and practical help on how to implement an effective water pricing policy. A first step to do so would be to set up a new economic group that includes experts from various sectors including agriculture. This could, besides handling other issues in other sectors, ensure that clarification of implementation issues is achieved before the second cycle fully starts (e.g. 2013) by developing common definitions and methodologies (e.g. environment and resource costs).

Well-founded agricultural water allocation and pricing policies could contribute significantly to the objectives laid out in the WFD, while at the same time causing beneficial side-effects in mitigating water scarcity and droughts and adapting to changing water supply caused by anthropogenic climate change. In the long run,

³ http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/com627/627_en.pdf

⁴ http://www.circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/implementation_convention/workshop_economics/wfd-economics-workshop-o/_EN_1.0_&a=d

the agricultural sector would support itself by promoting a more sustainable use of its most important production input resource. The design of a fair water allocation and pricing scheme for the agricultural sector is difficult, as it should meet several criteria. A fair scheme should be acceptable to both the agricultural sector and society, minimise negative impacts on farm income and give incentives to save water and recover a larger share of costs including external costs. Therefore, it is important that allocation and pricing policies take into account **local and regional circumstances** regarding (history of) water use and water rights, water availability, farm sizes and crops grown, possible alternative crops and marketing channels, alternative technologies to save water or change irrigation techniques and existing subsidies.

Water allocation, water pricing and water trading only work within a well-established framework based on **environmental flow regimes**. Such environmental flow regimes are currently only established in a few basins (e.g. Australian, Romanian and French cases). It is highly recommended to set up thresholds on a basin level for each stretch of the river in the next cycle of RBMPs. For transboundary basins, this clearly calls for close coordination in order to come to an agreement. The work on developing appropriate methodologies to define such flows should be carried out in a specific working group on environmental flow regimes within the CIS process. This group should discuss the issue in a broader context including related aspects such as irrigation, hydropower, saline intrusions and flood protection.

In order to ensure the protection of groundwater resources it is essential that the abstraction rates from groundwater are sustainable and follow the WFD-requirement set out in Art 4.1.b (ii).

1 Background and introduction to the study

Water of good quality and sufficient quantity is essential in order to satisfy the needs of Europe's citizens. It is also vital for the preservation of natural habitats and species of wild fauna and flora. Traditionally, the management of water resources across Europe has focused on a supply-side approach. A regular supply of water has been ensured by means of a combination of reservoirs, inter-basin transfers and increasing abstraction of both surface water and groundwater.

However, the historically disproportionate emphasis on supply has provided no incentive to limit water use in any sector, leaving the major driving forces unchanged. As a result, it has promoted the excessive abstraction currently observed in many parts of Europe and the associated harm to aquatic habitats. Continued expansion of supply is not, therefore, a viable management option in the future, particularly given the anticipated increase in the frequency and severity of droughts across Europe.

Europe needs a sustainable, demand-led approach to water resource management, focusing on water conservation and more efficient use. Integral to this is a more equitable approach to water abstraction that addresses not only the requirements of competing economic sectors but also the need for healthy freshwater ecosystems.

In recent years, a growing concern has been expressed throughout the EU regarding water scarcity problems and the significant impacts on water resources by agricultural activities.⁵ Managing water use in agriculture has been identified as one of the key themes relating to water scarcity and drought. The present study explores what role water pricing and allocation plays / could play to promote a more sustainable use of water in agriculture in Europe. The overall objective of the study is to provide a general overview of the use of water pricing and water allocation policies in agriculture, and to assess the impacts of policies implemented in order to identify good practices and to draw EU-level conclusions of practical implementation.

The next chapter portrays the theory behind water pricing and water allocation policies. The description focuses on the different concepts behind policies and what these imply for the agricultural sector. Chapter 3 provides a general overview of current policies across the EU in the agriculture sector. Chapter 4 analyses seven case studies (river basins) within the EU as well as in third countries in order to assess practical applications and impacts of water pricing policy and water allocation policy in agriculture. The case studies describe what impact the existing water pricing and allocation policy has on agricultural water use, the main drivers and barriers and which additional mechanisms are needed to make water pricing work. Chapter 5 draws conclusions from the case studies, making comparisons among the countries to determine what factors help or hamper the goals of water pricing and allocation policies in the given countries. The main impacts of the presented policies are compared. The chapter further analyses on an EU level the link between water pricing and other EU policies in order to investigate whether any conflicts or synergies exist. The study concludes with the development of recommendations for Member States and river basin management authorities in relation to water pricing and allocation policies.

⁵ See http://ec.europa.eu/environment/water/quantity/water_agri.htm

Draft results of the present study have served as input to the conference on water pricing in agriculture, organised in Warsaw (Poland) on 14 September 2011. The minutes of the Conference and the discussions can be found in annex 5.⁶

⁶ For further details, see http://ecologic-events.eu/water_pricing_conference_2011/

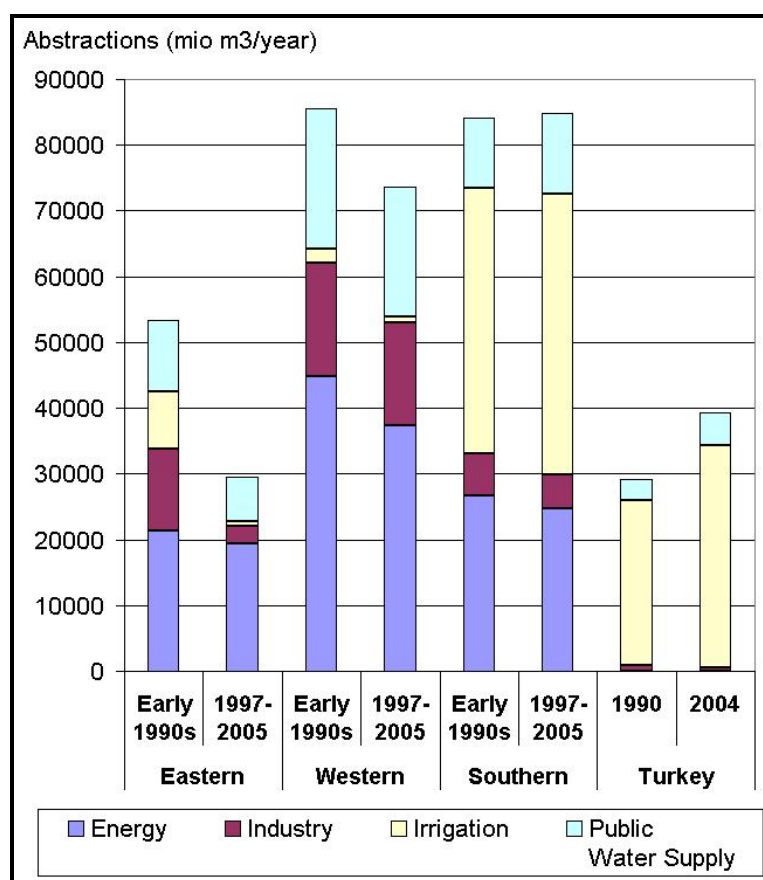
2 Definition of the theory behind water pricing and water allocation policy and its implications for the agricultural sector

2.1 Introduction

Access to good quality water in sufficient quantity is fundamental to the daily lives of every human being and to most economic activities. However, limited availability, declining quality and the growing demand for fresh water have now emerged as a major worldwide challenge, and climate change is expected to make matters worse. Solutions to water scarcity issues and possible use efficiency gains in the various sectors using water resources are therefore becoming more important focal points of research and policy formulation.

The main users of water resources include sectors such as agriculture, domestic energy, industry and tourism. Agricultural water use across Europe has increased over the last two decades, accounting now for around 24% of total water abstraction mainly due to irrigation practices. In some parts of southern Europe, where crop irrigation has been practiced for centuries and is the basis of economic and social activity, this figure can reach up to 80% or even higher (see Diagram 1; Berbel/Manos/Viaggi 2009; EEA 2009).

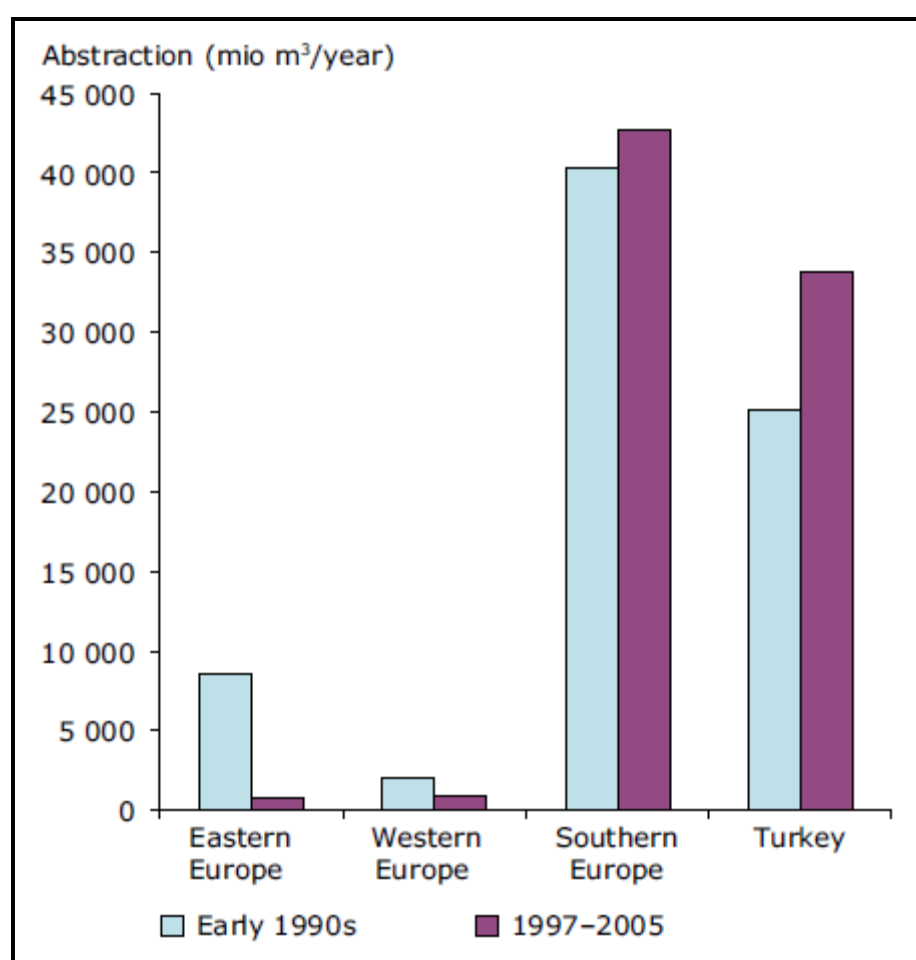
Diagram 1 : Water Abstractions in Europe and Turkey



Source: EEA 2009.

These extremely high numbers are mainly due to the region's dry climatic conditions and low summer precipitation; without irrigation in some southern locations crop production would be severely limited and could cause great economic hardship or even land abandonment. Other drivers of water use include adverse subsidies such as prices not reflecting the full financial cost of water provision, pricing structures that do not incorporate environmental costs, or CAP regulations fostering the production of water-intensive crops as it has been the case before the last CAP reforms have tended to solve the issue. A major issue with respect to agricultural water use is its highly consumptive nature, as only around 30% of the water used is returned to ground- or surface waters for downstream usage (EEA 2009). Although agricultural water use has now stabilised at a high level, it is expected to increase due to future demand for energy crops, world population growth and increased water stress pressures resulting from climate change and drought events.

Diagram 2: Water abstracted for Irrigation in 1990 and 1997-2005.



Source: EEA 2009.

Both good water quality and quantity have a unique value: not only is it important for the sectors mentioned above, but it is also necessary for maintaining environmental uses and the provision of ecosystem services such as providing natural wastewater treatment or habitat for wildlife. The provision of sufficient clean water under a changing climate will become more and more important in the future. To ensure on one hand the protection of water ecosystems, the provision of ecosystem services and to guarantee on the other hand a

sustainable long term development of the economy, including the agriculture sector, a careful use of the water resources is highly important.

With this view, the EU Water Framework Directive – WFD (2000/60/EC) – was introduced to establish a framework for the sustainable management of water resources across Europe. The main tools to achieve its ambitious environmental objectives are river basin management plans and corresponding programmes of measures, which the WFD required to be finalised and published by December 2009. The implementation of the Directive has been a considerable challenge for the Member States and EU institutions, as highlighted by the results of the 2007 Implementation Report and by the difficulties some Member States are having in finalising their river basin management plans in accordance with the Directive's timetable. One of the next steps in the implementation of the Directive is to operationalise Art. 9 regarding water pricing policy. By the end of last year (22.12.2010), Member States should have ensured that *“water-pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of this Directive”* (EC 2000b). Moreover, water-pricing policies should ensure an adequate contribution of the different water uses, disaggregated into at least industry, households and agriculture, to the recovery of the costs of water services taking account of the polluter pays principle.⁷

The EC-funded project *“The role of water pricing and water allocation in agriculture in delivering sustainable water use in Europe”* focuses on the role pricing mechanisms can play in promoting efficient and careful use of valuable water resources. In accordance to the EC communication of water pricing policies, the project definition of water price is as follows:

“The term water price is used here in its very general sense and defined as the marginal or overall monetary amount paid by users for all the water services they receive (e.g., water distribution, wastewater treatment), including the environment. Thus, it encompasses elements linked to the quantity of water extracted from the environment and to the pollution emitted to the environment” (EC 2000).

Water pricing is most of the time categorised as a water allocation mechanism (see e.g. World Bank, 1997). However, the present report does not follow this characterisation. To give water a price does not represent in itself an allocation mechanism, although water prices influence the way water use-related decisions are taken. For example, a high water price could exclude certain user groups from using water or re-allocate it to uses with high economic output. As these potential consequences are usually unintended, water pricing is a complementary policy instrument (for example to allocation mechanisms such as public allocation or water markets) to enhance sustainable use of water resources.

Due to the overall focus of this project on water allocation in agriculture, the effects pricing policies may have on water use and irrigation practices (quantity issues) are considered to be of more interest than pricing policies to reduce pollution (quality issues). Therefore, the latter are not considered in the present report. In addition, please note that the virtual water aspect has not been considered in this study as it is being addressed by a parallel study.

⁷ Open infringements with Member-States on the interpretation of article 9 are on-going.

This summary report details the main concepts identified from collecting information regarding the economic theory and principles behind water allocation and water pricing in agriculture. The report will first explain the main concepts, illustrated by boxes presenting an example of the respective concept (2.2). After this, the underlying economic theory behind water allocation will be introduced, along with an explanation of the main allocation mechanisms, including water markets and water banks. Water pricing is described in detail in the following section, beginning with the general theoretical background and then focussing on water pricing in agriculture (section 2.4). The closing sections of chapter 2 will examine the legal framework for water pricing in agriculture in Europe (2.5), mainly focusing on the regulations of the Water Framework Directive, and conclude with a short summary and outlook (2.6).

2.2 Explanation of main Concepts

This section briefly defines the most relevant allocation and pricing mechanisms and the basic meaning of “water rights”.

Water rights

Generally speaking, water rights, or water use rights, define the extent to which a water user has access to water resources or “*the right to take and use water subject to the terms and conditions of the grant*” (FAO 2003). Water rights are sometimes divided into the basic human right to have access to a quantity of water sufficient to satisfy basic needs (drinking water, sanitation etc.)⁸ on the one hand, and the variously defined right(s) to have access to water for purposes beyond satisfying these basic needs on the other hand (UNESCO 2009). The present report focuses on the second dimension of water (use) rights. As the definitions and categorisations of water use rights differ in literature, the following table gives an overview of possible characteristics associated with them:

Table 1: Attributes of Water Use Rights

Attribute	Description
Quantity	The amount of water (volume) the holder of the right may abstract/use.
Quality	The quality of the water to be abstracted/used.
Source	The specific source from which the water may be abstracted/used.
Timing	Restrictions on the time that the right applies, i.e., times that the volume may be abstracted.
Conditionality	The conditions of use, particularly in terms of quantity and quality; some rights are absolute—100% guarantee of a certain quantity and quality, while other rights have variable assurance of supply and quality, depending on the available resource; other conditions can include any “hands off” flow requirements to protect minimum environmental flows.

⁸ For example, in July 2010 the General Assembly of the United Nations adopted a resolution declaring that safe and clean drinking water and sanitation is a human right essential to the full enjoyment of life and all other human rights.

Attribute	Description
Use	The specific use for which the water is abstracted (e.g. irrigation, mining etc.).
Duration and Ownership	The duration for which the holder is entitled to the rights conferred; some rights are permanent while other rights expire after a period of time. Most of the time, water rights are of a usufructuary nature, meaning that the user is entitled to use the water for beneficial purposes, but do not grant the ownership of the resource.
Transfer	Whether the right may be sold, transferred or location, or inherited.
Security and Enforcement	Details of the administrative body with the legal mandate to award the right, including the extent of that mandate; important is whether the rights are guaranteed, what measures are taken if the rights cannot be fulfilled and the compensation received if the rights cannot be fulfilled or if right is removed.

Sources: FAO 2004a; Asian Development Bank 2008.

Water use rights may be clearly defined through an allocation process (see below), tied to land ownership (or separated from land ownership), inherited by tradition or custom, or not defined at all.

Water Allocation

“Water allocation” generally refers to a set of possible mechanisms to distribute water resources/water rights among a varying number of possible users. Such a process of water allocation sets out how, by whom, and on what basis decisions are made over who will be entitled to abstract water (FAO 2003; FAO 2004a), or *“whereby an available water resource is distributed to legitimate claimants and the resulting water rights are granted, transferred, reviewed, and adapted. Hence, water allocation processes generate a series of water rights governing the use of water...”* (WWF 2007).

EXAMPLE: One Basin – one Permitter, Japan (Source: Asian Development Bank 2008)

After World War 2, water demand in Japan increased significantly because of rapid industrialisation, urbanisation and population increase, thus putting pressure on the existing system of water allocation. One river system had multiple “permitters” who authorised the use of river water independently and without integration, leading to water shortages downstream. A central reform of the 1964 River Law was the “one basin, one permitter” principle for water allocation. Permission for river water use in a river basin is now granted by a single river administrator. Bigger river systems often cover more than one administrative entity and under the River Law are now managed by the national government through the Minister of Land, Infrastructure and Transport, whereas smaller river systems generally lie within a single prefecture and are managed by that prefecture in consultation with its municipalities. Before 1964, the applicable law stipulated that each prefecture governor had the authority to issue permission for river water use, thus leading to the possibility of inconsistent water rights administration.

The “one basin, one permitter” principle has been successful, leading to:

- broader-based consideration of river water use;
- water-use rights within a basin can be established across administrative boundaries
- (downstream-upstream linkages); and
- improved coordination among multiple water users, especially during drought events.

It should be noted here, however, that the amount of water used does not necessarily have to equal the amount actually licensed, as fluctuations in water demand can lead to very significant differences between the two amounts.

Water Pricing

A water pricing scheme is basically a system in which a water (use) right is charged in monetary terms.

"The term water price is used...in its very general sense and defined as the marginal or overall monetary amount paid by users for all the water...they receive..." (EC 2000a).

Prices usually come either in the form of a water withdrawal or water abstraction charge or tax, where a certain amount of money is charged for the direct abstraction of water from ground or surface sources (Roth 2001), or as a charge/tariff for water supply services covering extraction, treatment and transport of the resource (Interwies et al. 2005)⁹.

EXAMPLE: Water Pricing in Spain

The Spanish water allocation and pricing system is well-documented in literature and official documents. A high share (about 70%) of the area under irrigation is serviced by one of approximately 6500 registered "irrigator's communities" or "irrigator's districts". These have a major role in water management both at the River Basin Authority (RBA) and district levels, and administer the water resource and infrastructure.

Water charges paid by farmers usually comprise of a "regulation levy" and a "water use tariff", paid to the RBA via the irrigator's district/community. Additionally, farmers are charged an additional tariff to cover the costs of the irrigation district/community itself.

Average price levels paid in RBA-supplied irrigation districts range from 0.02 Euro/m³ to 0.09 Euro/m³. These figures are well below the financial costs incurred to supply the water at the level of the public supplier (average costs of 0.12 Euro/m³)

There are regions in Spain, however, where the water charges are significantly higher than the above mentioned price ranges, such as the Segura basin, a region facing water scarcity problems. In this basin, most farmers pay prices based on volumetric tariffs, with prices varying according to the source (0.03 Euro/m³ for water originating from the basin itself to 0.34 Euro/m³ for desalinated water). Average price levels, however, are at 0.11 Euro/m³ (prices based on a 2007 assessment).

Source: OECD 2010c.

⁹ EEA (2005) defines the difference between (environmental) taxes and charges as such: a) environmental taxes are designed to change prices and thus the behaviour of producers and consumers, as well as raise revenues; b) environmental charges are designed to cover (in part or in full) the costs of environmental services and abatement measures such as waste water treatment and waste disposal. The present report, however, does not distinguish between charges or taxes, as on the one hand from a theoretical viewpoint considering the effects of water pricing on the agricultural water user, the difference is not of great importance; on the other hand, the report has the aim of providing non-economists with easily accessible background information.

Water Markets or tradable permits

Water markets, or the issuing of tradable permits, represent a water allocation mechanism, causing market forces to allocate water to its most economically efficient use¹⁰. In a water market, each legitimate user is issued a number of tradable water use certificates or permits, so each may decide whether to use his/her permits, sell them wholly or in part, or buy additional ones.

EXAMPLE: Watermove, Australia

The water exchanges conducted by the *Watermove Programme*, established in 2002, are divided into six regions, whereas each region is divided into trading zones. Watermove operates as a clearinghouse for the temporary trade of water rights and aims to link buyers and sellers. It also provides information about water prices and market depth, allowing participants to buy and sell decisions from week to week based on current market information. Trading is limited to agricultural users who are supplied water from certain water authorities and there are restrictions on trades between zones. Trading is conducted on a weekly basis and typically takes place at 10:00 a.m. on Thursdays. Results are notified by noon, and offers need to be placed by noon on Monday (although they can be cancelled up to noon on Wednesday). The lowest price seller within a trading zone is the first seller eligible to trade. The highest price seller within a trading zone is the last seller eligible to trade. Similarly, the highest price buyer within a trading zone is the first buyer eligible to trade, and the lowest price buyer within a trading zone is the last buyer eligible to trade. Weekly data allow detailed analyses of prices and quantities traded, associated responsiveness of demand and supply to price changes (elasticity), and estimation of the economic values that buyers and sellers earn through market transactions.

Source: Brooks/Harris 2008; Qureshi et al. 2009; OECD 2010d.

Water Banks

Water banks are a special form of water markets, and can be seen as a framework or design option for the trade of water use rights. A water bank is an organisation that sets rules on prices and quantities regarding the trade of water use rights and acts as a kind of intermediary between buyers and sellers. The concept is intended to provide trade security and low transaction costs, and is often established in scarcity and drought environments, with the aim to mitigate drought impacts and encourage inter-sectoral water transfers (see example).

¹⁰ In cases where a water market imposes conditions on the participation of certain economic sectors, or defines certain sectors to be excluded from trading, the economic efficient allocation might take place only within the boundaries of one specific sector (see section 3.1.3).

EXAMPLE: California Drought Water Bank, USA

California established a Drought Water Bank initially to mitigate the effects of the 1987-92 drought and encourage water transfers from agriculture users in the north to higher value urban, municipal and agricultural users in the south. Differential sale and purchase prices were set to cover transaction costs and encourage a surplus of sellers over buyers so that the balance could be used for allocation to the environment and groundwater recharge (prices were set at USD125 for a user to sell an acre-foot of water [around 0.1 USD per m³; an acre-foot is equal to 1233m³] compared to USD175 [or 0.14 USD per m³] to purchase the same amount). In 1991, over 300 transactions were recorded, representing the sale by users of 1,000 million cubic meters (mcm) and the purchase of 480 mcm.

In 2009, around 92 mcm of water were transferred through the California Drought Water Bank, whereas in 2010, a year without drought phenomena, it did not engage in water trade.

Sources: World Bank 1997; California Department of Water Resources/

U.S. Bureau of Reclamation 2010; OECD 2010f.

2.3 Water Allocation

As outlined above, water allocation describes a process that sets out how, by whom, and on what basis decisions are made over who will be entitled to abstract or use water (FAO 2004a; WWF 2007). Furthermore, water allocation processes can take place on all spatial scales – local, sub-basin, basin and national or international - and between economic/societal sectors and/or individual water users. Numerous forms of allocation mechanisms exist, ranging from complete control by public agencies or governments to a mixture of market and public allocation, to predominantly market allocation (even the latter, however, requires a state regulatory framework; see below). Since countries and circumstances vary widely, water allocation mechanisms within any country can be regarded as a unique system for sharing the available water across the known sources of demand (World Bank 1997).

Historically, water allocation mechanisms have been in place in most areas to guarantee water availability for basic needs, sanitation and the production of food. Most of these allocation mechanisms were not based on a formal law but on tradition and custom (FAO 2004a). The subsequent intensification of agriculture led to growing investments in water supply schemes, mostly reservoirs and irrigation canal networks. Usually, a large share of these investments was public expenditures, as societies and governments were focussing on new development goals (agrarian reforms due to population growth etc.). Thus, the influence of public agencies in water allocation grew (World Bank 1997; OECD 2010c).

Investing in infrastructure and thus augmenting on supply side measures was for a long time sufficient to meet the growing water demand raised by the intensification of agriculture, and the introduction of more advanced water allocation mechanisms was not yet necessary.

However, today pressure on global water resources is heavier than ever before, and it is assumed to rise steadily. This necessitates the need to find better mechanisms to allocate scarce resources between various

competing sectors of society. Furthermore, tighter public budgets force decision makers to recognise efficiency in public expenditures as important criteria. Water allocation through public agencies is considered by some sources to be not very efficient regarding cost recovery issues (World Bank 1997; World Bank 2006). Therefore, demands to apply stronger economic efficiency standards to water allocation mechanisms and attain an economic value to the resource have been expressed, for example at the 1992 International Conference on Water and Environment in Dublin (ICWE 1992; EC 2007b). Although the potential efficiency gains by applying economic criteria to water allocation cannot be neglected, the issue is complex as water is a commodity with attributes and values that distinguish it clearly from other economically treated goods (EC 2000b), such as (World Bank 1993; Klaphake/Scheumann 2001; Interwies et al. 2006):

- Water is a social good, providing basic life-sustaining functions and cultural and spiritual values to societies and people which cannot be addressed by treating it as a purely economic commodity.
- Water is a public good, meaning that use by one user may not necessarily exclude others from using it as well (non-consumptive use; FAO 2004a), which may lead to market failure, as investments in water infrastructure may benefit investors and non-investors (“free riders”). On the other hand, some uses do exclude other users from using the same resource (consumptive use).
- The physical nature of water makes it difficult to transport and distribute. Like all network-bound commodities, water distribution is characterised by high investment costs, which are generally provided by public agencies, and relatively low per-unit costs, which may lead to market distortions through natural monopolies and imbalances regarding capital costs.

Therefore, the process of water allocation cannot be regarded as a purely economic issue, nor can efficiency criteria be ignored. In the following section, the most basic allocation mechanisms are described in more detail with regard to advantages and disadvantages, spatial scales and actors involved.

2.3.1 Water Allocation Mechanisms

Water allocation mechanisms become necessary in cases where the water demand exceeds the (sustainably available) water supply, or when other circumstances necessitate a planned approach to water use, for example in irrigation schemes with temporary varying water supply. The different mechanisms work on different scales, with different actors involved, and naturally affect user groups differently. Therefore, since circumstances vary widely between countries, regions and locally, the appropriate allocation mechanism varies from area to area, and must respect local conditions. There are a number of key systems of water allocation, though it has to be stated that there is no generally accepted classification of water allocation mechanisms in the literature (see for example World Bank 1997; FAO 2004a; WWF 2007).

Each allocation system by design sets a stronger focus on either the equity or the efficiency aspects of water allocation where:

- Equity refers to the “spreading of income across sectors and societal groups”, e. g. the equal distribution of benefits derived from water use across the various economic and societal sectors (World Bank 1997).
- Efficiency means an “allocation to where the highest economic gain results from one more unit of water”, e. g. the distribution of water follows purely economics as the decisive (World Bank 1997).
- These principles can be regarded as the two extreme positions wherein each water allocation scheme can be located. In practice, most allocation systems try to strike a balance between those two principles (FAO 2004a).

2.3.1.1 Public Allocation

In the case of public allocation, the right to abstract or use water is issued by an administrative or bureaucratic authority, for varying durations (renewable on a yearly basis or with regard to an economic development plan, or – rarely - permanently) (WWF 2007).

Rights may be distributed on the one hand according to a planning process (sometimes called “implicit allocation”; Asian Development Bank 2008) that may execute societal economic or social goals (food production, industrial growth, environmental protection etc.) and may also include various forms of public consultation. On the other hand, water rights may be given by issuing licenses or permits (“explicit allocation”; Asian Development Bank 2008), in accordance to priority targets set by the public authority. The explicit allocation is generally considered to be more reliable with regard to water use rights and investment security and may eventually be the basis for a water trading system (see section 2.3.1.3). Generally, public allocation processes are the most widespread form of formal allocation mechanisms (World Bank 1997; FAO 2004a; WWF 2007).

Actors and scale: Local, regional, river basin district (RBD)-wide or national public water authorities/ministries, according to the scale of the allocation scheme.

Advantages: Publicly managed allocation systems (implicit and explicit) have the possibility to allocate water resources to poor economic or societal sectors or to areas where water is scarce and expensive. Thus, the equity (and sometimes the environmental) aspect of water allocation is often strongly represented in public allocation schemes (Meinzen-Dick/Mendoza 1996; Asian Development Bank 2008).

Disadvantages: Public allocation may lead to misallocation from an economic efficiency perspective, as economic criteria such as scarcity values and economic output of water use are not central in these allocation systems (FAO 2004a; Asian Development Bank 2008).

2.3.1.2 Traditional or customary user-based Allocation

A range of allocation approaches exist that are based on traditional, non-state law or custom. The number of different systems is far too great to describe in detail, but farmer-managed irrigation systems serve as a good example. Generally, in user-based allocation systems water allocation can be based on various criteria, for example timed rotation, arable land area or flow shares, and also include inter-sectoral allocation issues through managing the shares available for irrigation, domestic or animal husbandry needs (World Bank 1997; WWF 2007).

Actors and scale: To regulate water allocation in user-based allocation systems, a locally respected, non-state institution such as a village council is generally employed. The spatial range is usually confined to the beneficiaries of a local tank/pond or a part of a larger irrigation scheme, though not limited to it as various levels of Water User’s Associations can govern much larger, though functionally connected areas (Meinzen-Dick/Mendoza 1996; FAO 2004a; WWF 2007).

Advantages: Besides a generally high political acceptance, user-based allocation systems are highly flexible regarding local needs. Furthermore, if a general understanding of the importance to conserve water exists,

mutual social control of water consumption can turn such systems into an effective tool in water conservation and sustainability (Yoder 1994; WWF 2007).

Disadvantages: User-based allocation systems are often prone to injustice in water allocation because of traditionally inherited social structures or classes, and may be inflexible in integrating the needs of additional water uses, including the environment (World Bank 1997; WWF 2007).

2.3.1.3 Water Markets

In some countries, water use rights are allocated – or reallocated – on the basis of trade rather than by authoritative decision. In a formal water market, each legitimate user is issued a number of tradable water use certificates or permits. Each user may decide whether to use his/her permits, sell them wholly or in part, or buy additional ones. Market forces then determine the price of one unit of water, theoretically guaranteeing economic efficiency. Economically efficient allocation of water is desirable to the extent that it maximises the welfare that society obtains from available water resources. Welfare in this context refers to the economic well-being of society and is determined by the aggregate well-being of its individual citizens. Economically efficient allocation maximises the value of water across all sectors of the economy, which is achieved by allocating water to uses high in value to society and away from uses with low value (Rosegrant/Binswanger 1994; FAO 2004a). Water markets may be designed to allow or restrict trade between certain sectors and/or areas (e. g. excluding industry from trading, or limiting inter-basin transactions), thus setting limits on the level of economic efficiency that can be achieved, or limiting economic efficiency gains to a specific sector.

Most of the time heavy intervention of public authorities is required beforehand to create the conditions necessary for the market to work, including:

- the initial definition and allocation as well as legal guarantee of tradable water rights,
- the creation of institutional and legal frameworks for trade and enforcement, and
- the investments in basic infrastructure to allow and control water transfers (Kraemer/Interwies/Kampa 2002).

It has to be noted that the economic efficiency a formal water market may achieve is first of all theoretical as many distorting factors exist that may prevent a market from working properly. Such constraints include subsidies and taxes as well as transaction costs. Further restrictions include regulatory limitations, information asymmetries, lack of entitlement security, and unclear property rights (Brooks/Harris 2008). Their existence will distort the market and reduce the economic efficiency of the allocation (Tsar/Dinar 1997).

In addition to such regulated, official water markets, many informal water markets exist, where, for example, a seller offers water pumped from his own well to neighbouring water users. In an informal market environment, the mechanisms usually attributed with a formal water market do not work in the same way, as there is generally no competition or limited supply¹¹ (FAO 2004a; Asian Development Bank 2008).

¹¹ In the case of groundwater pumping, the limit of supply is usually not reached within the confines of a single market transaction, and will therefore have no influence on the price of the commodity. With sinking groundwater tables, however, it may be necessary to drill

Actors and scale: Buyers or sellers active in a formal or informal water market can be economic sectors, public and private companies or individual users. As mentioned above, in formal water markets the involvement of public authorities usually is required to guarantee it functions properly. Spatial scales vary: informal water markets are mostly limited to local transactions, whereas formal water markets may manage even inter-basin water transfers (see section 3.1.4) (Zekri/Easter 2005).

Advantages: Formal water markets theoretically offer several advantages. First, a seller can, under certain conditions, improve the profitability of a unit of water if the price is higher than the income generated by using the water. Second, a water market increases the relative water availability for the buyer. Third, because a water market incorporates the scarcity value of the resource, it sets incentives to save water. Fourth, a market can compensate water users for water transfers, and finally, markets are flexible and can react to changing conditions, such as crop prices or water availability (Colby 1990; FAO 2004a).

Informal water markets do not incorporate these advantages, as the basic economic principles fostering efficient allocation do not work in the typical informal environment because of various existing market distortions (FAO 2004a; Asian Development Bank 2008).

Disadvantages: Objections to formal water markets arise because treating water mainly as an economic commodity can limit the access of poor or less economic successful sectors to the resource, as they may not be able to compete in a market environment. These objections have to be considered when designing a water market and in the initial allocation process (Asian Development Bank 2008). Further difficulties are created when consumption patterns or return flows are changed due to transfers between sectors or from downstream to upstream uses, which influence in-flow water quantities and pollution patterns. Many other disadvantages or challenges exist, namely the difficult measurement of water, quite high administrative costs involved, possible market distortions, the definition of water rights under changing flow regimes, enforcing mechanisms, and the sale of “water for cash” by poor farmers (World Bank 1997; WWF 2007; Molden et al. 2010).

2.3.1.4 Water Banks

As mentioned above, one challenge in designing water markets lies in the identification of ways to mitigate the potentially negative social impacts while unlocking the considerable economic and environmental benefits (WWF 2007). Water Banks can be seen as a framework or design option for the trade of water use rights, with a focus on great amounts of water to be transferred or a special purpose, as is the case with the California Drought Water Bank (see section 2.2).

A water bank is an organisation that sets rules on prices and quantities regarding the trade of water use rights, and acts as a kind of intermediary between buyers and sellers, thus providing security and low transaction costs. A water bank may even buy an amount of water rights itself to guarantee social and environmental minimum water availability. As in the case of regular water markets, water banks require clearly defined water use rights and a strong regulatory and enforcement framework (World Bank 1997).

deeper wells, which definitively will affect the price.

Actors and scale: As in other water market design systems, water trading through a water bank can theoretically take place both on local as well as regional scales. As a strong regulatory framework is an inherent element of a water bank, a public authority is almost certainly involved, and the necessary effort to establish such a trading system actually necessitates the exchange of large volumes. Thus, the practical examples available exclusively describe regionally active water banks engaging even in inter-basin water transfers (OECD 2010d; OECD 2010f).

Advantages: Besides the general advantages concerning water markets listed above, water banks usually operate as a clearinghouse to link sellers and buyers of greater amounts of water, informing market actors about price levels and availability, thus lowering transaction costs and fostering market transactions. In the case of drought prevention or environmental concerns about minimum flows, a water bank can even act as a market actor on its own and withdraw the necessary amounts of water from the market (World Bank 1997).

Disadvantages: Besides the general disadvantages concerning water markets listed above, the high administrative effort to establish water banks is actually worthwhile only when the potential market transfers exceed a certain amount.

2.3.2 Water Allocation in Agriculture

With regard to water use and water allocation and its role in modern society, agriculture needs special attention. To begin with, this economic sector plays an important role in modern societies: agriculture provides very basic functions, foremost the production of food and the guarantee of food security. Furthermore, certain forms of agriculture conserve traditional values and cultural heritage, maintain landscape diversification and protect the environment (Berbel/Gutierrez 2004; World Bank 2006; Deutsche Vernetzungsstelle 2010).

At the same time, agriculture uses the greatest amount of water out of all economic sectors worldwide and in Europe rates second to energy (EEA 2009; OECD 2010c). Additionally, nutrient and pesticide run-off from fields can pollute surface and ground waters, further reducing the availability of high quality water. Water use rights, especially in the case of using groundwater for irrigation, are rarely clearly defined¹². This often results in uncontrolled groundwater extraction and the lowering of groundwater tables on a regional scale, which, among other consequences, threaten the economic viability of farming itself (OECD 2010b).

A further important difference exists between agriculture and other economic sectors (such as energy, which ranks second in global water use; WBCSD 2009) regarding consumptive and non-consumptive use. Whereas almost 100 % of cooling water used in energy production is restored to a water body (although of a different quality, e. g. temperature), the consumption of water through crop production and evaporation typically means that only about 30 % of water abstracted for agriculture is eventually returned (Molle/Berkoff 2007; EEA 2009).

The aforementioned factors – the importance of agriculture in providing food security and other important social and environmental services on the one hand and its high water consumption and the connected

¹² For further information, see the Task 1b Report of the same project.

potentially detrimental effects on local and regional water supply on the other hand – underline the special attention needed when analysing water allocation mechanisms in agriculture or policy instruments to control agricultural water use. Against this background, the following section describes water pricing first in general terms (see 2.4.1 and 2.4.2) and thereafter (2.4.3) focuses on the special circumstances regarding water pricing and agriculture.

2.4 Water Pricing

In the most general sense, water pricing refers to monetising the abstraction, use or pollution of water. Following this broad definition, pricing is not a water allocation mechanism in itself, but is a supporting policy instrument to control water use (or pollution) and (re-)finance water use-related costs (OECD 2009). Water pricing can under certain circumstances act as a de facto allocation mechanism by excluding certain users who are not able to pay the price of its use (WWF 2007), but this is rarely intended (Bosworth et al. 2002). Therefore, in this report water pricing is treated as a complementary policy instrument¹³.

2.4.1 Variations and Objectives of Pricing Schemes

A water price¹⁴ is usually charged in form of either:

- A water charge/tariff, meaning that the provision of water (abstraction, treatment, transport) is charged by the providing entity (public or private), and/or
- An abstraction tax/fee, payable to a public authority, that distributes property rights (Interwies et al. 2005; OECD 2010a).
- Varying from country to country, public revenues generated by abstraction taxes or water charges are often earmarked for explicit water management purposes (EEA 2005; Interwies et al. 2005)¹⁵.
- The pricing of water can serve as a policy instrument to achieve the following policy objectives (for the European context, see section 5) (EC 2000; WWF 2007; Molle/Berkoff 2007):
- Cost Recovery: A water pricing scheme may be a financial tool aiming to recover direct (water supply and infrastructure) and indirect (environmental, social and opportunity) costs.
- Incentive Function: It may also aim to conserve water and promote a more sustainable use of the resource, address water scarcity problems and foster investments into alternative, less water-intensive crops or water saving technologies.

2.4.1.1 Cost Recovery Function

There are two main aspects of cost recovery (OECD 2009):

- Supply cost recovery: recovery of financial (“internal”) costs of water supply, including investments in infrastructure, O&M and administrative costs etc.
- Full cost recovery: recovery of financial as well as water use-related environmental, social and opportunity¹⁶ costs. If the latter is not integrated into prices (if they have not been “internalised” into

¹³ As mentioned above, pollution fees are not further described in this report.

¹⁴ Examples for price levels in European countries can be found in Grandmougin et al. 2009.

¹⁵ For further information, see EEA 2005, the OECD/EEA database on environment-related taxes at <http://www2.oecd.org/econinst/queries/index.htm> and the websites of Ministries of Finance and Environment of the countries of interest.

prices), they are referred to as “external costs” or “externalities”¹⁷.

Therefore, the meaning and the level of cost recovery depends on what is actually considered to be part of the “price” of providing and using water. External costs are, by nature, much more difficult to define and quantify and are therefore rarely considered in current water tariffs (ENTEC 2010; OECD 2010c).

Closely related to cost recovery issues is the question of “who” should actually bear the costs of water supply. It is generally accepted that payments should be linked to the actual use/abstraction or that there is a contribution from all users in relation to their consumption (or pollution). This usually is referred to as the “polluter pays” principle, but its application in practice is often subject to debate (ENTEC 2010; see section 5).

2.4.1.2 Incentive Function

When resources - like water - are under-valued, they are treated as though they are abundant. Setting a price that more accurately reflects the “true value” of the resource – e.g. a price that includes external costs - may correct this mistreatment of a scarce resource and alter the consumption patterns of users (EEA 2009; OECD 2010a). Furthermore, pricing policies can help to not only reduce water use in quantitative terms, but also make users more efficient in their use of water resources by giving them financial incentives to shift to more efficient technologies and practices (OECD 2009).

To yield such effects, however, “*pricing policies must be designed so that a reduction in the quantity of water used...would lead to a simultaneous reduction in the total bill for the particular user. This means that the price of water should be proportional to the quantity of water used*”, meaning the instalment of a tariff that includes some variable element (CIS WG WATECO 2003).

2.4.2 Options in Tariff Design and Price Level

For a pricing scheme to deliver the optimal level of cost recover, and to ensure a sustainable use of water resources through incentives and investments in water saving technologies, the design, structure and price of the tariff are crucial success factors (OECD 2009).

2.4.2.1 Design Options: Tariff Structure

When designing pricing schemes, the structure of the tariff is an important element: for the incentive function to work effectively, for example, a functional relation between the amount of water used and the price paid must be clearly defined (i. e. the tariff contains some variable elements). Poorly designed pricing schemes can result in adverse incentives to use more water (e.g. through tariffs not connected to the amount of water used) or switch to non-authorised water abstraction (CIS WG WATECO 2003).

¹⁶ Opportunity costs represent the costs of foregone opportunities which other uses suffer due to the depletion of the resource beyond its natural rate of recharge or recovery.

¹⁷ Activities can impose losses or gains in welfare on individuals other than those engaged in the activities. If these losses or gains go uncompensated or unpaid for, they are described as externalities (negative and positive, respectively). Externalities are not incorporated into market prices, so are not accounted for in market-based allocation. This results in socially suboptimal resource allocation. Optimal allocation of water would require that supply costs be increased to reflect the costs of mitigating the negative externalities (FAO 2004).

The following tariffs are most commonly used in agriculture (Bosworth 2002; Molle/Berkoff 2007):

- Uniform user charge: all users are charged evenly, independent of the amount each user consumes.
- Area-based charge: mainly used in irrigation, where an irrigator is charged according to the area irrigated, the crop cultivated, or a combination of these two. Priorities in water supply or reduced charges may be justified by crop priorities (e.g. for food security).
- Volumetric charge: water is charged based on the actual consumption, on a per-unit basis, either on the level of individual users or a group of users (bulk water supply). For a volumetric tariff to work properly, metering or a similar method of assessing water consumption is necessary.
- Volumetric block tariffs: volumetric charges may be fixed for different levels of consumption, instead on a per-unit basis.
 - Increasing block tariffs: the amount charged grows proportional to the water used.
 - Decreasing block tariffs: the more water is consumed, the bigger the “discount” gets.
- Mixed tariffs: charges may combine an area- or crop-based flat-rate with a volumetric element.
- Quotas: a quota for using or abstracting water is administered, based on area or crop.
 - Quotas at fixed charges: users are charged according to the quota set and may not use more water than their quota allows.
 - Quotas and marginal volumetric pricing: users may access more water than their quota allows but such additional use is charged at a proportional higher rate.
- Seasonal varying tariff: charges (either flat-rate, volumetric or quotas) vary with changing water availability over the course of the year.

Tariffs combining fixed and variable elements are also referred to as “two-tiered” or “two-part” tariffs (ENTEC 2010). The impacts of changing prices under the tariff structures used in agriculture are explained in more detail below (see section 2.4.4).

2.4.2.2 Design Options: Setting the Price right

In addition to the structure of the tariff, the price level charged is of crucial importance. In economic theory, if prices are set too low demand for water would be excessive, and if prices are set too high water from the costly source would not be used (World Bank 1997).

To set a price level that fulfils the supply cost recovery function, the financial cost of providing water has to be calculated, which is a difficult and debated task, especially regarding the inclusion or exclusion of historical investment costs and possible direct or indirect public subsidies (see section 2.4.3.1) for more detail).

For a price to reflect the “true value” of water, however, the matter gets even more complicated, as external costs would have to be included in the charges accordingly. External costs are methodologically complex to correctly determine (Saunders et al. 1977; EEA 2005). Some European water agencies estimate the environmental or external costs at 20-25% of the financial costs, but it is questionable if such a cross-the-board approach can truly reflect locally or regionally varying factors influencing the cost of water supply (Berbel/Calatrava/Garrido 2007).

Furthermore, equity issues have to be considered in price setting. For example, in periods of shortage or scarcity, if prices increase lower income groups or economic sectors strongly dependant on water for production may be negatively affected (see section 2.4.4).

Another challenge when considering an appropriate price level is the expected impact of the pricing scheme on water demand, i. e. the changes incurred in water use due to changing price levels (CIS WG WATECO 2003). This relationship is usually referred to as the “price elasticity of demand”. So far, only a handful of large-scale studies have clearly demonstrated a link between agricultural water prices and a proportional reduction in water use (EEA 2009).

Generally, the price elasticity of demand is expected to be low. For example, higher prices have little effect on actual water use when a) the price paid for water represents only a small percentage of a user’s production costs or income, or b) the water user has no alternative or possibilities to reduce his/her water consumption (due to technical, social or economic constraints) (CIS WG WATECO 2003). The factors influencing price elasticity of demand in agriculture will be further detailed in the following section.

Setting an appropriate price level “high” enough to internalise the external costs, “fair” enough to not exclude user groups from water use, and “well-designed” enough to affect water consumption is, therefore, a highly complex task and can be considered to be more political than economic in nature (Interwies et al. 2005).

Another possibility of determining the price of water is through a market mechanism, which is further described above in section 2.3.1.3.

2.4.3 Water Pricing in Agriculture

With regard to the aforementioned factors regarding both the importance of agriculture as a provider of basic societal necessities as well as its often detrimental effects on the water environment, water pricing in agriculture will be described in more detail in the following section. The special challenges of water pricing in agriculture include (World Bank 1997; EEA 2009; OECD 2009):

- Cost recovery issues: The generally high financial costs involved in setting up irrigation schemes, the high water consumption of the agricultural sector, and the implications for calculating cost recovery rates.
- Groundwater use and non-authorized water abstraction.
- Price Elasticity of Demand: The relationship between changing prices and water demand in agricultural water use.

2.4.3.1 Cost Recovery Issues

Regarding the calculation of cost recovery rates, it should be distinguished between:

- general methodological issues of determining financial costs, and
- issues regarding the inclusion of external costs.

When calculating price levels to recover financial costs, the question arises if what is to be recovered is limited to recurrent costs (such as O&M) or if it encompasses some or all of the capital costs invested historically (Molle/Berkoff 2007). This is especially important in irrigation schemes, which usually require heavy – often public – investments (World Bank 1997).

Whether these “historical” investment costs should be included, to what extent and through which methodology¹⁸ is a hotly debated topic (ENTEC 2010). It is argued that the inclusion of full past financial costs of major infrastructural investments would be socially unacceptable, as an *“extreme interpretation of...cost recovery would render many large schemes financially unsustainable”* (Bosworth et al. 2002; see section 2.4.4).

Instead, coverage of recurrent costs is often demanded, excluding the costs of past investments (Bosworth et al. 2002). Empirical evidence confirms that this is the case in most irrigation schemes, where pricing covers only O&M costs (Molle/Berkoff 2007; OECD 2009).

Including external costs into cost recovery rates is extraordinarily complex. Due to the magnitude of the effects agricultural production can have on the water environment, the full inclusion of external costs would increase the financial impacts on agriculture to a much higher degree than the sole inclusion of historical financial costs. Not including full external costs into water prices, however, generates a situation where agricultural water use is cross-subsidised by other sectors of society (e. g. the tax payer), because farmers do not pay the full price associated with their water use (Jordan 1999).

This fact, however, has to be seen in the context of the traditional role agriculture plays in societies. The extent to which irrigation is being and should be cross-subsidised by excluding historical (public) investment or external costs into financial cost recovery calculations is part of the political process of setting the “right” price level for water use.

2.4.3.2 Groundwater Use and non-authorised Water Abstraction

In cases where irrigation water is extracted from groundwater sources, most or all capital is usually privately provided by the farmers themselves. This includes investing in pumps and the maintenance and electricity necessary to operate the equipment (OECD 2010c). As private pumps and bore wells are much more difficult to control and monitor by public authorities than water distributed in irrigation schemes, most countries do not use tariff systems to control groundwater use, with some exceptions (Berbel/Calatrava/Garrido 2007; OECD 2009). Instead, other instruments are mostly relied upon to control groundwater use, such as quotas, caps or zoning. This means that irrigation water pricing is nowadays primarily focused on surface water and where infrastructures have been built to convey water from the source to the fields (OECD 2010c).

Besides these general difficulties surrounding the pricing of groundwater use, a significant amount of groundwater abstraction takes place without being registered or monitored by any water authority (EEA 2009). Non-authorised water abstraction can be found in surface water extraction as well, although to a much lesser degree (Dworak et al. 2010b).

¹⁸ It would exceed the scope of this report to explain the methodological differences in detail; for further information, refer to: Bosworth et al. 2002; Molle and Berkoff, 2007; Berbel/Calatrava/Garrido 2007.

Such non-authorised water abstraction might include (Llamas/Garrido 2007; Dworak et al. 2010b):

- Wells and surface water intakes that are exploited without previously applying for authorisation from the competent authority. This situation is typical in areas where water resources, especially aquifers, are overused (the water authority not being able to grant new concessions due to the lack of resources) and/or in cases of unauthorised land use (e. g. non-authorised transformation to irrigated farming from public land or protected areas).
- Abstractions with pending licences. In many cases water authorities are behind schedule with the procedures of granting new concessions. Many applicants start abstracting water without any permit before the authority replies to their application.
- Users abstracting greater volumes of water than what they are entitled to. Licence holders usually can only abstract the volume assigned by their water authority. However, many users extract amounts exceeding this limit, or not according to the time period established by the permit.
- Transfer of water rights among water users or to new potential users when it is not foreseen in the country water law. Non-authorised trades are not subject to any assessment of damages to third parties or the environment.
- Un-authorised changes in the characteristics of the water intake, e.g. though the deepening or widening of a registered well.

When water is extracted in a non-authorised manner, high external costs may be generated either through overuse of the resource at hand (in case of groundwater aquifers) or through the effects such water use has on downstream users (in cases where surface water is abstracted from rivers or irrigation channels). Nevertheless, non-authorised water abstraction for agricultural purposes is commonplace in certain areas (Llamas/Garrido 2007; Schmidt et al. 2010).

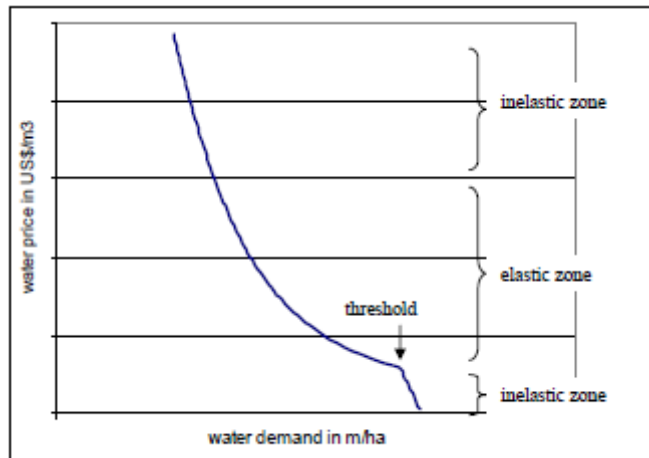
As mentioned above, when resources are under-valued or not priced at all, they are treated as though they are abundant, which, in the case of groundwater, severely impacts groundwater tables and can rapidly deplete aquifers (OECD 2010a). Furthermore, non-authorised abstraction negatively affects the effectiveness of water pricing, as it allows water users to obtain water at lower economic costs than offered by the authorised supplier (Dworak et al. 2010b).

To tackle the problem of non-authorised water abstraction, the challenge lies in establishing some form of extraction control, e.g. through abstraction fees (as is the case in France, Denmark, the Netherlands, England and Wales), and in setting the price to reflect the true scarcity value of the resource. Since evidence shows that increased groundwater charges alone do not necessarily lead to reduced abstraction, the establishment of efficient monitoring systems as a supporting measure is crucial (OECD 2009).

2.4.3.3 Price Elasticity of Demand

There is a relation between price and demand following a demand curve (see diagram 3). The dimensionless slope of this demand curve is called the price elasticity of demand. It is defined as the percentage of increase in demand resulting from a percentage of increase in price. This elasticity is a negative number since demand is expected to decrease as price increases. However, the lower the price elasticity, the lesser the change in behaviour will result from a marginal price increase.

Diagram 3: Price-Demand Curve



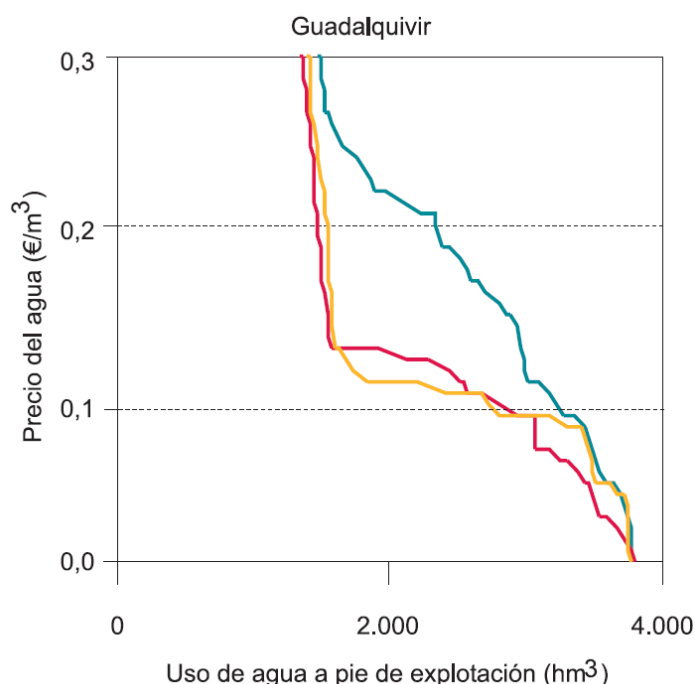
Source: De Fraiture/Perry.

An important measure of whether or not pricing policies are likely to have an impact on agricultural water use is therefore this price elasticity of demand (OECD 2009). Although in general a price level that accounts for local environmental, economic and social conditions will provide incentives for a more sustainable use of agricultural water or for investments in water saving technologies, there are situations where a higher price for water may not lead to significant reductions in water use, e.g. where the price elasticity of demand is low. Elasticity depends on (Bosworth et al. 2002; OECD 2006a; Dworak et al. 2007):

- The initial price of water: the lower the initial price, the lower the price elasticity of demand.
- The initial efficiency in water use: the higher the initial efficiency, the lower the price elasticity.
- The availability and relative cost of alternative water sources (i. e. groundwater).
- The share water charges have in the overall production cost for farmers: if water is only a small part of the overall input costs, there is little economic incentive to save water.
- The value of crops cultivated: high value crops usually lead to low price elasticity and low value crops to higher price elasticity.
- The ability or possibility to change cropping pattern.
- The availability of more efficient irrigation technology.

Nevertheless, there are studies that suggest that the price inelasticity of demand diminishes upon reaching a certain threshold of water prices, dependent on factors such as water productivity, the price of water compared to other production inputs, alternative production strategies, etc. (Bosworth et al. 2002; Berbel/Calatrava/Garrido 2007). Moreover, depending on the framework for changing irrigation techniques (costs involved, subsidies on investments, generation of revenue by saving water etc.), demand responses to rising prices may take place in the long run instead of by short-term reactions (Bosworth et al. 2002). The following Diagram demonstrates exemplarily a price-demand curve for the Guadalquivir river basin, with the X-axis indicating the water use corresponding to a price level (Y-axis).

Diagram 4: On-farm water demand curve for the Guadalquivir



Source: Gutiérrez and Gómez, 2009.

Again, with regard to agriculture and the local/regional conditions of farming, the introduction of pricing schemes face severe challenges in drawing the best suited design option.

2.4.4 Possible Impacts of Water Pricing on the Agricultural Sector

In most countries, some form of agricultural water pricing already exists, with the above mentioned exceptions concerning non-authorized water abstraction. Therefore, when regarding the possible impacts of water pricing on agriculture, the focus will not be on the initial establishment of pricing schemes. Instead, this paper focuses on the adaptation of current price levels to better reflect “true costs” of agricultural water use, as is required in most modern water legislation. Nevertheless, the following impacts can be adapted to situations where a pricing scheme is initially established.

Although the price elasticity to demand in agriculture can be quite low, according to local and regional circumstances¹⁹, water pricing reflecting the true scarcity value of water can give incentives to reduce water consumption via a number of possible responses, including improved irrigation efficiency through water saving technologies, reduced irrigated land area, and modified agricultural practices such as cropping

¹⁹ For example, in the EU the share that water costs have in the overall production costs of farmers vary to a great degree; some sources state that irrigation costs account for less than 10% of total production costs (Bosworth et al. 2002; Berbel/Garrido 2005), or water costs of net farm income (Molle/Berkoff 2007), whereas in other regions or forms of agriculture, the ratio water/irrigation costs to production costs may rise to over 20% (in the case of almonds in Spain: García et al. 2005).

patterns and timing of irrigation, as demonstrated by several studies (Hernández/Llamas 2001; Rodríguez-Díaz 2004). Water pricing can also be an effective tool to control groundwater use, especially in cases where groundwater extraction can be measured and priced on a volumetric basis (Molle/Berkoff 2007).

Most analyses of the effect of increased water prices foresee that the agricultural sector would be severely affected economically if the price levels would reflect the true cost of water, including historical capital costs as well as external costs (Hellerger/Perry 2006). This is especially true for small-scale and family farms (Berbel/Calatrava/Garrido 2007). In existing pricing schemes, farmers often pay very low water prices in comparison to other economic sectors, namely households and industry (EEA 2009). This fact has again to be evaluated against the background of the role agriculture plays in societies and considering the different quality of water most farmers receive (OECD 2010a). Nevertheless, raising prices from low to higher levels will certainly affect agricultural income, as several studies predict. These studies indicate that price level increases between 0.03 € and 0.1 €/m³ - still mostly below full cost recovery rates –result in reductions in farm income ranging from 10% to 50% or increasing food prices (Berbel/Gómez-Limón 1999; Berbel/Calatrava/Garrido 2007). Naturally, the decrease in farm income depends on many other factors. Farmers have the possibility to adapt to higher prices, and the impacts of price increases will vary greatly according to market structure, technological opportunities to save water and possibilities to change cropping patterns (which, in turn, would be dependent on possible markets for alternative products). The impacts of changes in water pricing schemes are furthermore dependent on the structure of the tariff system, as laid out above in section 2.4.2.1 (Bosworth et al 2002; Molle/Berkoff 2007) and are here specified for agricultural use:

Area-based charges represent a commonly used pricing structure in agriculture. As prices do not rise proportionally to the amount of water used, these tariffs are generally considered to be unsuitable for giving incentives and promoting a more sustainable use of water resources. On the other hand, area-based charges could serve as a starting point to calculate block tariffs and to reduce opposition (as a certain amount of water is still priced as before) and impacts (as the currently paid price is also not changed). To fulfil cost recovery and incentive functions, however, any area-based charge would need to increase in price or be combined with a decreasing quota to have any future effect on water consumption.

Well designed volumetric tariffs have the greatest potential to fulfil cost recovery and incentive functions, but also possibly have the greatest negative impacts on farm income or food prices. First of all, metering devices are necessary, which are complex to install and monitor. Second, a volumetric tariff reflecting the true value of water on a unit base would increase water prices for farmers without any possible resort to a relatively “cheap” basic tariff, as can be provided by other pricing structures. Therefore, in cases where water use is already highly efficient, rising water prices on a volumetric basis would have severe negative economic impacts.

The impacts of decreasing quotas or higher prices in systems using quotas and marginal volumetric prices can similarly be severe on agricultural water users, as in addition to a lower use rate the additional charge is increased as well. On the other hand, a quota system may have similar positive effects as increasing block tariffs. The latter can be used as a tool to secure basic water supply to poorer parts of a community or small-scale farms by charging a relatively low price (less than the full recovery costs) for low water consumption

and a relatively high price (above full cost recovery) for amounts exceeding a specific threshold, which discourages extensive water usage. Decreasing block tariffs, on the other hand, represent an adverse incentive, as the price for a unit of water shrinks in relation to the amount used; such tariffs are applicable only in regions where water is abundant. Introducing seasonally varying tariffs could strongly affect availability of certain water-intensive crops in times of reduced water availability or affect the prices of those products accordingly.

It is a difficult task to predict the impacts that increasing water price levels may have on agricultural water use, farm income or food prices on a “cross-the-board” scale. Instead, the impacts have to be assessed and analysed on an individual basis, taking into account local and regional circumstances regarding water use, water availability, farm sizes and crops grown, possible alternative crops and marketing channels, alternative technologies to save water or change irrigation techniques. In terms of fairness of water pricing schemes, the importance of water as a production factor and its varying importance in the cost structure of agricultural production, as well as the agricultural market situation and competitiveness of farmers have to be thoroughly considered. Water pricing is a steering mechanism that can possibly impact water users significantly. However, water is not a regular economic good. Since there are no substitutes or alternatives to water use, and since water is a necessary basis for many economic activities with large social importance, including agriculture, care must be taken in policy decisions that affect the costs of water use (Interwies et al. 2006).

2.4.5 Conclusions

It is not a simple task to design pricing schemes in agriculture that a) are acceptable to both the agricultural sector and society, b) minimise negative impacts on farm income, and c) give incentives to save water and recover a larger share of costs including external costs. Reflecting on the information provided in the sections above, some general conclusions can be drawn.

First of all, a new pricing scheme or higher price levels need to reflect local and regional circumstances regarding water use and water rights, water availability, farm sizes and crops grown, possible alternative crops and marketing channels, alternative technologies to save water or change irrigation techniques and existing subsidies (see also OECD 2010c). These factors will certainly vary from region to region, and can best be assessed through a broad stakeholder consultation involving all users concerned. Such consultations would at the same time increase the chances of successful implementation, while making the price changes socially and politically more acceptable (Interwies et al. 2006; OECD 2009). At the same time, the consultation should develop a common understanding of the objectives of the new pricing scheme/of higher prices (EC 2000a).

As “*no pricing policy will ever make progress if irrigators’ benefits are severely compromised as a result of its full implementation*” (OECD 2002), an ex-ante assessment of the social and welfare effects is needed, drawing on the information gained during the stakeholder consultation process (Interwies et al. 2006). Thus, the price changes could be flanked by equity-raising measures or subsidies to prevent or limit social hardship and to take into account the economic and social concerns that may be raised on the behalf of small-scale farming or low income farmers (OECD 2010c).

If cost recovery is the main objective of the scheme in regions where water is abundant, for example, it may not be necessary to adapt or change the already established tariff structure. If the prices should give incentives to conserve water, however, agricultural water pricing systems will need a variable element and a change in tariff structure may be needed (Interwies et al. 2006). Thus, an assessment is needed to analyse the transaction costs (i.e. administrative costs and the costs for the information required to set an incentive price) as well as the costs for changing the tariff structure (i. e. the costs for metering devices) to determine if a change in the pricing structure is cost-efficient (Interwies et al. 2006).

It should be noted, however, that pricing schemes alone will not be able to reach the target of “sustainable water use”, esp. due to issues related to the price elasticity of demand. Instead, water pricing should be recognised as one of several possible policy instruments in a well balanced policy mix and in regard to regulations in related policy fields to promote conservation of water resources.

2.5 Legal Framework for Agricultural Water Pricing in Europe

The following section describes the legal regulations surrounding agricultural water pricing in Europe²⁰. Naturally, an analysis of all national and regional legislation regarding agricultural water pricing would be too complex and not within the scope of this report. At the same time, it has to be stated that those legislative frameworks play an important role in defining the specific circumstances surrounding pricing policies as well as price levels. Therefore, this section focuses principally on the WFD regulations and provisions of special relevance to agricultural water pricing and points out the main concepts or topics. Some provisions of the WFD, namely of Article 9, whose definition or operationalisation have significant impacts on water pricing in agriculture, will be introduced. Finally, a short overview on intersections of WFD regulations regarding agricultural water pricing and related policy fields is provided.

2.5.1 WFD – Overview of Provisions regarding Water Pricing

The Water Framework Directive establishes an integrated approach to water management based on the functional boundaries of river basins and relies to some degree on economic instruments to reach its target of “good ecological status” in both qualitative and quantitative terms by 2015. Several provisions in the WFD relate to water pricing.

To begin with, according to Article 11, water pricing should be considered as a *potentially cost-effective measure* for the implementation of the Directive’s objectives. Under Article 11, EU Member States had to develop a Programme of Measures (POM) for each River Basin District (RBD), taking into consideration the results of the characterisation of the particular river basin. However, according to an assessment of the draft River Basin Management Plans (RBMP), it can be assumed that the use of water pricing in agriculture as a measure is only used rarely (Dworak et al. 2010a). It can be assumed that the final POMs submitted so far do not present a very different picture.

²⁰ For further information regarding general targets and regulations established by the WFD, see the homepage of EC DG Environment: http://ec.europa.eu/environment/water/water-framework/index_en.html.

More specific provisions regarding water pricing are listed in Article 9. This article introduces the concepts of *incentive pricing*, *cost recovery* and the *polluter-pays-principle*, which can be seen as “guidelines”, or “criteria” for establishing water pricing schemes (see also section 2.4.1 and 2.4.2). The three concepts are closely related but not equivalent, with each concept imposing specific requirements on the pricing system (Interwies et al. 2006; Donoet et al. 2010; ENTEC 2010):

- Cost recovery is about the amount of money that is being paid for water services. The principle, however, extends not only to the financial costs for the provision of a water service, but it also covers the costs of associated negative environmental effects (environmental costs) as well as forgone opportunities of alternative water uses (resource costs)²¹.
- The polluter-pays-principle looks at the adequacy of contributions from the different water uses towards the total cost based on their role in causing these costs, i.e. it addresses the question who pays for water.
- Incentive pricing deals with the way water users pay for their use and whether the right price signals are transmitted, i.e. it addresses the question how is water being paid for and how the water price affects the behaviour of water users²².

Thus, for example, a pricing system based on flat-rate tariffs can fully recover its costs, but would still fail to provide incentives for efficient water use (Massarutto 2005). Alternatively, a pricing system may achieve cost recovery but violate the polluter-pays-principle by recovering a large share of the cost from a group of water users that did not contribute to the water problem at hand. One of the key challenges for the successful implementation of the WFD will be to devise a pricing system that satisfies all three requirements to an adequate degree (Interwies et al. 2006).

The interdependence between incentive pricing, cost recovery and the polluter-pays-principle is depicted in the following diagram.

²¹ Three cost categories are distinguished in European water legislation, corresponding to similar concepts of internal and external costs referred to in section 4.1:

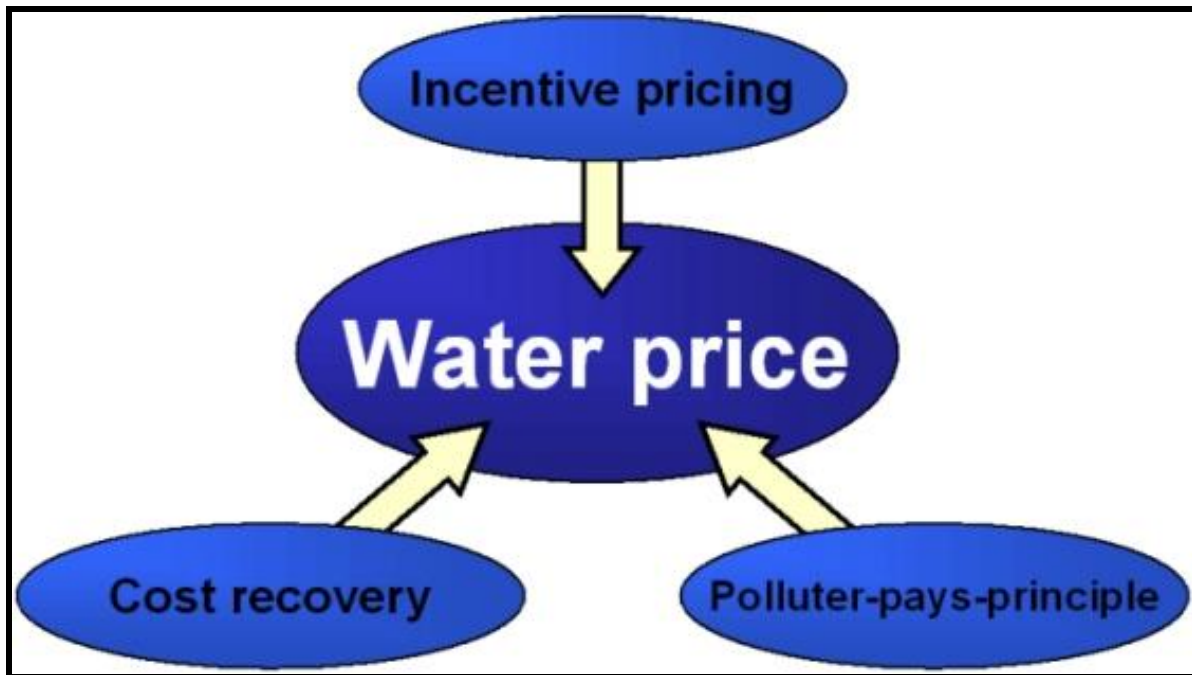
- Financial costs of water services include the costs of providing and administering these services. They include all recurrent costs, and capital costs.

- Environmental costs represent the costs of damage that water uses impose on the environment and ecosystems and those who use the environment (e.g. a reduction in the ecological quality of aquatic ecosystems or the salinisation and degradation of productive soils).

- Resource costs represent the costs of foregone opportunities which other uses suffer due to the depletion of the resource beyond its natural rate of recharge or recovery (e.g. linked to the over-abstraction of groundwater) (EC 2000a; CIS WG WATECO 2003). A slightly different definition is provided by Drafting Group ECO2 (CIS DG ECO2).

²² Further information is available in the different CIS-Guidance Documents, namely of the CIS WG WATECO, CIS Drafting Groups ECO1 and ECO2. Furthermore, ENTEC (2010) provides an up-to-date analysis surrounding the legal requirements of Article 9.

Diagram 4: Incentive pricing, cost recovery and polluter pays principle



Source: Interwies et al. 2006.

The concepts of cost recovery and the polluter-pays-principle are the core elements by which the cost of water services are translated into the price users of those water services pay. Cost recovery establishes the overall *amount* that users are charged for water services, while the polluter-pays-principle establishes how these payments should be *allocated* among water users. However, it is important to note the wording of the Directive, which states that the principle of cost recovery should be taken into account and that the different water uses should provide “*an adequate contribution...to the recovery of the costs*”, rather than strictly demanding full cost recovery. Furthermore, according to Article 9, when adapting their water pricing policy Member States can take social, environmental and economic effects into account as well as the geographic and climatic conditions of the region or regions affected, thereby allowing some flexibility (ENTEC 2010). In combination with this flexibility, it is to be expected that cost recovery will be addressed in a pragmatic way by most Member States. Therefore, full cost recovery of water services is not likely (Interwies et al. 2006).

The cost recovery provisions contained in Article 9 only have to consider “water services”, i.e. “*all services which provide...: abstraction, impoundment, storage, treatment and distribution of surface water or groundwater...*” (WFD Article 2 (38)) as opposed to “water use”, i.e. “*water services together with any other activity...having a significant impact on the status of water.*” (WFD Article 2 (39)). This characterisation of water using activities as a “service” or “use” is very important for the design of water pricing schemes, especially in the calculation of the appropriate price level. Although it has been discussed extensively, there is still disagreement between the Commission and some Member States on whether agricultural irrigation or self abstraction should be considered as a water service with its associative principle of cost recovery (and, therefore, include environmental and resource costs into the prices) (CIS WG WATECO 2003; ENTEC 2010). An infringement procedure against some Member States is still ongoing on the issue surrounding the definition of water services.

The following table summarises the main provisions of the WFD important for agricultural water pricing schemes and parts thereof where room for interpretation is given:

Table 2: Interpretation Issues in WFD regarding agricultural water pricing

Concept	Reference (WFD)	Interpretation Issue
Cost recovery	Article 9 (1)	What does "adequate" contribution or "shall take account of" mean? Should historical financial costs (e. g. for irrigation schemes), external costs and opportunity costs be included in the calculation of cost recovery, and according to which methodology?
Environmental and Resource costs	Article 9 (1)	Uncertainties pertain to the definition of these costs, the methodology for estimating them and the degree to which these costs are to be included in price levels.
Incentive Pricing	Article 9 (1)	What does "adequate incentives" mean? To which degree is certain water pricing tariff structures (e. g. "flat rates") not providing adequate incentives according to the WFD?

Sources: ENTEC 2010; Interwies et al. 2006.

2.5.2 Other Policy Fields

Common Agricultural Policy (CAP)

To develop proper water pricing schemes along WFD provisions, there is a clear need to link the water pricing system to the current system of agricultural subsidies that affects the way in which farmers use water and how these subsidies relate to the incentives transmitted through the water pricing system.

Under the two pillars of the Common Agricultural Policy (Pillar 1: direct payments; Pillar 2: Rural development), farmers receive different payments. These may influence cost recovery and/or the incentive function of a water price. Payments issued through the EU Rural Development Fund, for example, allow Member States to support new or modernise existing irrigation infrastructure. These payments can be used to decrease the period to recover costs potentially leading to lower water prices after a certain period or lower prices over the lifetime of the system.

The incentive function of water pricing schemes may be influenced by subsidising specific production methods or crops which are more or less water intensive. These subsidies change the input/output cost ratio of a product, allowing a farmer to produce a certain type of crop even if a high water price would have stopped him/her. However, these direct payments (of Pillar 1) have been to a large extent fully decoupled from production, especially in 2003 and 2009. Member States may choose to maintain a partial degree of coupling for certain crops (e.g. cotton) in order to take into consideration social and economic issues (e.g. avoiding land abandonment).

Nevertheless, to guarantee that WFD and CAP integrate into a harmonised policy approach that balances the objectives of both policy fields, close coordination with regard to water pricing schemes and CAP payments should be aspired.

Water Scarcity and Droughts

Agricultural water pricing can provide a significant contribution to water scarcity and drought mitigation objectives, especially with regard to agriculture's high water consumption and water use efficiency potential (EC 2007a; EC 2010) by lowering water demand and developing possible alternative water supply sources (ENTEC 2010). A pre-requisite of rendering a significant contribution to these objectives, however, is to include irrigation abstraction as a water service under Article 9 (OECD 2009, ENTEC 2010). This would guarantee the recovery of financial, environmental and resource costs and help to alleviate the water scarcity and drought phenomena, as the amount of water used in irrigation is so significant (OECD 2009, ENTEC 2010).

Furthermore, the effectiveness of water pricing as a tool to alleviate water scarcity and drought related problems will depend (in addition to the general concepts outlined in section 2.4) on possible adverse incentives through uncoordinated subsidies issued under other policy fields. The coordination with such policy areas as the CAP is necessary (OECD 2009; ENTEC 2010).

In the Communication on Water Scarcity and Droughts adopted in July 2007 (EC 2007A; EC 2010), the Commission identified an initial set of policy options to be taken at European, national and regional levels to address water scarcity within the Union. At the heart of such policy options is the need to put the right price on water, with the "user pays" principle becoming the rule regardless of where water is taken from. Water pricing in combination with compulsory water metering is a key measure for promoting the installation of water saving devices on taps, shower heads, and toilets or to make irrigation more efficient.

Based on the information received from the Member States, the second follow-up report on the EU's 2007 Communication on Water Scarcity and Drought (EC 2010) clearly stresses that the adaptation of tariff systems to take into account the principle of cost recovery may result in increased water bills for citizens. Experience shows that the price increase may not necessarily lead to a decrease in consumption (see section 2.4.3.3). Pricing is only one possible tool to be considered; additional measures are needed to encourage the efficient use of water. Examples of the most widespread measures used in the Member States are the application of block tariffs, penalties for excessive consumption and discounts for water savings.

Climate Change Adaptation

Closely related to the water scarcity and droughts policy field is the adaptation to changes in the aquatic environment and water availability expected to take place because of anthropogenic climate change. Reducing water demand and using water resources more sustainably is necessary to adapt to an overall reduced water supply. Therefore, water pricing policies could contribute significantly to the objectives of

climate change adaptation, as is the case in mitigation of scarcity and droughts. Again, to fulfil its designated role as an instrument to give incentives to conserve water (beside the general concepts outlined in section 2.4), coordination with related policy fields such as the CAP is necessary (OECD 2009; ENTEC 2010).

2.6 Conclusions

To set up or reform the agricultural pricing schemes in Europe in line with WFD objectives while also being socially agreeable and acceptable to farmers is not a simple task. Reflecting on the theoretical background of the issues as provided in the sections above, some general conclusions can be drawn.

The present chapter of the report gives only a theoretical overview of water allocation and water pricing and the underlying economic concepts. Such a theoretical background is certainly interesting and necessary. To draw concrete conclusions for designing water pricing policies, however, the practical situation “on the ground” has to be assessed in more detail and on a case-by-case basis, as will be done in the following chapters of this text. Nevertheless, it is possible to identify topics which are crucial when considering the design of policy options for water pricing in agriculture in Europe.

1. One obvious conclusion of analysing the theoretical framework of water allocation and pricing is the great variability of agricultural conditions. Therefore, any new pricing scheme or different price levels need to reflect local and regional circumstances, such as water use, water availability, farm sizes and crops grown, possible alternative crops and marketing channels, alternative technologies to save water or change irrigation techniques.
2. By respecting these local and regional circumstances, the proper levels of equity, fairness and social compatibility of the pricing scheme can be assessed.
3. It is furthermore advisable to reflect about different options for supporting measures in order to soften economic hardships for strongly affected farmers.
4. In this context, assessing the most important parameters/local circumstances of a farming sector in a given region affected by a changing pricing policy in an easy, consistent and understandable manner would be advisable. This would help to design compatible and consistent pricing policy approaches across regions on the one hand, and would enable policy makers to more easily decide about possible compensation mechanisms on the other hand.
5. Other design options, such as the tariff structure and price levels, also have a great impact on the effectiveness and social compatibility of pricing mechanisms, and need to be carefully developed.
6. Volumetric pricing has to be considered as one of the most effective water pricing tools with regard to actually providing incentives for water saving. The establishment of water metering, however, represents a significant investment, and is not yet employed to its full potential in the European agricultural sector.

It should be noted, however, that pricing schemes alone will not be able to reach the target of “sustainable water use”. Instead, water pricing should be recognised as one of several possible policy instruments in a well-balanced policy mix and with regard to regulations in related policy fields such as the CAP to promote the sustainable use and conservation of water resources. Nevertheless, agricultural water pricing could

contribute significantly to the objectives laid out in the WFD, while at the same time causing beneficial side-effects in mitigating water scarcity and droughts and adapting to changing water supply caused by anthropogenic climate change. In the long run, the agricultural sector would support itself by promoting a more sustainable use of its most important production input resource.

3 Current use of water pricing policies & water allocation policies in the EU and for the agricultural sector

3.1 Introduction

Water pricing and allocation policies in agriculture differ significantly throughout the European Union. Historical policy decisions are inspired by the specific context and depend for example on the access to and availability of water resources or the importance of irrigated agriculture in the region. Under the EU Water Framework Directive there is a requirement for Member States to reform water pricing and financing policies towards full cost recovery including pricing of water for agriculture (due 2010). Comparable cross country information on the institutional arrangements for agricultural water pricing is however incomplete (OECD, 2010b). The aim of the chapter is not to provide a detailed or exhaustive overview per Member State, taking into consideration that policy aspects and objectives can be quite different (regional characteristics), even within one country. The primary objective is to depict the tendencies in allocation and pricing mechanisms that are applied throughout the European Union.

The overview has been compiled from various publicly available literature sources²³, where it was a difficult task to assess the status (up to date) and quality of the information. After a first screening of literature, (most) Member States had the opportunity to validate the draft presentation of collected information. 11 Member States (mainly through water pricing experts) or more than one third commented and further completed the information presented: Italy, Spain, Cyprus, Germany, Lithuania, Romania, Belgium (Flanders), UK, Poland, France and Hungary. The key tendencies and principles in water pricing and allocation in agriculture across the EU have been presented at the Water pricing conference in Warsaw mid September 2011²⁴. A second consultation round has been organised and some further modifications were received before the end date mid-October.

²³ European Commission studies, OECD publications, regional studies, national documents and websites (sources are included in the list of references)

²⁴ Conference on water pricing in agriculture: on track for a fair and efficient policy in Europe? 14 September 2011, Warsaw, Poland. See programme and list of participants http://www.ecologic-events.eu/water_pricing_conference_2011/

3.2 Current baseline in the EU: summary of water pricing and allocation policies in agriculture

The description of the baseline situation represents the result of an extensive data collection process. It has been a challenge to find a good balance between information availability, content and a sound structuring of raw and diverse data. The current situation of water pricing and water allocation in agriculture in the European Union has been summarised in the two tables presented in annex 1 and annex 2, reflecting some key features of water allocation and water pricing in the different EU Member States. These overviews provide a good perspective on the current situation in the EU, without ignoring uncertainties and lack of clarity due to sometimes incomplete, dated or non-validated information.

Regarding **water allocation** policies, the table includes information on water use rights (public allocation system, duration, quantities, ...), the allocation process, priorities and the competent public authorities. The table format allows to include information for groundwater and surface water separately, if different systems are in place. The table on **water pricing** policies describes the mechanisms (tariff design) in place for self-supply (abstraction) and for water provided. Further details have been added regarding the importance of self-supply (mainly for irrigation), cost recovery and the installation of water metering, as these aspects can further help to understand the variety in water pricing policies.

Paragraph 3.2.1 further elaborates on how Member States distribute water resources / water rights among different uses and agricultural use in particular. Paragraph 3.2.2 then briefly summarises how and if water pricing is applied for agricultural water users.

3.2.1 Water allocation

The diverse landscape of allocation mechanisms throughout the EU confirms the long history and spatial variation of installed mechanisms to ensure water availability for different uses. Specific circumstances in countries and regions justify the multiplicity of systems as the appropriate allocation system ideally considers local conditions in its search to balance efficiency and equity.

In most EU Member States, water rights are separated from the ownership of the land. Austria (groundwater), Portugal and Spain attach water rights to land ownership while no specific information has been identified on the formalisation thereof.²⁵ Water trading as an allocation mechanism is limited across the EU. There are only some experiences in EU Member States, notably in Spain and the United Kingdom. Some Member States explicitly prohibit the trading of water rights (e.g. Romania). OECD (2010b) confirms that the use of water markets and trading of water entitlements to allocate water is only practised in a very limited number of OECD countries (e.g. Australia).

National laws in several Member States stipulate that water is a common property and water use rights are owned by the State. Most commonly, the right to abstract or use water is initially issued by a public authority (**public allocation**) and explicit, through the granting of authorisations, licenses or permits. The public

²⁵ OECD Member Country Questionnaire Responses on Agricultural Water Resource Management (2010), available at <http://www1.oecd.org/dataoecd/7/31/44763686.pdf>

bodies responsible for issuing rights differ according to the country and can be local (municipalities, local councils e.g. Belgium), regional (Provinces, (RB-)districts, departments e.g. Belgium, the Netherlands, Austria, France) or national (Cyprus, Malta, Luxembourg, Romania).

Authorisation procedures and formalisation (e.g. requirements for permits) are likely to depend on the quantity (of water) abstracted or the pumping capacity. Legal approval, permits or licenses for water abstraction are then needed above a certain threshold or pumping capacity (Belgium (Flanders)²⁶, Bulgaria, Estonia, Finland, France, Hungary, Latvia, Lithuania, The Netherlands, Poland, Portugal, Spain and the United Kingdom). These thresholds are sometimes stricter for groundwater than for surface water (Belgium, Estonia).

The rationale behind the initial allocation usually considers the availability of water resources, the aim of the abstraction (use), environmental needs and other uses and the source. It is however not feasible to further describe in detail the actual implementation of the guiding principles behind the allocation decision for the individual Member States. Some countries explicitly relate authorisations or permits (predominantly for groundwater) to the local circumstances and impact of the water abstraction:

- Hungary: available water resources, importance of the water use, time of recharge (hydrologic and hydro-geologic assessments).
- France, Germany (groundwater), Belgium - Flanders (groundwater), Sweden, United Kingdom: permits include (environmental) impact / effect. In Sweden, a permit would not be required if the water abstraction is not likely to cause environmental effects.

Water metering for permitted abstractions is at least obliged in Belgium (Flanders), Bulgaria, Czech Republic (above monthly or yearly threshold), Denmark, Estonia, France, Malta (groundwater), Lithuania, Romania and Spain. It is of note that the list may not be exhaustive, as some other EU Member States also apply volumetric charges which necessitates some type of water metering. In France, water tariffs include incentives to speed up the shift to metering. Furthermore, water metering is part of cross compliance (Good Agricultural and Environmental Conditions (GAEC) in France.²⁷

Time periods or duration of permits or authorisations can differ significantly between Member States. Some have installed annual volumes and / or quota (Cyprus, France, Italy (collective systems), Romania) while other Member States provide permits for a longer time period (Bulgaria, Denmark, Germany, Italy (groundwater), Portugal, Spain and UK).

In several countries, legislation is in place to give the authorities the right to (at least temporarily) suspend the right to abstract water (for agricultural purposes) or ban irrigation in periods of drought or priority to other uses (e.g. Bulgaria, Latvia, the Netherlands, UK, Spain, Romania, France). Legislation then often explicitly ranks priorities in water use. Water for human consumption (domestic supply) always ranks first. Agricultural use is preferred over other uses (excluding human consumption) in Italy, while some other countries further distinguish between different agricultural uses: animal farms and fish ponds (3rd) rank higher than irrigation

²⁶ Threshold set at 500 m³ per year, for navigable rivers and groundwater abstractions. For un-navigable rivers, riparian owners have use rights.

²⁷ See e.g. <http://www.daf974.agriculture.gouv.fr/Les-Bonnes-Conditions-Agricoles-et>

and other uses (5th) in Hungary. The Netherlands give priority to irrigation of capital intensive crops over other agricultural water uses. In Cyprus, livestock is included in domestic supply and greenhouse agriculture and permanent crops have the highest priority within other agricultural uses.

In order to cope with water scarcity and drought events, the government of Cyprus developed an interesting (yearly recurrent) water rationing system for surface water from Government Water Works or Projects GWP (see text box). The strict rationing system can serve as an example of “*implicit allocation*” (Asian Development Bank 2008) as it follows from a structured planning process including multiple socio-economic goals and stakeholder participation. It is likely that such systems are common practice at a lower spatial scale in different Member States, e.g. within the boundaries of (collective) irrigation schemes.

Example: Water rationing in Cyprus

Cyprus suffers from long and often severe droughts with its natural water resources relying mainly on the annual rainfall. Within the process of water rationing, every January, the farmers are invited to submit to the Water Development Department (WDD) their application for the supply of irrigation water from the Governmental Water Projects / Works (GWP or GWW), giving information related to the area and the type of the crops they plan to cultivate (permanent, seasonal, greenhouses etc). Based on this information and taking into consideration the annual water demand per crop per area, WDD estimates the water needs per GWP for the coming irrigation period, from January to December. In spring, when the rainfall period comes to end, the WDD estimates the available total water quantities for the coming period, based on the dam storage at that time and the quantities that can be purchased from desalination plants and from the tertiary treatment of sewage. Considering the above demand and supply conditions, WDD prepares the scenario for the allocation of water to the different uses, for the coming period. The procedure and priorities are as follows:

- The estimated domestic water needs to be satisfied by 100%.
- A certain amount of water has to be maintained in the reservoirs, both for environmental as well as for safety reasons (keep storage for the years to come, considering possible droughts).
- A certain amount is left for recharging the aquifer downstream the dam, during the year.
- The remaining quantities are allocated to irrigation, according to the farmers' applications above. If the available quantities are insufficient to satisfy those needs (this is the usual scenario), water is allocated to the different crops by priority: i.e greenhouses and permanent crops are first allocated a portion of their normal water needs (varying from 40%-100%) and then the seasonal crops (from 0% to 70%).²⁸
- It is interesting to note that the scenario is prepared with the participation of the different stakeholders, like local authorities' representatives and farmers' organisations. After this consultancy procedure, the final scenario is approved by the Council of Ministers.
- With the approval of the scenario, each farmer is informed about the quantities per plot he is allowed to use for the coming irrigation period. If he exceeds these quota, he has to pay an over consumption rate (multiple of normal level of the charge) for the extra quantities, while the supply is soon disconnected.

²⁸ For the period 1990 to 2011, there was only one year where the full irrigation demand was met. This occurred in 2004 when all dams were over spilling.

Source: Communication by the nominated expert on water pricing for the Republic of Cyprus, Agathi Hadjipanteli (Water Development Department)

France is currently in the process of introducing a new approach to water allocation in agriculture. According to the Water Law of 2006, starting in 2012 and if agreed at local level, an "*organisme unique pour la gestion des prélèvements d'irrigation*" can be set up. This mechanism is obligatory – but not limited to - distributing water use rights in water deficit areas (*Zones de Repartition d'Eau* or ZRE). The allocation system can be described as a multi-annual authorisation for water abstractions (maximum amounts) given by the *Préfet de département* to the *Organisme*.²⁹ The Organisme then further shares the water between the irrigators. The authorisation (volume) is based on the requirement to respect low flow water level objectives 8 years of 10. The indicators for these environmental flows are to be defined for all water bodies and must be integrated in the management plan (SDAGE).

Complementary to or (even) within public allocation schemes, collective irrigation systems or some farmer-managed irrigation systems (lower spatial scale) can serve as good examples for a (more traditional) **user-based allocation mechanism**. Such systems exist for example in some Southern EU Member States where collective irrigation systems are important (France, Italy, Cyprus). User rights are then for example granted according to a defined time schedule (m³/hour) or quota for a specified period if water can be stocked. In Italy, Reclamation and Irrigation Boards receive quota at the beginning of every year (availability versus needs) and individual farmers in their turn are further submitted to quota or abstraction turns (Sardinia). Non-government or small irrigation schemes in Cyprus, chaired by District Officers rely on similar practices.

3.2.2 Water pricing

The presence and design of tariffs for (irrigation) water differs for water provided and self-supply (abstraction). Prices usually reflect i) the amount of money charged for the direct abstraction of water from ground or surface water sources (abstraction tax or fee) or ii) as a charge or tariff for water supply services (abstraction, treatment, transport). Some tendencies identified across the EU Member States are further detailed below for direct abstraction (paragraph 3.2.2.1) and water provided (paragraph 3.2.2.2). Paragraph 1.2.3.3 groups some elements on the level³⁰ and principles of cost recovery, though noting that information thereto is not readily available. More details on the variation, the concept and objectives of water pricing mechanisms can be read in the theoretical background of chapter 2.

²⁹ For further information, see for example <http://www.eau-adour-garonne.fr/page.asp?page=3311>

³⁰ The following paragraphs are including some examples of tariffs, it is of note however that these are not necessarily representative for the Member State, as large (regional) differences exist.

3.2.2.1 Pricing mechanism or practices for self supply (abstraction)

Self supply for agricultural purposes (irrigation in particular) is widespread in the EU, often through groundwater abstraction. Groundwater is the source of water for a large share of irrigated farms in the EU, 20% to 100% depending on the region and the Member State. Irrigation water pricing today is still primarily focused on surface water and (collective) schemes where infrastructures have been built to convey water from the source to the fields (OECD, 2010b). In Northern parts of the EU, waterways are more commonly accessible to farmers who can easily pump water out for irrigation. In these cases, as well as in groundwater irrigation, costs for water are borne by the farmers themselves (private on-farm costs). These abstractions are more difficult to control and monitor by public authorities than water distributed through (collective) schemes. According to the collected information, agricultural use (Greece, Malta, Spain, Cyprus, Hungary and the Netherlands³¹) or irrigation (Estonia, Slovakia and Finland) specifically are exempted from abstraction taxes meaning that the costs of water abstraction are limited to the **private on-farm costs** and no water price is charged. The following diagram shows that there is no perfect relation between the importance of agriculture / irrigation in total abstraction and the granting of exemptions, though exemptions appear to exist in several Member States where the share of agricultural water abstractions is significant. Overall, more than one third of the Member States has no tariff system for individual abstractions of farmers (or irrigators) and does not recover any ERC for these abstractions.

³¹ Irrigation is exempted from the national groundwater tax. Groundwater extraction is also exempted from the provincial groundwater levy for quantities below fairly high threshold values (e.g. below 40.000 m³/year), which can be considered as an indirect exemption to agriculture and domestic abstractors. (Mattheiss et al. 2009)

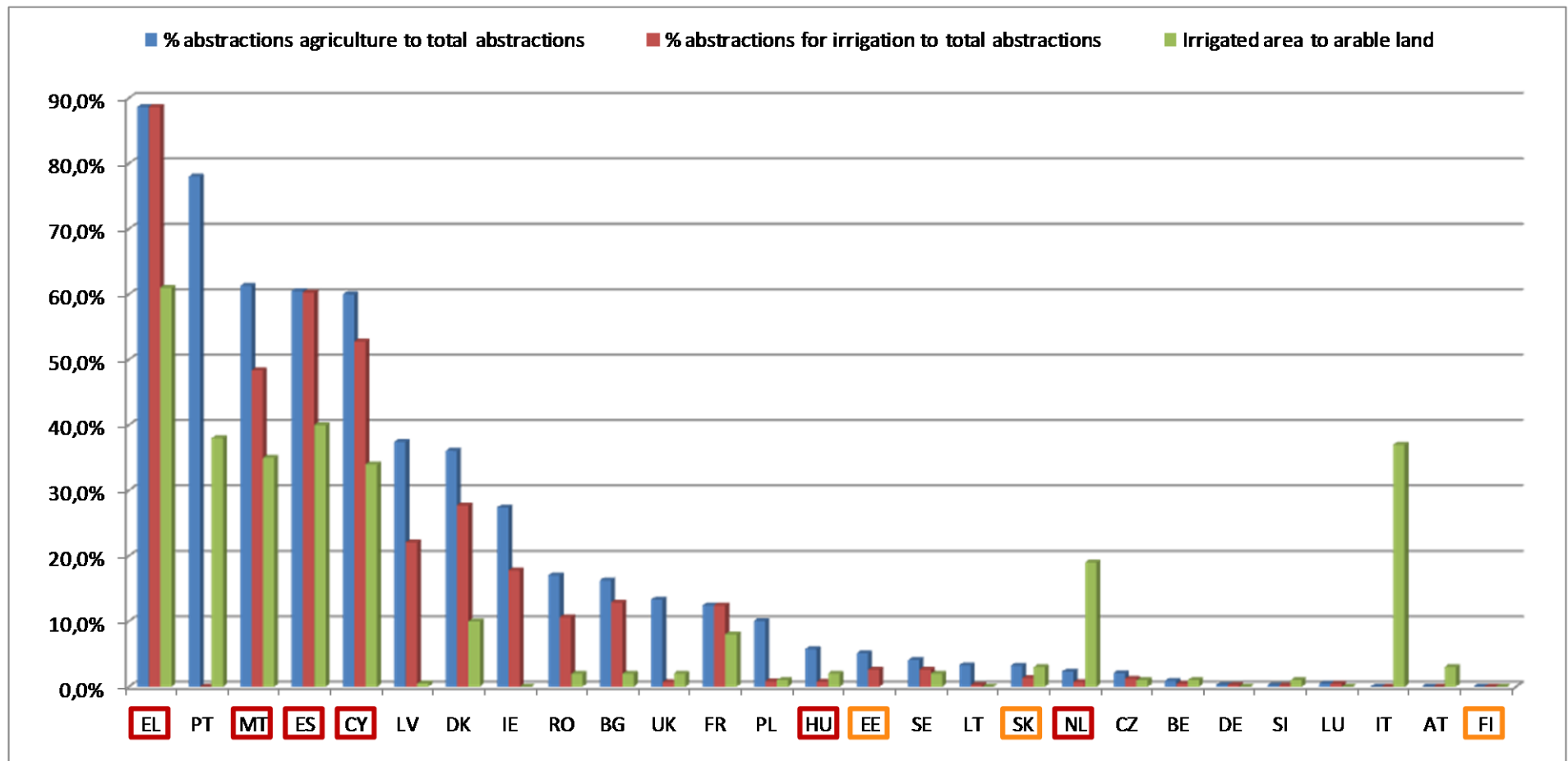


Diagram 5: Member States where exemptions from water abstraction taxes are granted for agriculture (red marking) or irrigation (orange marking). (Source: own compilation of different information sources)³²

³² It is of note that there is a lack of reliable data for direct water abstractions. The graph is included for illustrative purposes and may contain incomplete or partially incorrect information.

The majority of EU Member States have installed **water abstraction taxes / fees** for direct water abstractions:

- In Belgium, France, the Netherlands, United Kingdom, Czech Republic, Germany, Finland and Ireland, the tax is payable above a defined threshold. These threshold values are rather low in most countries except for the Netherlands where agriculture is indirectly exempted with thresholds of e.g. 40.000 m³ per year.
- No minimum abstraction quantity stated for Denmark, Italy, Lithuania, Portugal, Bulgaria and Slovenia.³³ It is however unclear if the tax applies to the agricultural sector or for irrigation purposes in all these countries.

The structure and mainly the level of the tariff may differ significantly between the Member States. Most Member States have installed a flat volumetric tariff based on the quantity of the abstracted and/or permitted volume. Most Member States then further differentiate between groundwater and surface water abstractions (except e.g. Slovenia where the same fee has been installed). In Romania, direct abstractions from groundwater sources are not allowed for irrigation.

Many Member States are considering the state of the resource in the design and level of the tax. The Flemish region in Belgium applies a volumetric charge for surface water abstractions in navigable rivers above 500 m³ per year (0.0631 €/m³). Abstractions from un-navigable rivers are free of charge. Groundwater tariffs are differentiated according to the volume (0.05 €/m³ for annual quantities below 30,000 m³ from sources with low pressure), the aquifer and existing pressure on the groundwater resources in the region (base rate 0.062 €/m³ increased with a correction factor for the aquifer and large volumes). In France, higher tariffs are usually installed in permanent water deficit areas (ZRE), for more vulnerable (ground)water sources or for surface water bodies benefiting from recharge from 'reservoirs' in low water periods (e.g. *soutien d'étiage* Garonne).³⁴ The Water Agency tax is very dependent on the River Basin (factor of more than 10 between lowest and highest tax across a selected number of basins). In Adour-Garonne, the tax for irrigation ranges from 0.0034 – 0.0097 €/m³ outside ZRE and increases with 20 to 35% in ZRE.

The tariff system in Latvia has built in surcharges when farmers abstract more than permitted quantities: excess amounts are charged at a rate +/- 3 times higher compared to the base rate of +/- 0.003 €/m³ for surface water and +/- 0.007 €/m³ for groundwater.

Some Member States have developed differentiated tariff systems where the total price depends on more parameters (for example season, area, ...). The United Kingdom (England and Wales) allows farmers to chose for a special scheme for spray and trickle irrigation (two-part tariff), where half of the abstraction charge is based on the licensed quantity and other half on actually metered quantities.³⁵ Portugal has introduced a new Water Resources Levy split-up in several components. Some of these components are based on quantities of water abstracted (0.003 €/m³ and 0.0006 €/m³ for component A and U respectively, for the individual use of water) while component O depends on the area occupied.³⁶

³³ This does not necessary imply that such threshold values do not exist.

³⁴ <http://www.eau-adour-garonne.fr/page.asp?page=1194>

³⁵ http://www.environment-agency.gov.uk/static/documents/Abstraction_scheme_2011-12.pdf

³⁶ Ministry of the Environment, Spatial Planning and Regional Development Decree-Law no. 97/2008 11th of June

Some examples have been identified where direct abstractions do pay a fee but independent of the volume. In Italy, modest concessions are paid for licenses or permits usually based on the permitted quantity (e.g. Sardinia 40.11 € per 100 l/s).³⁷ In the Netherlands, farmers pay an area based charge to cover costs for Water Boards (59.71 € per hectare for farmers under the Water Board *Scheldestromen*). These costs relate to a broad set of activities of the Water Boards and the resulting water price for farmers thus covers more than the access to water. This system does not include incentives for water savings as water intensive crops pay less on a per m³ basis.

Generally, there appears to be a lack of incentive elements in the pricing of direct abstractions. Some Member States allow exemptions for agricultural water use or irrigation specifically, also in water stressed areas e.g. in Southern Europe. The level of the water price (excluding private on-farm costs) appears to be modest (well below 0.01 €/m³ in many cases), though some Member States have introduced higher tariffs, especially for specific water resources where availability is low. A limited number of implemented tariffication systems includes no incentives for water savings as quantities of water use have no relation with the amounts to be paid.

3.2.2.2 Pricing mechanisms for the provision of (irrigation) water

Similar to the water price for direct abstractions, there is a large heterogeneity of tariff systems for the provision of water for irrigation or to farmers in general. Public supply services or collective (irrigation) systems set **water charges or tariffs** in order to recover (a share of) their supply and water management costs.

Irrigation districts or (collective) schemes provide mainly surface water and, less frequently, groundwater to individual farmers. The costs then include cost items directly related to the supply of (irrigation) water. The costs of running and maintaining infrastructure and associated facilities serving a clearly identified set of irrigators are in principle paid by farmers, irrespective of the kind of ownership of the district's infrastructure. For Europe in general however, as for OECD countries, a common conclusion across countries is that irrigators have been, and still are, heavily subsidised, primarily in terms of insufficient capital cost-recovery (OECD, 2010b). According to the same source, Environmental and Resource Costs (ERC) are hardly paid for by irrigators (see also paragraph 3.2.2.3).

Multiple tariff structures and levels prevail when comparing MS and even within regions of one state, as collective schemes need to recover their own financial (supply) costs while facing own specific characteristics (age of the irrigation infrastructure, ownership of the infrastructure, accessibility). In Romania for example, the tariff (including pumping and transport cost for the public scheme) can vary significantly depending on the height distance ranging from 0.002 to 0.247 €/m³. In France, differences in water tariffs (more than x%) have been observed between (neighbouring) collective systems (run by *Associations Syndicales Autorisées* or ASA) within the same region Haute-Garonne (0.08 to 0.233 €/m³).³⁸ Different prices for farmers are then mainly due to capital costs of the irrigation system. The price level further

³⁷ Communication by the nominated expert and local contacts on water pricing from Italy

³⁸ Chambre de l'Agriculture de la Haute-Garonne (2010). Gestion de l'eau. Le coût de l'irrigation en Haute-Garonne. Article of 10 September 2010.

depends on the level of the service, where pressurised water supply comes at a higher price compared to gravity-fed distribution systems. Water tariffs for treated sewage effluent can be lower (Cyprus) in order to promote alternative sources.

The different pricing mechanisms for the provision of water and key features have been explained in the theoretical chapter 2 on water pricing and allocation. The baseline situation (see tables in annex 1 and 2) confirms the diversity of systems across the EU, while some patterns can be observed. In most Member States, a volumetric charging mechanism does exist though it is of note that this is generally not the only system in place. According to a recent OECD questionnaire³⁹, mixed systems of a fixed fee and volumetric charges predominate, but no clear details have been identified on the individual tariff systems. Per-hectare water charges (flat rate) are widely used for gravity fed irrigation systems (OECD, 2010a). For several Member States, multiple systems can be identified as the tariff structure can still differ per regional entity or even within regions. The most common water pricing mechanisms have been described in chapter 2 and some of these are further illustrated here with some practical examples in EU Member States.

(Flat) **volumetric charges** are generally applied in Cyprus and Luxembourg. These schemes charge based on actual consumption. Government schemes in Cyprus charge 0.15 €/m³ to irrigator's organisations and a somewhat higher fee (0.17 €/m³) to individual irrigators. In Malta, a flat volumetric tariff for the supply of non-potable water from public boreholes to agriculture is set at 0.093 €/m³. Some collective systems in Greece, Spain and Italy apply volumetric tariffs (0.04 – 0.07 €/m³ in Southern Italy, tariffs above 0.20 €/m³ have also been identified), but this is a clear minority. Water must be metered before it can be charged volumetrically. Metering is often obliged for permit holders, though limited evidence on the actual implementation and control at the farm level could be identified.

Mixed tariffs are commonly used for the provision of water to farmers. These charges combine area or crop based flat-rate with a volumetric element and are also called two-tiered or two-part tariffs (ENTEC, 2010). According to the results of the OECD questionnaire Austria, Czech Republic, Finland (livestock and dairy farming), Germany, Ireland, Poland and Spain are using mixed tariffs for water supply for agricultural use. No further details on the systems are available there. In Spain, the volumetric component depends on the volume or the irrigation time. In France, mixed or binomial tariffs are most commonly used for non-gravity fed systems. One example of a tariff in the Adour-Garonne River Basin for example consists of a fixed charge per subscribed hectare of 157 € and a volumetric component of 0.082 €/m³. Another example charges for the capacity (fixed 51 € per m³/hour) and used quantity (0.0568 €/m³).

In Belgium (Flanders), **volumetric block tariffs** are in place. These (decreasing) block tariffs are combined with a small fixed charge based on diameter of the pipe. Price range for small abstractions (0.87-2.62 €/m³) and larger abstractions (1.05-1.58 €/m³) illustrates these decreasing tariffs. It is assumed that water for irrigation is generally directly abstracted.

Despite the absence of incentives for sustainable water use resulting from **area-based charges**, the mechanism is still widely applied for irrigation water use in the EU. An irrigator is then charged according to the area irrigated, the crop cultivated or a combination of the two. Many Southern European Member States

³⁹ OECD member country questionnaire responses on agricultural water resource management (2010). (See <http://www1.oecd.org/dataoecd/7/31/44763686.pdf>)

(Spain, Greece, Italy, France, Malta and to a lesser extent Cyprus) still rely on this pricing mechanism. In Italy, Irrigation Boards (RIBs) establish systems independently and a wide variety of systems is in place. Per hectare (flat rate) water charges predominate. Area rates can be based on land registry area, irrigated area or a differentiated charge per crop area. The level of the charge still significantly differs between and within Member States: Greece (73 – 210 €/ha), France (gravity-fed systems 39 – 50 €/ha, 158 €/ha for some non-gravity fed systems in Adour-Garonne), Italy (50 – 150 €/ha in the North, 30 - 100 €/ha in the South⁴⁰).

Illustrations of uniform user charges or seasonal varying tariffs for the provision of water have not been identified.

Pricing mechanisms sometimes foresee differentiated tariffs for individual farmers or collective (irrigation) systems. Bulk supply to irrigation divisions in Cyprus has a lower charge compared to delivery to individual farmers. Irrigation Water User Associations (IWUAs) in Bulgaria managing state infrastructure pay lower water prices than other agricultural users or IWUAs managing their own infrastructure. Certain water supply systems in a number of Member States (e.g. Cyprus, Spain, France) apply penalty charges for exceeding limits or for excessive use where water is scarce. In Cyprus, farmers must pay an overconsumption rate for extra quantities (compared to allocated quantity for the irrigation period) which is multiple times higher than the normal rate (0.56 €/m³ compared to 0.17 €/m³), while the supply is soon disconnected.

It can be concluded that there are significant variations in water charges for farmers not only across countries, but also between regions and different water basins within regions. This applies for both the structure of the tariffs and the level of the water price.

3.2.2.3 Cost recovery

Chapter 2 explained the WFD meaning of cost recovery and identified the two main types of costs to be recovered, notably 'financial' (i.e. full supply costs) and 'environmental and resource' costs (i.e. full cost recovery).

OECD (2010b) made a preliminary analysis on water charges and cost-recovery rates in some Southern EU Member States. It was concluded that operating and maintenance (O&M) costs are reasonably covered, while capital costs are poorly covered and environmental and resource costs (ERC) appear to be neglected by pricing policies. Allocation of scarce water resources is merely influenced by water tariffs and resource costs are for the considered countries only implicit in quotas, use rights and other rationing mechanisms.

Some MS (typically non-water stressed: Austria, Denmark, Finland, the Netherlands, Luxembourg, UK) report 100% financial cost recovery. The recent OECD questionnaire confirms however the incomplete cost recovery (even for financial costs) in quite a number of EU Member States. The large investment in irrigation infrastructure (also modernisation) is often subsidised and capital subsidies to their irrigators is one direct and simple way to help them be more competitive. According to OECD (2010b), countries do not provide transparent information at district or irrigation scheme levels on actual subsidies rates and cost recovery

⁴⁰ Figures up to 700 €/ha have been identified, so values can significantly differ both according to the region and (literature) source.

levels of capital costs are difficult to compare. For Spain, Portugal, Poland, Italy, Greece, Bulgaria and Cyprus, O&M costs for the provision of water are only partly recovered.

Some Member States argue that (an unspecified share) of environmental and resource costs are recovered (UK, the Netherlands, France, Belgium (Flanders), Germany, ...).⁴¹ This (partial) internalisation of resource costs is generally realised through water abstraction fees. It is of note however that no clear evidence could be identified on the (allocation of) environmental and resource costs related to agriculture as a water user and associated cost recovery levels. Abstraction fees are generally low, as has been further detailed in paragraph 3.2.2.1. OECD (2010b) refers to Riesgo and Gómez-Limón (2006) to indicate the (potential) usefulness of a low water tariff that favours the implementation of the WFD environmental objectives. A low price on water might still be regarded as necessary in order to make farmers conscious of the value of water to society, and the importance of using it properly.

Cost recovery calculations in RBMPs are sometimes omitting environmental and resource costs, even where abstraction charges are in place to cover (part of) these costs (e.g. Germany). Further work is needed in order to fulfil the requirements for full cost recovery under WFD. Some MS are in the process to improve the evaluation and internalisation of ERC (e.g. Cyprus, Spain, ...).

3.3 Conclusion

This chapter described an overall picture of the EU baseline situation regarding water allocation and water pricing policies in the agricultural sector. The summary overview of Member State policies are presented in two large tables (see annex 1 and 2). Some key tendencies and general conclusions have been brought forward in this chapter. The main challenge to compile a solid baseline lies in finding the balance between information availability (general and publicly available literature) and its diversity in terms of specificity (limited information on agriculture), quality (older limited information) and nature (differences within one MS, level of detail). Consultation with MS at different steps in the process has improved the robustness of the presented information and confirmed the situation for 12 or nearly half of the EU Member States.

Generally, the right to abstract or use water is initially issued by a public authority through the granting of authorisations, licenses or permits. Authorisation procedures and formalisation (e.g. requirements for permits) are likely to differ according to the quantity (of water) abstracted or the pumping capacity. Thresholds are sometimes stricter for groundwater than for surface water.

The rationale behind the initial allocation can consider the availability of water resources, the aim of the abstraction (use), environmental needs and other uses and the source. Time periods or duration of permits or authorisations for agricultural / irrigation water abstractions differ significantly between Member States. Some MS explicitly relate authorisations or permits (predominantly for groundwater) to the local circumstances and impact of the water abstraction (prior assessments).

⁴¹ OECD member country questionnaire responses on agricultural water resource management (2010). (See <http://www1.oecd.org/dataoecd/7/31/44763686.pdf>)

In terms of water pricing, there is a large heterogeneity both in structure and in level of prices. For water abstraction (self-supply), charges or taxes are generally volumetric, at low tariff and above a minimum threshold. Some MS differentiate the tariff according to the state of the resource. In more than one third of the Member States, farmers do not pay for their water abstractions. Furthermore, these exemptions tend to exist in several water stressed Southern European Member States. This means that an important share of water abstractions for agriculture in the EU is not priced. For the provision of water to farmers, multiple pricing mechanisms exist. Area based charge with no incentive effect are still common for gravitational supply systems, while mixed systems and volumetric tariffs are gaining importance. Volumetric pricing can be limited to certain regions of a country and then usually depends on the service provided (pressurised water supply). Some MS have installed penalty charges for over-consumption.

The level of cost recovery across the EU is highly different as well. For at least 30% of the MS, O&M costs for the provision of water are only partly recovered. Capital costs (investments) are even more often (at least partly) subsidised by the state/regions. Environmental and resource costs (ERC) do not yet form a central element in pricing policies. Non-water stressed MS typically tend to report the highest level of financial cost recovery. Capital subsidies to irrigators in water-stressed regions help farmers to be more competitive. Transparent information on actual subsidies rates and cost recovery levels of capital costs is often lacking and difficult to compare. Some MS are in the process of improving the evaluation and internalisation of ERC, however water management authorities indicate that it will take time before this is successfully and fully implemented.

In conclusion, authorisation procedures and formalisation of allocation are likely to differ according to the quantity (of water) abstracted or the pumping capacity. Some interesting water allocation policies have been identified in a limited number of MS. Authorisations or permits (predominantly for groundwater) are in some good practice cases explicitly related to the local circumstances and impact of the water abstraction (prior assessments). Water use rights can be revoked or limited in periods of water shortages and some interesting allocation mechanisms have been identified, such as the strict rationing procedure in Cyprus or the innovative 'organismes uniques' in France.

It is difficult to make overall conclusions on water pricing policies, considering the large variability in both tariff design as well as price level, not only between Member States but also between RBDs and even within a RBD. Generally, the incentive in the water pricing mechanism to manage water sustainably has to be considered weak. It is a good practice that volumetric tariffs, which have the greatest potential to fulfil cost recovery and incentive functions, are generally used for self-supply and increasingly for water provision. However, tariffs are low to very low and an important share of water abstractions for agriculture in the EU is not priced yet.

4 Analysis of case studies

4.1 Aim of the case studies

After having investigated the theory behind water pricing policy and water allocation (chapter 2) and having provided a general overview on tendencies in water pricing policies and water allocation policies in agriculture in the EU (chapter 3), the local context relating to water pricing and water allocation in agriculture is further illustrated.

This chapter covers the selection and analysis of seven case studies (river basins) within the EU as well as in third countries in order to assess practical applications of water pricing policy and water allocation policy in agriculture and to demonstrate best and worst practice examples. For each case study, the following questions are looked into:

- What impact does the existing water pricing and allocation policy have on agricultural water use?
- What are the main drivers and barriers that drive or hamper the impact?
- Which additional mechanisms are needed to make water pricing work?

Detailed results of the analysis are integrated in Annex 4, whereas this chapter highlights the conclusions of each case study.

The next chapter formulates elements for policy recommendations, on the one hand based upon the main findings of these case studies which are considered useful for other river basins and on the other hand based upon the link between WFD and other environmental policies.

4.2 Selection of case studies

A long-list of potential case studies was developed in close cooperation with the EC and based on previous work such as the assessment of Art 5 reports⁴², the OECD Reports⁴³ the assessment of draft river Basin Management plans⁴⁴, EEA report⁴⁵, FAO reports⁴⁶ and consultation of other water pricing experts⁴⁷.

The selection of this long-list is based upon the following main criteria:

- Presence and/or pressure from agriculture e.g. in terms of share of water abstractions, irrigated land to agricultural land
- Experience in implementing water pricing and allocation policies
- Special characteristics regarding water and agriculture e.g. share of self-supply, farm types

⁴² Report available to the EU Commission.

⁴³ OECD. (2010): Sustainable Management of Water Resources in Agriculture, Paris, 118 p.

⁴⁴ Dworak, T.; Berglund, M.; Thaler, T.; Fabik, E.; Miguel Ribeiro, M.; Laaser, C.; Matauschk, M.; Amand, B.; Grandmougin, B. (2010): Assessment of agriculture measures included in the draft River Basin Management Plans

⁴⁵ EEA. 2009. Water resources across Europe – confronting water scarcity and drought. Available from:

<http://www.eea.europa.eu/publications/water-resources-across-europe>

⁴⁶ Turner, K. et al. (2004). Economic valuation of water resources in agriculture, From the sectoral to a functional perspective of natural resource management, FAO water report 27, Rome

⁴⁷ Contacted experts are a.o. Alejandro Maceira, Carlos Maria Gomez, Dominic Moran, Eugenio Barrios, Francesc La-Roca, Josefina Maestu,

Pierre Strosser, Ricardo Sandoval, Rob van der Veeren.

- Information availability and/or language capacity
- RB both within and outside the European Union. Where case studies outside the EU are identified, the transferability of the results of the analysis to the EU needs to be considered. According to the ToR, one case study should involve Australia.

From a first screening along these criteria, the following countries/RBs were identified as having potential as case studies:

- Australia (Queensland)
- Bulgaria
- Chile (Limari Valley)
- Cyprus (entire island)
- France (Adour-Garonne)
- Greece (Plastiras and Smokovo in Thessaly)
- Hungaria (Tisza Basin)
- Israel
- Italy (Emilia Romagna)
- Latvia
- Poland
- Romania
- Southwest USA (California)
- Spain (Guadalquivir)
- The Netherlands (Meuse or Scheldt)
- UK (South Anglian)
- Mexico

Each of these potential case studies have been presented in a fact sheet (see annex 3). In the fact sheets, each case study is screened against the following criteria:

- Characteristics of the country or regions
 - Water exploitation index
 - Occurrence of scarcity and droughts
- Characteristics of agriculture and (its) water use:
 - Importance of agricultural water abstraction as opposed to other abstractors
 - Arable land to total (utilised) agricultural land
 - Irrigated land to agricultural land
 - Agricultural water demand per irrigated area (level of abstraction)
 - Type of irrigation
 - Water provided or self-supply
 - Type of abstraction
 - Level of illegal abstraction
 - Type of production
- Information on water allocation in agriculture
- Information on water pricing in agriculture
- General information on water pricing:
 - Main aim of the policy
 - Type of payment or tariff structure
 - Specific details for surface water and groundwater
 - Cost recovery

- Information availability and/or language capacity

The chosen set of case studies should offer a balance between new and old Member States, as well as between northern and southern Member States. In close cooperation with the EC and after consultation of the CIS Expert Group on WFD & agriculture during the meeting of April 5, 2011 the following set of case studies have been selected for in-depth analysis:

- Australia - Murray-Darling
- Cyprus
- France - Adour-Garonne
- Mexico - Lerma Chapala
- Netherlands - Scheldt
- Romania - Buzau Ialomita
- Spain – Guadalquivir

The case studies overall cover a variety of policies in terms of objectives (cost recovery, incentive), design (e.g. tariffs, charges) and way of implementation. This variety better allows assessing the impacts of water policies implemented in order to identify good practices and to draw EU-level conclusions of practical implementation.

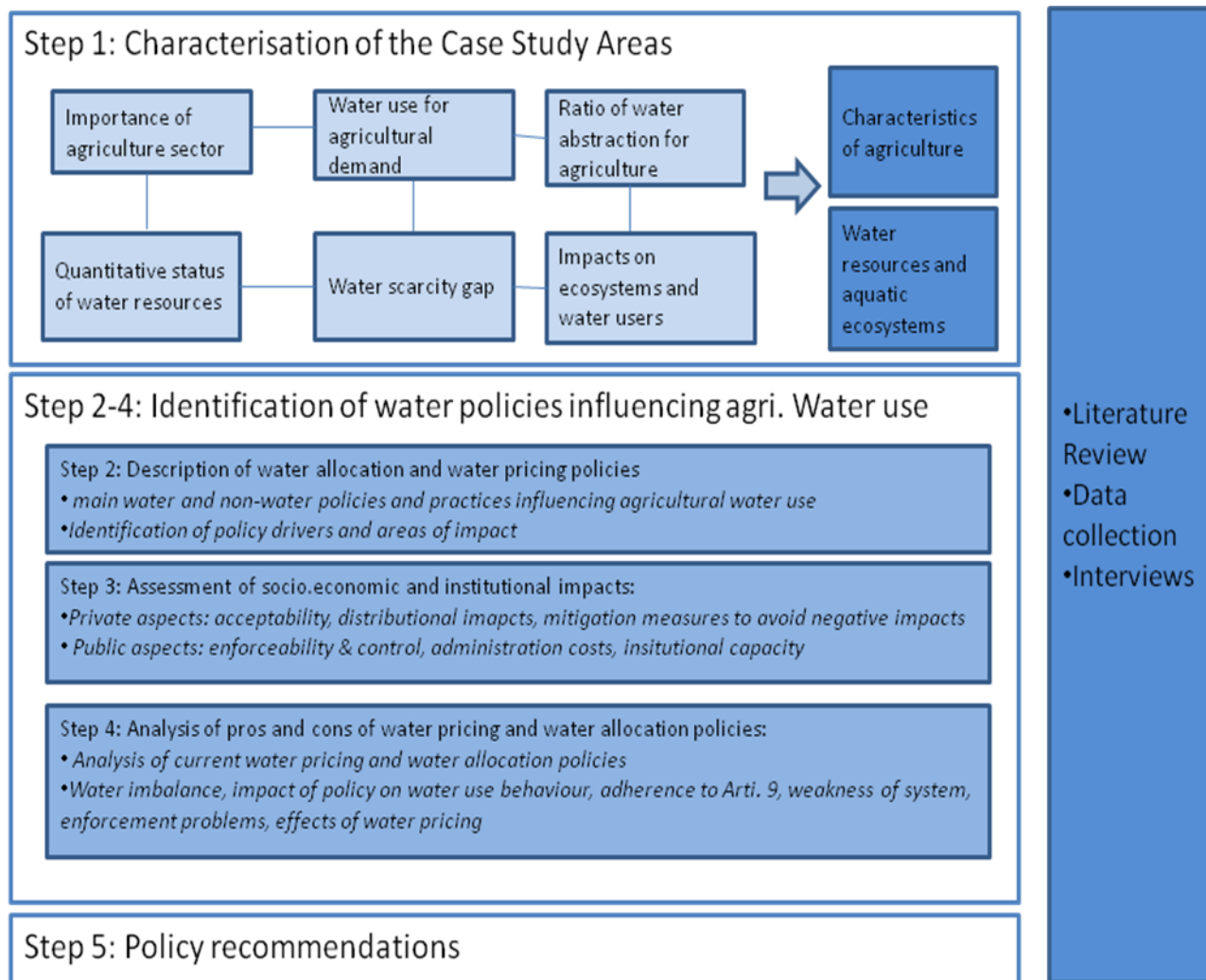
The case studies of Cyprus and France run in parallel with the project “Water Savings Potential in Agriculture in Europe”. The latter study provides information on the current situation in EU river basins as regards water abstracted, consumed and used for agriculture, and compiles conclusions from available studies to identify how water can be saved in agriculture. The project considers options to maximise water savings in agriculture in the EU, their water saving potential and the applicability of each option in EU river basins, especially in water scarce zones. Those solutions include techniques and practices to reduce water losses in agriculture, but also alternative solutions such as water reuse, storage or harvesting. Not all options necessarily save water as such, but reduce pressure on water bodies through reduced abstraction or moving abstraction to times where adverse impacts are lower.

One of the tasks of the study has been to analyse case studies in certain EU river basins, to gather in-depth knowledge about how water has been saved in current agricultural practices and what are the lessons learned. Case studies provide real-life information on the implementation of selected responses and their benefits. The study is conducted by Bio Intelligence Service, with its partners Cranfield University and Risk & Policy Analysts Ltd (RPA).

4.3 Case study methodology

The case study methodology takes a consistent approach to the analysis so that the findings are comparable. The approach is summarised in the following Diagram. Note that Step 5 Policy Recommendations will be covered in the last chapter.

Diagram 6 : Case study methodology and link with policy recommendations



The steps in this case study outline are briefly described below. They indicate which specific information needs to be collected from a range of sources. It should be clear that the depth of the analysis depends on the degree to which data are shared with the project partners.

Data collection started from a thorough literature and document review, consisting of existing reports, documents and databases at different scale (river basin, region, country), especially characterisation reports prepared for each river basin districts as part of Article 5 and RBMP reports, including information on trends collected in some cases for the development of the baseline scenario.

The information needs from the case study outline were translated into a 'Data collection guide' which was pre-filled per case study on the basis of the literature and document review. This survey was sent to the key

contact at the water administration in order to get specific information and to fill the gaps in the data. The contact had the choice to either fill in details on specific issues or to send policy documents/reports/statistics available for screening by the project partners. This was complemented by telephone interviews with relevant contacts where required. Not all River Basins have been in the possibility to provide the same level and type of information. Information on water pricing and allocation policies in agriculture has been rather limited for the Netherlands, Mexico and France, where the analysis has primarily been based on literature screening. **The next chapters (4.4 to 4.8) present the analysis of the different selected case studies.** The case studies have been submitted to the RB authority in order to provide comments or to approve them. The description of each of the cases includes the following steps:

Step 1. Characterisation of the case study

The information collected in Step 1 is used to characterise the main water abstractors in the system, their economic importance, the link to the hydro-system in terms of abstraction and recharge, the hydro-systems in terms of flows, the land use patterns, the ecological status and connection to and importance of ecosystems/wetlands. Furthermore, it describes the main economic impacts of water pricing.

Where data are available, specific attention is given to the spatial variability of indicators within a year or a season, in particular when describing the quantitative status of water resources⁴⁸. The interaction between surface water and groundwater and between water bodies and connected ecosystems such as wetlands also needs specific consideration. These will be important when investigating the environmental impacts of water pricing.

Step 2. Identification of current water policies and practices influencing water use

In this step, the main water and non-water policies are presented as well as practices influencing agricultural water use (in place, or proposed in the short-medium term) along with a clear identification of their policy drivers and areas of impact. This also allows to understand the preconditions (historic evolution of water pricing policy) why the water pricing and water allocation policies have been as they are now. This identification includes water rights, as understanding them is crucial in order to understand why certain pricing mechanisms do or do not work.

Step 3. Assessment of socio-economic and institutional impacts

This step focuses on both private aspects/costs and public costs or issues related to the institutional context.

Private issues include e.g. acceptability, distributional impacts, mitigation measures to avoid negative impacts or specific consequences at the farm level (e.g. small-scale farmers). Public issues relate to e.g. enforceability & control, administration costs or institutional capacity.

⁴⁸ Indeed, the average annual river flow might not indicate much in terms of quantitative status since most abstractions occur during the summer period with limited rainfall.

Step 4. Analysis of pros and cons of water pricing and water allocation policy in place

This step analyses the current water pricing and water allocation policy in place. Drivers and Barriers are considered, with parameters to be evaluated such as the performance of the water price system (efficiency, cost recovery), the main weaknesses of the current system (e.g. low enforceability capacity, lack of metering devices, lack of monitoring), acceptance of the current system by the farmers (e.g. link between farm advisory services and farmers, impact on income, ability to adapt production)

The outcome the water pricing policy on the socio, economic and environmental situation of the case study area is evaluated to a degree where information is available. Potential effects a water pricing policy may include direct effects (in terms of effect on water use) as well as indirect effects (demand responses of users to water prices e.g. impact on farm income, illegal abstraction).

4.4 CASE STUDY: MURRAY-DARLING BASIN IN AUSTRALIA

4.4.1 Characterisation

The Murray-Darling Basin is located in the south-east of Australia and is the catchment for the Murray and Darling Rivers and their many tributaries. The climate of the Murray-Darling Basin is relatively dry compared to other regions of Australia. In the last decade, together with a climate that became drier, the water use increased exponentially in the Murray Darling Basin. According to Cullen (2007) the long term inflow should be at 10.5 billion m³, where it was only 4.3 billion m³ on average in the period 2001-2007. The water use from consumption reduced the annual stream flow in the Murray mouth by 61 per cent during 2007 and 2008. This meant that the river stopped flowing through the mouth 40 per cent of the time during this period. This resulted in a decrease of water availability in the basin affecting the Basin's natural balance and ecosystems, resulting in severe land degradation and salinisation of the land.

The irrigators in the Murray-Darling Basin times were also affected by this drop in water availability. During the last decade the economic performance of the agricultural sector in the basin declined, mainly because of the drought. This meant a lowering of their yearly income and a decline in the amount of people they employ. The basin's area is important for Australia's agriculture and accounts for about 40 per cent of Australia's total gross value of agricultural production. About 1 million ha or 10% of the total surface of the Basin is irrigated. The irrigators use on average 4,000 m³ water per ha. The biggest users of water per ha are the fruit trees, nut trees and other berry fruits with 5,700 m³ per hectare. They are followed closely by the cotton farms, which use 5,600 m³ per hectare. The cotton farms also use the largest total volume of water. Other crops that need a lot of water per hectare are the vegetables for human consumption, grapevines and plants used for decoration. Other crops under irrigation are sugar cane, rice and different pastor and cereal crops.

In total the agricultural sector uses 3.6 billion m³ surface water per year or 83% of all the surface water used. Besides this surface water, which makes up only about half of their water use, they also use groundwater (27%) and water captured from their own dams, rivers or lakes (26%).

4.4.2 Water allocation policy in the agricultural sector

The Australian water policy went through lots of reforms in the last couple of decades. Currently a water trading system is in place. With the water trading system the government came up with a way to allocate water where it has the highest economic value. The water trading system has some innovative features like unbundling the management of the entitlements, the licences and the allocations, licensing water shares instead of vast volumes, setting the goal of full costs recovery, reducing transaction costs to a minimum, different levels of security entitlements, ... The unbundling of the water rights, the water licences and the water allocations means that three different authorities are responsible for each of the steps an irrigator has got to go through to get water.

The allocations are done seasonally and are based on the available water in the dams. Water entitlements are mandatory for all users and no new ones are given anymore. New irrigators need to get their water

entitlements on the water market. The trading system has proved to be useful in times of drought in allocating the water to where it has the most value. During the drought of 2007-08 this meant a flow of water entitlements went from the dairy producers and the rice producers to the horticulturalists. Horticulturalists need water for their long-lived assets, whereas the dairy producers needed the extra money to buy fodder for their cattle.

This appears to be an efficient, progressive system on paper but the creation of a new basin plan, that is now in process, proves that the system is not flawless yet. Especially the over-allocation of the available water is a problem. The amount of water that is set aside for environmental purposes is too limited. The problem is that too much water rights have been distributed, not leaving enough water for the health of the ecosystem. In a system where everybody is given rights without the possibility of selling these rights, there will always be people who don't use all their rights. So these rights that are not called up on are an extra buffer for the ecosystem gets more water. Once trading comes in place, these same people will see an extra income in selling their abundant rights. So, all rights will be exercised and less water than before goes to the ecosystem.

To tackle the problem of over-allocation the government is buying back water rights from farmers. The system is controversially because of the negative effects on the local communities and because of not reaching its goals. The local communities were affected because the locals who sold their rights also moved away or stopped their agricultural business, leaving holes in the social system ('Swiss cheese effect'). It also resulted to be more difficult than expected in getting the farmers on board. Consequently, the amount of water rights that the government wanted to buy back was not reached.

4.4.3 Water pricing policy in the agricultural sector

The ownership structure and corporate form of water businesses varies across jurisdictions. Some are state government owned, others are private co-operatives or companies owned by irrigators. In the past, the operational costs of water supply schemes were heavily subsidised by the government. Now, farmers pay charges to the supply scheme operator that minimum cover the costs.

The States in the MDB committed to "lower bound pricing". This means that the water price should minimum cover the operation, storage, maintenance and supply costs – but not include a commercial return on the assets. The eventual goal is to move towards upper bound pricing. This is the level at which, to avoid monopoly rents, a water business should not recover more than the operational, maintenance and administrative costs, externalities, taxes or tax equivalent regimes, provision for the cost of asset consumption and cost of capital. The way water charges are set varies across the states. Some rural water businesses are not yet at the lower bound of full cost recovery, and many are not yet on a path towards the upper bound.

When water is traded as a commodity, the value (price) of water is set in the market, determined by the consumers' willingness to pay. This willingness to pay differs from season to season and from the source of the water. Some pools have a higher water security than others, and so irrigators are willing to pay higher prices for them.

4.4.4 Conclusions

Severe droughts and high water use have severely affected the Australian irrigators and the ecological state of the basin. Water is allocated on a seasonally basis to the holders of water entitlements, which are for sale on the water trading market. Water trading is an instrument that shifts water from agricultural sectors where it has a low added value to sectors where it has a high added value. A downside of the current system is that it didn't take the necessary environmental flows enough into account. There was an over-allocation of water rights. Therefore, water entitlements are being bought back from the irrigators by the government. This process will continue in the future with the new basin plan that is being set up, although the buy-back programme also has negative effects and wasn't as successful as hoped. The Australian government will have to come up with a plan that suits both the environment, the community as the economy in the basin.

4.5 CASE STUDY: CYPRUS

4.5.1 Characterisation

In Cyprus, water shortages in the summer months are standard, and droughts are one of the matters of highest importance, as surface water availability changes significantly from year to year. Due to this fluctuation, the figures regarding average yearly available water supply do not accurately represent the water situation in Cyprus, and to specify an average "scarcity gap" is not possible.

Due to the varying availability of surface water, both the sources for agricultural water abstraction as well as the amount consumed vary from year to year. Yearly water needs of agricultural activity sum up to an average of 178.5 Mm³; however, as this demand is rarely satisfied, the actual water consumption in agriculture varies accordingly (around 150 Mm³/year), representing around 60% of Cyprus' water consumption. Of the approximately 150 Mm³/year, around 132 Mm³/year are used by irrigated agriculture. Irrigated agriculture represents a share of around 28% of the total area under crops.

The crops under permanent irrigation in Cyprus are: Citrus (27% of water consumption), Olives (20.2% of water consumption), other deciduous crops (13.5% of water consumption); and avocado, bananas, walnut, fig, grape and pistachio. The crops under seasonal irrigation are: potatoes (10.8% of water consumption), forage crops (7.9% of water consumption); and vegetables, melon, legume, greenhouse crops and strawberries. The major non-irrigated crops are wheat, carobs and other forage crops.

4.5.2 Water Pricing in the agricultural sector

Water pricing in the agricultural sector - as well as the domestic - has a long tradition on Cyprus, reaching back to the operation of the first Government Water Projects (GWP) in the 1960ies. The underlying aim of the pricing schemes then was the recovery of the project's costs, which were in part financed through loans provided by the International Bank of Reconstruction & Development (IBRD) and other financing institutions. Accordingly, the price levels were calculated based on the terms included in the Loan Agreements between the Government of the Republic of Cyprus and the IBRD. From the beginning on, the pricing schemes on

Cyprus were designed on a volumetric basis. The calculated prices are recorded to have led to a “considerable recovery of the project’s costs” (Hadjipanteli 2011a).

Due to socio-economic considerations regarding domestic food security, preservation of rural landscapes, avoidance of unemployment and urbanisation trends, prices of irrigation water were subsidised. Prices were also differentiated from GWP to GWP, because they were applied as soon as each project began operating (Iacovides 2005; Hadjipanteli 2011a).

In 2004, following the final payment of the IBRD loans and Cyprus’ accession to the European Union, a new tariff system incorporating considerably higher prices was introduced, implementing also European legislative demands such as the principles laid out in the WFD. In the irrigation sector, a mayor goal was then to provide irrigation water at an equal price level in all GWP, which was realised after a three-year adjustment period, in 2006 (MoA 2010).

Regarding further provisions of the WFD, especially concerning Art. 9, the Government of Cyprus is momentarily in the process of revising the pricing policies both in the agricultural as well as the domestic sector, to include new concepts such as the polluter-pays principle, and adequate cost recovery including environmental and resource costs into the pricing structure (Hadjipanteli 2011).

The present prices for agricultural water in Cyprus range between 0.05 €/m³ (price for Irrigation Organisations for agricultural production and tertiary treated effluent) to 0.56 €/m³ (overconsumption charge for exceeding the annual allocated quantity per field); the average, normal price is 0.17 €/m³.

4.5.3 Conclusions

Agricultural water use in Cyprus is heavily influenced by the strongly distinguished Mediterranean climate, represented by cool and rainy winters, and hot and dry summers. Agricultural production is dependent on the replenishment of water resources through rainfall, and on the careful use of water resources. Similarly, farmer’s decisions regarding production and cropping pattern are strongly influenced by the varying water availability. Bearing this in mind, the Government of the Republic of Cyprus very early launched water supply and demand management schemes, to provide secure water supply for both the agricultural as well as the domestic sector.

Water pricing on a volumetric basis has been part of the demand side management strategies from the beginning onwards, but the focus of the pricing schemes has been put more on financial cost recovery issues (as agreed in the loan agreements between IBRD and the Government of the Republic of Cyprus) than on giving incentives to save water.

The pricing scheme is flanked by a water allocation mechanism that gives priority of water usage to other sectors than irrigation. The water allocation process at the same time sets limits on the yearly water use by each farmer, at least as the water provided through GWP is concerned, and imposes quite substantial overconsumption charges based on the individual farmer’s allocated amount of water.

The impact on agricultural water use of both the water pricing scheme and the water allocation mechanism has to be examined considering the background of this information: farmer’s decisions regarding agricultural

production (and therefore water use) are strongly dependent on water availability; the focus of the pricing schemes lies more on cost recovery than on water saving; the allocation mechanism sets limits on water use (from GWP), and establishes use limits before an overconsumption penalty is charged, but without effectively excluding the possibility to switch to other water sources (this is primarily achieved by the presently inferior quality of the groundwater aquifers due to overconsumption). Additionally, the current prices of water are relatively low, representing only a small share in the total production costs a farmer faces; and switching to other sources of water (i. e. groundwater) is possible (with restrictions regarding quality of groundwater), as control and enforcement mechanisms are quite weak, and stricter restrictions and the re-issuing of licenses are currently being implemented.

Therefore, it has to be stated that the current water pricing policy in Cyprus has a lesser impact on agricultural water use than the technical measures installed in most irrigation systems.

At the same time, the water pricing system in Cyprus presents some significant strengths, regarding its organisation and technical sophistication: volumetric water pricing is established since the first GWP started operating, and metering devices are installed and controlled throughout the GWP areas. The general acceptance of the pricing systems is very high, as well as the awareness of the importance of general water saving. Hence, there is great still potential for improving the water situation in Cyprus through changes in the pricing scheme and the general water management with regard to water saving.

First, the water prices for agricultural use are low, and have a small share of overall agricultural production costs. Thus, the potential for increasing prices at least to 0.21 – 0.25 €/m³ without causing negative serious impacts in the agricultural sector is given, as official sources confirm (MoA 2010/WDD 2011b). The effect of higher water prices, however, depends heavily on the access of farmers to alternative sources, and the still unexploited potential for further water savings (mostly through non-technological demand-side measures like change of cropping pattern etc.).

According to Zoumides/Zachariadis (2009), the water prices are relatively low partly due to the fear that water users will switch to alternative supply sources (groundwater) the moment prices increase. Thus, the legislation and new regulations currently being implemented to revise the groundwater abstraction permits should be seriously pursued, with the aim of restricting and controlling the easily available access to groundwater sources. At the same time, controlling and enforcement mechanisms should be strengthened as well.

With regard to the low share of water costs in relation to other agricultural input factors, it should be noted that the figures presented (demonstrating the low share of water costs) provide an average of costs from fields irrigated both from GWP and private boreholes. That means that the low abstraction costs from groundwater extraction are included in the water prices; higher groundwater abstraction costs, or restricted access to groundwater sources would probably change the figures in the table significantly, and influencing farmer's production decisions to grow less water intensive crops, or invest in water saving technologies.

The latter, however, are already in a very advanced state in Cyprus, and future water savings can probably be realised more effectively through a change in the cropping pattern, rather than investing in new water saving technologies.

4.6 CASE STUDY: FRANCE – ADOUR-GARONNE

4.6.1 Characterisation

Average annual abstractions for irrigation (2002-2009) in the total Adour-Garonne RB are 940 Mm³. Surface water abstractions dominate in the entire RB with nearly 60% of the abstractions (17% from dam reservoirs or retenues). 35% of the abstractions are from phreatic groundwater and only 7% of the abstracted volume comes from deep groundwater bodies. The share of these sources remains fairly stable over the years.

Since 1996, Adour-Garonne RB has taken action to cope with water shortages in dry periods by installing or guaranteeing water reserves that can be mobilised to fulfill minimum low-water flow levels. These additional reserves are still insufficient to cover demand in dry periods and an average deficit of roughly 250 million m³ persists, compared to total allocation or authorised abstractions. If compared to maximum total abstractions, there has been a deficit of 150 Mm³ over the past decade. This difference is due to the fact that in certain regions farmers do not abstract their full quota.

Total cultivated agricultural area in Adour-Garonne RB is 1.9 million ha. More than one third of this area (650,000 ha) is irrigated land and two thirds of the irrigated crops (area) are maize cultures. Irrigated land in Adour-Garonne is 12% of total utilisable agricultural area. This maize production and irrigated agriculture in general is a significant portion of the total figure for France (40%), while agricultural area in Adour-Garonne is only covering 20% of total agricultural area in France. Over the past decade, the irrigated area has decreased by more than 10% compared to 2000 (DRAAF, 2010).

The decrease in irrigated area is mainly due to the decline in surfaces with maize cultures. Decline in irrigated area is a rather recent phenomenon, since irrigated land showed a gradual increase for multiple decades. Since early 2000, more than 15,000 ha of irrigated area disappeared in the Aquitaine region. This is only partly explained by retiring small-scale farmers where exploitations are hardly economically viable. The crop pattern was also changing and more than half of the lost irrigated area has now been transformed to less water demanding crops (still cereals). The ratio irrigated area to irrigable area (+/-75%) in Aquitaine remains however at a very high level. The ratio is 50% in the rest of France. Irrigated land compared to total agricultural land (i.e. including grassland etc.) is 20% in Aquitaine whereas this is limited to 10% for France at a national scale.

4.6.2 Water allocation

The conditions under which users can abstract surface and groundwater resources and the procedure by which the Prefects (Préfets départementaux, who are the local State representatives) grant (water) use rights are stipulated in the (new) French Water Law of 2006. When an authorisation is demanded, the decision to grant it or not is made after an investigation for assessing the potential impacts of the project and consulting the population concerned. The authorisation is granted for a defined duration and maximum volume and is not final. It can be withdrawn or modified with a stricter purpose, without allowance, should there be a risk for public health (drinking water), safety (floods) or aquatic environments. Any authorisation given for water abstraction can be temporarily or permanently revoked or reduced by the Prefects in case of water scarcity,

as required to ensure adequate environmental protection and/or domestic water consumption. Abstraction rules are more stringent in some areas qualified nationally as suffering of chronic water shortage (ZRE, Zones de Répartition d'Eau) . Abstractions in these zones require an authorisation above the threshold value of 8 m³/h instead of 80 m³/h.

The enactment of the 2006 Water Law (LEMA) stipulated that the Prefects could establish zones in which the authorisation for water extraction is given (multi-annual quota) to one actor ("organisme unique") that will further manage allocation to farmers. Quota are based on statistical availability of water to guarantee 8 on 10 years availability of water resources. The implementation of the allocation through organismes uniques is obligatory in water deficit areas (ZRE) and possible outside ZREs and aims to adapt water demand to the availability. The system will normally be operational from 2012 but is / was subject of strong opposition from farmers. It is assumed that the mechanism would be able to reduce abstractions for irrigation by 12% (without new capacity) with large regional differences.

4.6.3 Water pricing

The French Water Law of 2006 defines the framework to determine charges that can be levied for water consumption by the 6 water agencies. In general, water charges across all irrigation units in France have been increasing over time. Water agencies charge all users, independently of the type of supply, a water tax inspired in the polluter / user pays principle. Abstraction volumes below 7,000 m³ (annually) are exempted from the tax. The objective of the "water abstraction tax" is to encourage water saving and the tax base is abstracted volume over the year. The rate is modulated according to the economic value of water depending on its use (irrigation, drinking water, industrial cooling, feeding of a canal, etc.) and according to water resource scarcity (abstraction from a balanced or unbalanced zone). Over the 2009 irrigation campaign, the average abstraction tax was 0.7 c€/m³ in the entire Adour-Garonne RB. This tax ranges from 0.4 c€/m³ in coastal areas (lower rate for groundwater abstractions in sand lands of the Landes) to 0.8 c€/m³ in the Garonne (sub-)basin (soutien d'étiage). The water abstraction tax is only a modest fraction of the irrigation water cost . Agriculture has a small contribution of Water agencies tax revenue in France: 3,6% for abstraction tax and 0,5% for pollution tax.

For collective system there is a price to be paid to the provider (canal de provence, CACG, ASA...). Remarkable differences in tariff structures and levels occur even within one basin (OECD, 2010). Two-part or binomial tariffs (mixed tariffs) and area-based tariffs appear to be widespread in collective irrigation systems in France. Regarding the tarification policy of collective systems, it is argued that, independent of the mechanism in place, the primary objective appears to be cost recovery and secondly the redistribution of the costs incurred to the different users. These costs are highly variable in time and between systems, depending on the investment cost of the network, age and financing costs (loan payments). Examples of water tariff levels often range between 0.10 and 0.15 €/m³.

According to OECD (2010), water pricing policies in France have been geared towards cost recovery objectives. Cost recovery for operational and maintenance costs is assumed to be close to 100% for both self-supply (energy, maintenance) and collective systems. No details could be identified on the estimated

level of environmental and resource costs related to agriculture. It appears that there are large capital cost differences across basins and irrigated areas, creating a large range of capital costs recovery, between 15% and 60%. The Adour-Garonne Water Agency has a long history of financial support for investments in (dam) reservoirs. The number of reservoirs in Adour-Garonne RB for water abstractions for irrigation is estimated at +/- 15,000 (300 Mm³). Since 2003, subsidies are only granted to investments in 'substitution' reservoirs, on condition that these are identified in the low water management plan (PGE) and managed collectively at subcatchment level.

4.6.4 Conclusion

On an annual basis, the Adour-Garonne River Basin has abundant water resources due to high rainfall mainly in winter time. Total water abstractions are modest compared to the total annual availability but in low-water periods and at certain locations there is persistent imbalance between demand (during low-water periods +/- 85% for irrigation purposes) and minimum (river) flows. Adour-Garonne RB has the largest share of irrigated agriculture in France. Cultivations that are most dependant of irrigation are maize, fruit and vegetable crops.

Current policy focuses on managing scarce water resources through a mix of demand side and supply side measures: planning instruments (low-water management plans (PGE) and Zones de répartition d'eau (ZRE)), promotion of rational water use, creation of additional water resources (basins). PGE and ZRE evaluate the availability of resources (state) and try to establish long-term equilibrium between supply and demand basically by stricter policy on water abstractions (allocation). Stakeholder participation and consultation between different water users are key features in the planning. The Water Law 2006 foresees the obligation to designate the allocation of water for agricultural uses (multi-annual basis) in certain areas to an organisme unique but the system has not found its entry yet (2012). Strong opposition from farmer's organisations stem from significant reductions of allocated volumes in several parts of the RB.

Water pricing has been installed through the Water Agency abstraction tax (polluter pays) and by collective systems (ASA, CACG) supplying water for irrigation (financial cost recovery). Water Agency abstraction taxes can be differentiated in water stressed areas or where support systems for low-water periods are installed. The level of this tax is too low to provide incentives for sustainable water use (some percentages of total irrigation cost; this tax is the only water tariff for the important share of individual abstractors in AG). Farmers (even in neighboring) collective systems can face very different water tariffs both in level e.g. depending on the modernisation of the irrigation infrastructure and thus capital costs and tariff structure leading to different or no incentives to water savings.

The annual water deficit has been reduced by more than 50% the past two decades. Several factors have contributed to this evolution: water quantity management (e.g. PGEs), stabilisation or slight decrease of irrigated area, water savings, ... The most important factor however seems to be the significant growth in the number of barrages and (dam) reservoirs that support low-water levels or provide irrigation water. The policy of subsidised reservoirs has been severely criticised by several stakeholders (mainly environmental organisations) as farmers tend to be the most important beneficiaries (increased yields, special crops) while

the investment is heavily supported through public funding of the Water Agency. Moreover, these organisations further refer to the water demanding cultivation of maize made possible through these reservoirs and the overall environmental pressures: soil degradation and use of fertilisers and pesticides associated with large (maize) cultivations and dams as migration barriers for fish.

The rather limited impact of current (pricing) policy towards sustainable water use is illustrated by the decreasing trend of irrigated area since 2000 which has not been followed by a decreasing demand for irrigation water. Farmers tend to reduce the irrigated area but apply the same water volume to the remaining water intensive crops. These farmer's decisions have been driven by high cereal prices (maize), long-term contracts and associated capital investments and the lack of alternative crops generating sufficient and reliable income. Alternative crop choices and associated water savings have not been stimulated by current pricing and allocation policy. While irrigation cost is about 20% of total production costs, it appears that farmer's decisions are not changing under current policy. Energy costs and own investment costs together with output prices and resource availability (allocation) are more visible for farmers and significant evolution thereof is more likely to lead to changing decisions.

4.7 CASE STUDY: MEXICO

4.7.1 Characterisation

The Lerma-Chapala basin is located in the central/western part of Mexico and covers five different states. The climate is semi-arid to sub-humid, with rainy summers. It is one of the world's most stressed basins. On the one hand the water is highly polluted because of the lack of a good sewage treatment system, the industry and the sediment run-off; and on the other hand there is a water shortage because of the increase in population, industry and agriculture in the surroundings of the basin.

The Lerma-Chapala basin accounts for about 11.5% of the national gross product, or 142.6 million EUR in 2006. The economic activities in the area of the river basin are diverse, ranging from agriculture to beverages, pulp and paper, leather goods and (petro)chemical products. Seasonal agriculture uses up 37% of the basin's surface area, followed by irrigated agriculture with 20% of the surface. The irrigated agriculture (about 830,000 ha) is the main user of water. About 415,000 ha are provided with surface water and around 380,000 ha are irrigated with groundwater, with an estimated 3.4 billion m³ water use per year.

The agricultural sector consists mainly in the cultivating of maize, sorghum, wheat, barley and garbanzo. Corn is the main crop in the basin, as well for rain fed agriculture as for irrigated agriculture. The average efficiency rate for agricultural water use is estimated at only 35%, what is quite low. However, in the upper part of the basin, where the restrictions are higher, the efficiency rates tend to be better.

In the basin there are 8 Irrigation Districts (DRs) and 16.000 Irrigation Units (UR). Nearly 52% of all reservoirs are presently dedicated to irrigation districts and units. The water resource management in Mexico is under federal jurisdiction, with the National Water Commission ("CONAGUA"). The National Water Commission is a decentralised, administrative, normative and technical agency of the Ministry of the

Environment and Natural Resources (SEMARNAT). This agency is responsible for water policy, granting water concessions, standards for water quality, collecting water taxes and water investment programmes. Many attempts have been made to improve the water governance in the Lerma-Chapala Basin, such as irrigation management transfer, stakeholder participation and allocation mechanisms. Those are the key elements of the so-called integrated water resource management (IRWM). Mexico gained international recognition for its efforts in the water policy area. In practice however, the basin isn't doing very well, mainly because of a lack of control and enforcement. The National Water Commission established Water User Associations ('COTAS') and made them responsible for irrigation management. The COTAS are structured following the divisions in irrigation districts and irrigation units. There are 45 COTAS in the Lerma-Chapala Basin.

4.7.2 Water allocation policy in the agricultural sector

Each November, the National Water Commission in Mexico decides how much surface water will be allocated the next year to each district. This is based on scientific data (i.e. water levels in the dams and lake, precipitation forecasts based on the last year's rainfall, surface runoff) and negotiations with the irrigation districts, which communicate to the Commission how much water they want. The allocation of next year's water based on last year's rainfall, leaves however room for over-allocation. When a wet year is followed by a dry year, this allocation system makes things even worse. Following the district allocation, negotiations take place internally to allocated water to the sub-irrigation units. This allocation is top-down and based on how far the modules are located from the dam, the amount of surface and the irrigation calendars. Each district develops a yearly irrigation plan where members (farmers) decide together which crops to grow next year based on the water allocation. Groundwater abstraction is allowed with a permit that specifies the annual volume allowed, which is based on the discharge of the well and the irrigated area. Licenses can last between 5-10 years. In theory this is a great system but in practice, again it doesn't meet up to expectations.

The use of surface water is exceeding the supply (river runoff) in all but the wettest years. The water scarcity gap between the available surface water and the demand for it, is believed to be between 1.6 and 1.8 billion m³ per year. As the groundwater aquifers are also overexploited, with about 1,200 – 1,300 million m³ per year, this gap is actually an underestimation. The overexploitation is a rough estimation as there are a lot of illegal wells and it is thought that even the legal ones extract more water than allowed. As a consequence, water sometimes stops flowing in certain parts of the River Lerma ('basin closure').

The main source of the water problem in the Lerma-Chapala basin is the lack of control on the amount of water extracted. There is hardly any water metering in the basin. Inspections are carried out but there are too few for the amount of landowners in the region. In Guanajuato alone there are over 25,000 little landowners. The government hoped to counter the problem by installing the COTAS with the intention of self-regulation. These water user associations didn't get any actual legal power, hence they were powerless to make a

difference. Any water restrictions are not followed by the farmers and any effect of more efficient irrigation techniques goes lost in expanding the irrigated area. When the government wants to decrease water use, farmers protest against it.

4.7.3 Water pricing policy in the agricultural sector

The water pricing policy in the basin does favourise the agricultural sector. Every year a license fee is to be paid. The agricultural sector however, does not have to pay this annual fee, in contrast to cities and other industrial sectors. Water charges are not paid either by the agricultural sector. Not for surface water and not for groundwater. The service fee that agriculturists pay for supplying the water, is 75% funded by the government. In contrast, the households (cities) and municipalities do pay for water rights and water charges for surface water. According to an OECD study the average domestic water price in Mexico is 0.36 EUR/m³. The only pricing policy that limits the water use of the agricultural sector is the price for electricity, necessary to pump the water up or around. In December 2002 the Rural Energy Law raised the prices for energy use. Farmers with a valid groundwater concession could get their energy at a lower tariff but their use (in kWh/year) was limited per well. Once above this limit another a higher tariff is in place. The law has reduced the water use a bit but again the lack of enforcement and rent-seeking surrounding the granting of water concessions limits the success of it.

The water businesses in Mexico don't manage to cover their costs and need subsidies from governments to do the necessary investments. It is not sure if they want to move to a scenario where costs are completely recovered. Tariffs differ from town to town, resulting in very divers levels and structures of tariffs.

The water policy has no real effects on the irrigators, as the policy itself fails to limit the water use or cover the costs. The only effects on the agricultural community are the effects of the decrease in water availability. Richer farmers pump up groundwater when surface water is scarce. The poorer farmers however, rely mainly on surface water and don't have the money to pay the electricity price for pumping up groundwater. They usually sell their land when groundwater aquifers have dropped too low and emigrate to the cities or to the USA.

Today, the transition of water management from the government to the states and the water users, is still in progress. Huge projects for transferring water from neighbouring basins are also underway for some smaller cities, while Guadalajara is expected to bring water from a farther source in the Santiago basin. According to the OECD (2011) the situation has improved recently because of the implementation of the integrated water resource management framework. The creation of a separate agency for the Lerma-Chapala Basin and a basin plan, together with the decentralisation of the institutional power and the stakeholder participation, improved the water use in the basin and hence the hydrological state of the basin. As a consequence the water levels in the lake Chapala are rising, the water quality has improved and the irrigation is done more efficient.

In Mexico lots of water reforms have been implemented by the book but in practice didn't have the estimated effects. There is a lack of enforcement, resulting in a situation where both surface water and groundwater systems are in danger.

4.8 CASE STUDY: NETHERLANDS

4.8.1 Characterisation

There is little quantitative information on water abstractions from or water use for agriculture in the Scheldt Basin. Most farmers use a combination of surface water and groundwater in a normal year (1.2 out of 1.6 Mm³ water in 2005). In the dry year 2003, this figure amounted up to 5.5 Mm³. At this time, groundwater was more frequently used than surface water but a large part of farmers still relies in the combination of both. Irrigation water demand varies thus significantly with climatic conditions. Arable farming (traditional cultures with limited irrigation water demands in the Netherlands) still predominate in many areas of the Southwestern Delta (broader than the Scheldt Basin). Other agricultural exploitations are however more dependent on the availability of (high quality) freshwater, i.e. horticulture (bulbfarming, chicory), fruit farming or glass house farming.

Water use in agriculture is low in terms of abstracted volumes. The availability of freshwater (supply) in the Scheldt Basin (and Southwestern Delta by extension) is however an ongoing concern. The chloride content in both groundwater and surface water bodies does not allow farmers to rely on important water abstractions for agricultural purposes. The water volume that is mobilised in order to make farming or crop choices in certain areas possible is high compared to the actual water use in e.g. irrigation. Freshwater for irrigation is for example supplied from lake Volkerak-Zoom. The threat of salinisation and the feasibility of the freshwater 'guaranteeing' (flushing of surface water bodies, mainly for agricultural purposes) is subject of an on-going debate in Dutch Water management because of both high costs and environmental concerns (blue algae). The lake Volkerak-Zoom (gravity fed (canal) distribution system for irrigation in certain areas) will most likely be salinated again in the future, by restoring limited tidal dynamics. The area is as such considered as a test area for changed farming practices (salt tolerant crops, aquaculture, developments in freshwater savings or alternative supply, and closed loop systems for water use).

4.8.2 Water allocation

Rules for water abstractions can differ significantly between regions, due to the availability of water and water quantity management in general. With the new Water Law (2009), nearly all groundwater water abstractions for agriculture require notification to or a license from the Regional Water Authority (Water Board). Before 22 December 2009, the province was the competent authority. The province is still responsible for the strategic vision on groundwater management while Regional Water Authorities translate this vision to the operational context. Abstractions for certain activities (including irrigation) only require a

permit above a minimum threshold value for the pumping capacity. These values vary per Water Board. Due to the lack of freshwater resources, the province of Zeeland (largest share of Scheldt RB) applied strict rules for groundwater abstractions (location, pump capacity) which has now been continued in the policy of the Regional Water Authority Scheldestromen. The Water Boards are responsible for new groundwater abstractions, their registration and the control and enforcement of existing permits.

The Regional Water Authorities are also responsible for surface water abstractions. Rules are also different by region and depend on water quantity and quality targets. In practice, there are little restrictions with the exception of "protected regions" with a nature function. Surface water abstractions for agriculture in the Scheldt Basin are fairly limited because of the high chloride content. The Water Board Scheldestromen (area of the province of Zeeland) makes permits obligatory for abstractions with capacity larger than 15m³ per day. Bans on water abstractions are sometimes installed in times of water shortage (quantity or quality). The provincial ranking of water supply for several uses applies in times of shortage, and water withdrawals can be restricted (e.g. irrigation of capital intensive crops ranks higher than other agricultural use).

4.8.3 Water pricing

The current principles of water pricing have been in place for some time now. The pricing policy in the Netherlands is inspired by the cost recovery principle. All farmers pay a price for surface water (water levels and maintenance of watercourses and dams) to the regional Water Boards based upon the (total) land area (water system levy or "watersysteemheffing ongebouwd"). Farmers pay as such a per ha charge for surface water but not solely for surface water supply or availability. Charging has historically grown according to the interest-payment-say principle. The levy is covering water management activities like supply and drainage of water as a service for agriculture. The Regional Water Authorities relevant for the Scheldt RB installed tariffs in the range of 31.19 to 79.73 € per ha annually. High chloride contents of surface water resources limit the availability of water suited for irrigation or agricultural purposes. Freshwater from the lake Volkerak-Zoom can be used in certain areas of the Scheldt RB: Tholen, Reigerbergsche polder on Zuid-Beveland.

Groundwater abstractions can be subject to groundwater tax from the State and groundwater levy from the province (volumetric charges). Since January 2006, irrigation is exempted from the national groundwater tax if more than 90% of the abstracted volumes is destined for irrigation of plants (Stoof et al, 2006). Irrigation (and agriculture more general) is indirectly exempted from the (provincial) groundwater levy by installing threshold values (Matthei et al., 2009). In the province of Zeeland, groundwater abstractions below 20,000 m³ per year are exempted from the (provincial) groundwater levy. This levy has been called provincial levy as it is payable to the province and earmarked for its activities in groundwater management and drought-related research.

The Netherlands report a nearly 100% (financial) cost recovery for water services. Self-supply in the agricultural sector (both user and supplier of the water service) is important. The allocation to sectors and cost recovery in sectors requires assumptions, though van der Veeren et al. (2005) argues that there are no significant cross subsidies between sectors. The River Basin Management Plan does however not provide information on the total costs that should be allocated to agriculture nor prices paid by the sector.

4.8.4 Conclusions

The Netherlands have always been confronted with abundance of water resources. Moreover, large (and small-scale) damming projects created opportunities for agriculture and other human activities in areas like Zeeland and other regions in the West of the country. Natural hydrological processes however impose limits on agricultural practices as several areas are facing the threat of salinisation. This is particularly relevant for the Scheldt RB where (riverine) freshwater inflow is nearly non existing.

Water shortages have not been considered as a serious threat in the Netherlands. The agricultural landscape in the Scheldt RB does not entirely reflect the situation of limited availability of freshwater resources. One weakness of the current allocation system lies in the obligation of the State or Regional Water Authorities (i) to (artificially) provide freshwater (chloride content below norms) in certain locations and (ii) for (too) long periods. This has created an artificial situation where irrigated agriculture (horticulture, fruit farming or bulbs) is possible in certain areas where freshwater is not sufficiently available. The debate on the freshwater status of the lake Volkerak-Zoom demonstrates that certain (crop and location) choices allowed under current policy are likely to be unsustainable in the long term. It is of note that these crop choices are generally inspired by climatological characteristics (close to the sea), historical choices and soil conditions. Certain capital intensive crops (high production value) can apparently justify occasionally customised - more expensive - options for water supply, e.g. private supply, tank transport, on-farm storage,

Due to local conditions (proximity of cities, primary activities of Regional Water Authorities), prices for water (water systems levy) in agriculture appear to be independent of the service levels provided to farmers by the respective Regional Water Authorities. Current policy discussions on water supply / availability also include the fundamental decision whether water supply or freshwater availability in certain locations should remain a public responsibility, e.g. when considering the social cost-benefit perspective. This discussion is particularly relevant in the said areas where irrigated agriculture depends on access to freshwater guaranteed by regional water authorities, while farmers not necessarily pay a higher tariff thereto. Many research initiatives are broadening the knowledge on the way forward, but it can be assumed that future strategies will include measures for both resistance (flushing of water bodies, possibly more differentiated in space and time) and adaption (self-sufficiency and storage, water savings, private supply and related pricing, ...).

4.9 CASE STUDY: ROMANIA - BAZAU-IALOMITA

4.9.1 Characterisation

Romania covers almost a third of the Danube river basin surface area. The mean annual precipitation is between 400-800 mm in the main agriculture area. Droughts are not uncommon, with a severe drought occurrence every 15-25 years. The driest periods occur in two seasons: in the winter due to the cold and at the end of the summer and the autumn periods due to lack of precipitation. During dry periods in the warm season, precipitation might be absent for 50-100 days, and due to this persistence of the drought the some rivers become completely dry. Precipitation rates vary greatly, both spatially and temporally. In the rainy years precipitation can exceed 1000 mm in some regions of plain and hilly areas, while in the mountain areas values of more than 2400 mm per year might be found. On the other hand, in the dry years the annual quantities of precipitation may reduce up to 200 mm in the southern and eastern zones of Romania and 400-600mm in the southeastern areas of Romania, where the case study is located.

Romania is considered both a poor and rich in water resources; there is a significant different between theoretical and usable water resources. The long-term annual average of available freshwater amounts to a theoretical potential of 6380 m³/person, which is much higher than the European average. On the other hand, the actual usable water resource is around 1770 to 2660 m³/person, making Romania among the countries with relatively scarce usable water resources.. Despite this, Romania does not have any water scarcity issues. This is because there are a significant number of reservoirs throughout the country that provide most of the water used for abstraction. As such, the uneven distribution – in terms of time and space – has been balanced and redistributed through the hydro-works. Out of the around 11 billion m³ available in the reservoirs, only around 6.5 billion m³ is being used in total every year.

Land use is predominantly agriculture. Arable land accounts for 63.2% of agriculture lands. The main crops grown on arable land are cereals (69%), such as wheat and maize, and oilseeds (14.4%). The contribution of agriculture towards the national GDP is high compared to the EU average accounting for 12.1% GDP. Around 32% of the population is employed in agriculture and forestry.

Farm size is very small; the average Romanian farm is 3.37 ha with an average of 1 ha per parcel. As such, agricultural output/performance is poor due to low yields, low growth and global competition. From 1991-2000, the productivity of the main crops show strong fluctuation due to the high frequency of droughts, lack of modern agricultural equipment, high fragmentation of land property, prevalence of small farms, irrigation projects failing, land degradation increase and dramatic drop in fertiliser use.

Out of the original 3.1 million ha equipped for irrigation, only around 1.5 million ha is still possible to use. Investments in irrigation have been largely absent since 1990 with state budgets for land reclamation decreasing over time. As a result, much of the former irrigation infrastructure has fallen into disrepair. Following the elimination of electricity subsidies for pumping water in 2010, irrigation area has decreased significantly. At the moment only around 75,000 ha are being irrigation. Thus, irrigation represents a very minor role in overall water abstraction with less than 10% share of total water use. Currently, Romania is only using 40-50% of its water capacities in their reservoirs.

4.9.2 Water allocation

Water allocation is managed by the National Administration 'Apele Romane' and its regional branches. The National Administration "Apele Romane" (RWNA), initially formed in 1991, applies the national strategy and policy regarding qualitative and quantitative water management of water resources. Water allocation is controlled through water management permits, which set quantitative limits to water use. Under the Water Law, water management permits and water management licenses are mandatory for all water users, for work on or related to water, except for small household level works. Groundwater is not permitted for irrigation.

Surface water abstraction permits for irrigation are based on a total water balance calculated at river basin level. The water balance takes into account: precipitation rates, runoff, "minimum flow to ensure the life of aquatic ecosystems" and evapotranspiration against the potential water demand. As all water use requires a permit, permit applications from all water-using sectors are calculated together to estimate the basin's water demand. This is then balanced against the hydrological and climatic elements.

4.9.3 Water pricing

In addition to water allocation, the RWNA set the water prices in Romania. Water prices differ according to use, even within the agriculture sector itself, as shown in the table below. Water prices do not differ across river basins, although some basins have much higher costs than others due to water management infrastructure of the basin. As such, the uniform pricing involves redistribution of financial funds between basins.

Table 3 : Water prices in the agriculture sector

Agriculture sub-sector	Surface water	Groundwater
Livestock	11.9 €/1000m ³	13.69€/1000m ³
aquaculture	0.12 €/1000m ³	2.62 €/1000m ³
Irrigation	.71€/1000m ³	Not allowed

The economic instrument for irrigation is the "Water supply tariff for irrigation" (charged by NALR) and involves: (1) "the contribution for using the water resource" (NALR to Apele Romane), which includes water use and water discharge; and (2) all necessary costs for abstraction, pumping, transport. Water is largely abstracted from reservoirs collecting water from the Danube and inland rivers. The water tariff is volumetric and metering is in place to monitor water use. An important component in the water price is the electricity cost of pumping and transporting water from the reservoirs. Many of the farms using irrigation are located on terraces high above the water source. Depending on the height distance from the water source, the total cost of irrigation can fluctuate significantly. Taking into account the cost of electricity – the further one is from the source, the greater the electricity need - the total cost of irrigation can range from a minimum value of 2 €/1000 m³ (of which the water price is 35% of total cost) up to 247 €/m³ (of which water price is 0.28% of

total cost). Therefore, the greater the height distance, the lesser the water price plays a role in the overall cost of irrigation.

Previous to 2010, the costs of pumping for irrigation was heavily subsidised. In the past, electricity was subsidised at a high rate and even increased in the last years to encourage irrigation. From 2006-2008, electricity was subsidised at a rate of 26.7€/1000m³/water pumped. In 2009, this was increased to 105€/1000m³ water pumped. As the irrigated area never surpassed 300,000 ha since 2004, it was decided to eliminate the electricity subsidy; this has resulted in a significant decrease in the number of hectares irrigated in Romania of around 75%.

With respect to the polluter pays principle, users pay or “contribute” for disposing waste water. The price/contribution is based on a set of parameters: General (chemical indicators; specific chemical indicators; toxically and very toxic chemical indicators; bacteriological indicators physical indicators) discharged into water resource (Kg). These parameters are monitored by the Apele Romane and applied for all users including agriculture (for example, for phosphorus the contribution is 44.3Euro/1000 kg). The money collected from the pollution tax is used to cover the budget for monitoring and enforcement.

Cost recovery for the water management system is considered to be at 100% as the “contributions for using the water resource” (paid by the water resource users) cover the operational and maintenance costs of the water management infrastructure system (Dykes, dams, water intakes, river regulations), as well as capital costs and environmental and resource costs. Here, operation and maintenance costs refer only to the general water supply infrastructure and do not cover individual irrigation systems – such costs are covered by the NALR or WUOs. Capital costs of irrigation infrastructure are not covered as a) there are no plans to expand the irrigation system and b) such costs would be the responsibility of the NALR or WUOs. Environmental costs are covered by the pollution tax, whereas Romania considers itself to have no resource costs – that is, there are no opportunity costs because all water users theoretically have no restricts as water scarcity is not an issue. However, at the moment only internal environmental costs are taken into account and not externalities; the water authority plans to develop a methodology to include externalities into account in the 2nd river basin cycle.

4.9.4 Conclusions

Water resources in Romania are not hampered by significant water scarcity and droughts. Water allocation is based on maintaining a water balance within the country's reservoirs. As only around 45% of the total water available is used on a yearly basis, it is clear that the water allocation policy in Romania is achieving sustainable water use. At the moment, water savings does not play a significant role in irrigated agriculture as it represents such a small percentage of overall water use.

The recent change in water pricing with the elimination of the electricity subsidy has significantly impacted water use in the agriculture sector. Farmer behaviour is greatly affected by electricity prices and the lack of irrigation systems that are suitable for smaller farms. There have been no significant studies undertaken to determine whether farmers on smaller farms would be interested in irrigating if a more adequate/suitable irrigation system was in place. Only around ½ of the former irrigation system is usable due to a lack of

maintenance and repairs in the past. However, it can be assumed that there is not a high unmet demand for irrigation, as highlighted by the only moderate increase in irrigation following the increase in electricity subsidies from 2006 to 2009. However, since the elimination of the electricity subsidy in 2010, irrigated agriculture dropped by 75%. It unknowns, however, what impact this elimination in subsidies and subsequent reduction in water use has had in yields and on farmer income.

From the case study, it is clear that there are two major barriers to water use for irrigation in Romania: (1) lack of proper infrastructure and (2) high irrigation prices due to electricity costs. In order to give farmers the possible to irrigate crops in the future, especially considering the forecasts for increased droughts in the future, it is necessary to repair much of the existing irrigation system and to consider new designs given the change in farm structure since the beginning of the 1990s. Modernisation of the irrigation infrastructure would on the one hand allow for more irrigation and potentially higher yields but it would also reduce water leakages in the conveyance systems, thus ensuring that the current sustainable use of water does not become unsustainable in the future.

Given that is not likely that the electricity subsidy will be reintroduced, agriculture production will most likely shift away from the terraces in the south-eastern part of the country along the Danube towards more lowland areas. This can only be confirmed through future studies. To ensure the environmental sustainability of the agriculture sector as a whole, un-economical agriculture production, such as those taking place on terraces, should be eliminated. The potential to use former agriculture land that was abandoned in the past should be investigated to ensure that there is not a significant drop in agriculture production or in agriculture jobs, given its high importance with respect to national GDP and employment rates.

4.10 CASE STUDY: SPAIN – GUADALQUIVIR

4.10.1 Characterisation

The Guadalquivir is a closed basin in terms of existing over-allocation of available water resources. The main water user is agriculture (87%), in particular the (drip) irrigation of formerly dry land crops, such as olives, grain cereals and industrial crops which assigns a special responsibility to agriculture). Supply risks occur at the average inter-annual level and in particular during drought years and seasons; and no practical new water supply developments are feasible. Thus, the main problem of the basin is to ensure that demand adjusts to a limited (and probably shrinking) supply without continuing freshwater ecosystem deterioration.

The main crop type in the basin is olive (intensive and extensive), and despite its low water consumption per hectare, it is now the major water user in the basin. Other key crops are cotton, rice, extensive winter cereals, horticulture and citric. Agriculture is responsible for 5.5% of gross added value (GAV) and is very relevant for part of the associated industry and tertiary sector, in particular, agro-industry. According to the Guadalquivir dRBMP, the total consumptive water demand reaches 3,833 hm³/year (in 2007); up to 87% of this total demand (or 3,329 hm³/year) is dedicated to agricultural uses.

Approximately 2/3 of irrigation areas in the Guadalquivir are supplied with surface water and 1/3 with groundwater. The groundwater share in this basin is much larger than the 80/20 distribution at the National

level. According to the dRBMP, the increase of officially irrigated areas between 2009 and 2015 will be +34,571 hectares, with an overall water consumption of 73 hm³/year. This means an additional water consumption of agriculture by +2.4%.

4.10.2 Water allocation

Water allocation is crucial for agricultural, but also overall economic development; and over the last century a strong development of water infrastructure has been publicly supported, in particular for irrigation purposes. The current allocation scheme strengthens agriculture (as it is high ranked in water uses priorities), though in drought periods agriculture suffers the most severe cuts from allocation. Water allocation is a multi-level and multi-agency process which operates within different institutional frameworks at different spatial and temporal scales, with differences on a temporal scale.

Water rights are based on a permitting system (sistema concesional), whereby individuals or irrigation communities request and are granted water permits (concesiones) by the RBA that give them a right to use a certain volume of water for a specific purpose, in a specific location, for a maximum renewable period (currently of 75 years).

Water allocation to the agricultural sector is influenced by the water hierarchy ranking agriculture in third place after drinking supply and environmental flows, allocation under drought events, increased efficiency by irrigation techniques (i.e. drip irrigation) form modernisation investments, existing inter-basin transfers (Negratín-Almazora) and water markets through a permit exchange center and seasonal sales.

Current figures of non-authorized water usage in agriculture for the Guadalquivir basin are 3- 15%, and pro-irrigation trends have continued over the last decade even when no legal water sources have been available with a low level of closure of illegal takings.

4.10.3 Water pricing

Cost recovery is considered as a main criterion for water pricing, which take place at three levels: River Basin Authority (which charges a regulation levy and a water use tariff to compensate investment costs borne by the Administration as well as operation and conservation of those works), irrigation district (where the Irrigation Community charges to their members an apportionment for the costs incurred on its activities, including RBA charges); and on-farm.

Water pricing has been traditionally established as a mean to (partially) recover costs of the investment, operation and management of the infrastructure on a per-hectare basis, discouraging water efficiency and saving. Despite WFD, however, no significant advances towards cost recovery have been made. Average water prices in agriculture are estimated to be around 0.0262 €/m³. However, there are big differences between prices from groundwater and surface water provided by the RBA through Irrigation Communities.

Area-based tariffs are by far the most common (76%) structure in the Guadalquivir. This can explain by large the strong irrigator's requests for larger water allocations to their crops. Water-consumption based (11%) and

fix (1%) tariffs are being applied to a lesser extent. The pricing policy historically remained flat-rate on a per-hectare basis before the promotion of latter modernisation plans, which involved adoption of metering devices in order to implement volumetric tariffs progressively, though it is still a fixed part on the tariff to collect levies and tariffs from the RBA.

Subsidies in developing/modernising irrigation schemes are linked with theoretical reductions in water permits for 20% of water consumption and increased costs. Investment costs are partly assumed by the authorities. At basin-scale, certain services are excluded from cost-recovery from users, since their beneficiaries are not easily identifiable or are society in general (e.g. flood protection, etc.) and are recovered by general taxes. Cost recovery is not complete wherever infrastructure has been financed by EU funds. The dRBMP foresees price increases of 0.01 €/m³ for agrarian uses, although this will not cover the costs of the PoM.

The water pricing policy is influenced by differences between surface and groundwater availability, quality and price, determining crop choice and adoption of efficient irrigation technologies. Increased water metering is one of the aims of the water policy and obligation to meter exists, though it is recognised that illegal abstractions are being realised. The Guadalquivir RBA has personnel in charge (guardería fluvial) of visiting, metering and controlling the water abstraction and correct compliance with what it stated in the water use license. Nonetheless, monitoring of abstractions – in particular of groundwater – are weak and registration of groundwater abstraction rights is still incomplete.

Though there are most possibly tens of thousands of illegal water abstractions across the RBD, the administrative process for fines and/or closure is very complex and has been developed successfully for only some hundreds of illegal abstractions over the last years; possibly with a lower ratio than the increase of new illegal abstractions and often blocked due to political sensitivity and irrigator's lobby. In addition, access to farms to identify illegal abstractions is often impeded, when rangers try to access for inspection without a court's authorisation. Illegal abstraction are considered as a minor infringement and fines have a low impact.

CAP payments are mainly addressed to irrigated agriculture, rather than rainfed, especially for the category of Pillar 1 "Other payments", while Pillar 2 payments are linked to investments on the modernisation of irrigation schemes modernisation. Pillar 1 "other payments" receiving areas coincide to a great extent with irrigation zones located on nitrate-vulnerable zones or schemes abstracting water from overexploited aquifers, e.g. Doñana National Park (RAMSAR and Natura-2000 site). Decoupling has different effects depending on the crop type: in high water productivity crops (e.g. cotton, beet, garlic, olive) consumption of water and agrochemicals decreases due to the reduced income, while for low water-productive crops such winter cereals and sunflower, these reductions did not take place. Partial decoupling under the current water pricing setup does not necessarily induces significant changes in the total irrigated area for competitive crops, with land reallocation from cereals to industrial crops. As decoupling becomes higher, the extension of irrigated land is reduced and, therefore, decoupling subsidies decreases irrigation agriculture. Nevertheless, this reduction on irrigated land does not have a similar effect on level of water consumption, which is however maintained. Decoupling itself does not save water, but enhances economic incentives to save water (and other inputs).

4.10.4 Conclusions

The Guadalquivir RBD suffers from overallocation of water resources due to irrigation and performance failures of the allocation system. The prioritisation of uses enforced by the Water Act, the rigidity of the permit system and the subsidised prices hinder optimal allocation of the resource. The structure of RBA charges does not prevent indirect users to be charged for the services, and environmental and resource costs are not being charged, hampering cost recovery.

Official water allocation policy has ranked high agricultural demand, and therefore pushes this sector, either by prioritising its water consumption in the allocation schemes or by low pricing. Farmers have a strong request to transform their plots into irrigation and even use non-authorised water, increasing the percentage of water exploitation. Increased energy costs resulted in positive effects in water use and productivity.

Price increases mainly impact agricultural income, and derive in a shift towards more productive crops. The increased efficiency in water usage with new technologies is improving farmer's life quality. The overall increasing water allocation level in the basin is placing additional stress in irrigation farmers and it is unclear how cost recovery will reduce costs to other users. Water savings derived from modernisation can be allocated to fulfill environmental objectives.

5 EU-level conclusions from case study analysis

The first part “Results from the Case Studies” of this chapter focuses on the analysis of the case studies. It seeks to compare the results of the different case studies as well as analyse and draw conclusions regarding water allocation and water pricing policies. The second part “Actions at EU level” of this chapter focuses on EU level analysis of the link between water pricing and other EU policies. These links to other EU policies have been analysed to see whether any conflicts or synergies exist. The output of Part A and B serves as the basis for developing recommendations for Member States and river basin management authorities in relation to water pricing and allocation policies.

5.1 Results from the Case Studies

5.1.1 Comparison of the Case Studies

The case studies represent a diversity of hydrological, socio-economic, institutional, and technological conditions. As such, it is important to take these differences into account when comparing the case studies. The table below summarises key elements to consider:

Table 4 : Key characteristics of the Case Studies

	Water stress situation	Share of agriculture water use compared to total	Administrative coverage
Murray-Darling RB, Australia	Overstressed	83% of total RB surface water abstraction	Several administrative units
Island of Cyprus	Stressed	60% of total RB consumption	Several administrative units
Adour-Garonne RB, France	Stressed	60% of total RB surface water abstraction	Several administrative units
Lerma-Chapala RB, Mexico	Overstressed		Several administrative units
Scheldt RB, Netherlands	Not stressed, lack of freshwater resources	>1% of total national water use ⁴⁹	Several administrative units
Buzau-Ialomita sub-RB, Danube Romania	Not stressed	>10% of total national water use	One administrative unit
Guadalquivir RB, Spain	Stressed	85% of total RB water use	Several administrative units

⁴⁹ <http://www.cbs.nl/NR/rdonlyres/68DCDF0D-76C6-458F-B3EC-073E8447DF13/0/2009c174pub.pdf>

5.1.1.1 Aim of water allocation policies

Water allocation takes on varied forms among the case study countries assessment, as shown in the table below:

Table 5 Water allocation policies in agriculture

	Surface water	Groundwater
Australia	Water entitlement to a share of the water pool. Exact allocation coinciding with that share, is announced throughout the year depending on water availability. Trading in place to move water to higher value uses.	no information, presumably similar to surface water
Cyprus	Water allocation on a yearly basis, depending on hydrological conditions; quotas are used to prioritise between different water uses.	Drilling and abstraction licences; process under review momentarily due to implementation of Art. 9 WFD obligations.
France	Abstraction licenses can be granted to farmers for both groundwater and surface water. Authorisation for abstraction is based upon impact assessment delivered by the department Prefects. These authorisations can be limited or revoked in situations of water shortages. Adour-Garonne is a water deficit area where pressure from especially agriculture is high during the dry periods. 70% of the Adour-Garonne RB has been classified as water deficit area (ZRE) for abstractions in surface water where stricter rules ⁵⁰ apply for authorisations to abstract water.	
Mexico	Yearly allocation policy based on water volume in the lake and surface runoff in each district separately.	Drilling and abstracting licences but in practice this system doesn't work because of a lack of control.
Netherlands	Responsible authorities for abstractions from surface water are the State and the Water Boards. When surface water is sufficiently available, smaller abstractions (< 10 m ³ per hour) are possible without notification for e.g. irrigation purposes. Abstractions between 10 and 50 m ³ per hour (middle range) need notification. Large capacity abstractions (over 50 m ³ per hour) always need a permit. Rules for the major part of the Scheldt Basin are however more strict: Permits for surface water abstractions are required for pumping capacities above 15m ³ per day. When water levels in water courses are too low, Water	Smaller groundwater abstractions are regulated by the Water Boards (used to be provinces before 2009). Regional differences occur for granting permits or general rules for authorisations. All known and permitted abstractions have been registered in a database. The province of Zeeland applies strict rules for groundwater abstractions (location, pump capacity). ⁵¹

⁵⁰ As of January 2011, implementation of LEMA 2006 (décret sur l'irrigation pour le Bassin AG) was about to change the allocation and authorisation procedure for agriculture, where all abstractions for irrigation were to be managed by a unique body (obligatory in ZRE, possible outside ZRE). This system changes annual allocations to individual farmers to multi-annual fixed quota to all irrigation, where volumes are determined in function of statistical availability of water resources 8 out of 10 years (and thus respecting DOEs or minimum low water flows). This new system of authorisations could result in 12% less abstracted water for irrigation but leads to unequal impacts for farmers of different regions (e.g. 50% reduction in Poitou-Charentes regions) and important local economic consequences. The system is still not implemented as of today and the irrigation decree will most likely be adapted before implementation.

⁵¹ The ordinances (keur) of the former 2 Water Boards in Zeeland covering the largest part of the Scheldt Basin (now combined in 1 Board Scheldestromen) laid down specific rules for groundwater abstractions. Notification and metering is obliged for groundwater abstractions above 5 m³/hour or annual abstractions above 12,000m³. An abstraction permit is obliged for all groundwater abstractions except exemptions described in article 21 of the ordinances. With regard to agriculture, no permit is required if (i) abstraction occurs in non-vulnerable freshwater areas and below 10m³/hour and 1,000m³ per month and 8,000m³ per year (for irrigation, less stringent thresholds are defined at 60m³/hour, 3,000 m³/month or 8,000m³ annually); (ii) abstraction occurs in non-vulnerable and non-freshwater area below 10m³ per hour or 30,000m³ per year.

	Surface water	Groundwater
	Boards can install irrigation bans from surface water.	
Romania	Abstraction licenses are granted on a yearly basis based on an application stating demand and timing requirements. A water balance of all users is made to determine whether abstraction is granted. A system for instituting water restrictions is in place but has not been needed thus far.	Groundwater use for irrigation is not permitted.
Spain	<p>Water allocation is a multi-level multi-agency process in Spain which operates within different institutional frameworks at different spatial and temporal scales. Its main aim is to stimulate economic development, and regarding the Guadalquivir RBD allocation policy is also relevant in order to prevent harmful situation due to water scarcity.</p> <p>The Spanish RBMPs build on existing water rights and try to increase availability for new users (new rights), as in Spain's large semi-arid climate areas and under the given low prices for water, "demand" is always growing. Thus, the Plan allocates water to current right holders and creates reserves for potential future "demands".</p> <p>Regarding surface water usage, allocation has been stimulated by governmental plans for irrigation development, including dam and infrastructure construction and modernisation works. Regarding groundwater, farmers take a more active role in development, with the administration lacking behind in terms of monitoring GWB evolution and permitting.</p>	

Water allocation to individual farmers and/or plots is carried out by different actors at different administrative levels in the case study countries. In the Netherlands water is allocated by the local Water Boards, whereas in France water is allocated by a mix of government bodies, government or private water user/irrigation associations and private abstractors. Cyprus and Spain both rely on either irrigation communities or private abstractors. Australia is similar in that they have a system of local, governmental bodies allocating water as well as private abstractor rights. In the case of Romania, irrigation systems are controlled either by the national agency or by private water user associations. In Mexico, however, water is solely supplied through government established irrigation associations.

The authorisation process for water abstractions are given on an annual or seasonal basis and are decided based on the following requirements:

- In Australia, the system differentiates between water entitlements, i.e. access to water, and water allocations, i.e. the specific volume of water allocated to an entitlement in a given season depending on water availability. Although water allocations are based on seasonal availability, similar to other case studies, they are set in water sharing plans that last for 10 to 15 years. These plans are very difficult to change but are only a framework. The amount of water that is allocated is decided on during the year (seasonally) by the authorities, depending on the dams storage level.
- In Cyprus, the Water Development Department (WDD) estimates the water needs per Government Water Project for the coming irrigation period. In late spring, at the end of the rainy season, the quantity of available water in the GWP is calculated as well, based on the dam storage levels at that time and the quantities that can be purchased from desalination plants and from the tertiary treatment

of sewage. Considering these two assumptions – the expected water availability on the one hand, and the expected water demands in irrigation and other agricultural and non-agricultural sectors on the other hand – the WDD prepares a water demand and allocation scenario, called “Drought Mitigation and Response Plan”, which governs the amount of water to be used by each sector.

- In France, the conditions under which users can abstract surface and groundwater resources and the procedure by which the Prefects (Préfets départementaux, i.e. the local State representatives, grant (water) use rights are stipulated in the (new) 2006 French Water Law. When an authorisation is requested, the decision to grant it or not is made after an investigation for assessing the potential impacts of the project and a public consultation with relevant stakeholders. Authorisation is granted for a defined duration and is not final. Any authorisation given for water abstraction which includes the maximum volume that can be abstracted can be temporarily or permanently revoked or reduced by the Prefects in case of water scarcity, as required to ensure priority uses, adequate environmental protection and domestic water consumption. Abstraction rules are more stringent in water deficit areas (or ZRE, +/- 70% of Adour-Garonne RB). The enactment of the 2006 Water Law is about to change the authorisation procedure to multi-annual quotas assigned to a *organisme unique* that allocates water to farmers; the system has not yet been implemented (negative reactions from farmers on volumes, accompanying measures) and will most likely be adapted before final approval.⁵⁰
- Each November, the National Water Commission in Mexico decides how much surface water will be allocated the next year to each district. This is based on scientific data (i.e. water levels in the dams and lake, precipitation forecasts based on the last year’s rainfall, surface runoff) and negotiations with the irrigation districts, which communicate to the Commission how much water they want. The allocation of next year’s water based on the rainfall of last year, leaves however room for over-allocation. In case a wet year is followed by a dry year, this allocation system makes things even worse. Following the district allocation, negotiations take place internally to allocated water to the sub-irrigation units. This allocation is top-down and based on how far the modules are located from the dam, the amount of surface and the irrigation calendars. Each district develops a yearly irrigation plan where members (farmers) decide together which crops to grow next year based on the water allocation. In theory this sounds like a good allocation system; however despite many requests we have found no evidence whether this system is fully implemented in practice. Groundwater abstraction is allowed with a permit that specifies the annual volume allowed, which is based on the discharge of the well and the irrigated area. Licenses can last between 5-10 years.
- In Romania, surface water abstraction permits for irrigation are based on a water balance calculated at river basin level. The water balance takes into account: precipitation rates, runoff, “minimum flow to ensure the life of aquatic ecosystems” and evapotranspiration against the potential water demand. As all water use requires a permit, all applications are calculated together to estimate the basin’s water demand. This is then balanced against the hydrological and climatic elements. As such, there is no specific Allocation Plan per se.
- In Spain, annual water allocation (of surface water) is decided in the “Dam Water Release Boards” with monthly meetings that facilitate estimates on water availability and allocation for farmers, and thus facilitate approximate allocation forecasts.

Unlike the other case study countries, which require water permits for any amount of abstraction, in the Netherlands (regional differences), Spain and France water abstraction licences are only needed above a certain threshold. For example, in the area covered by the Water Board “Hollandse Delta” of the Scheldt RB, small abstraction amounts do not require a permit: surface water abstractions below 20 m³ per hour do not need any notification. In Spain, abstractions less than 7,000 m³/year are considered as minor abstractions and do not require a permit. In the case of France, abstraction rules are more stringent in areas qualified

nationally as suffering from chronic water shortage (ZRE, Zones de Repartition d'Eau). In these zones abstraction more than 8 m³/hour requires an authorisation; in non-stressed areas a permit is only required above the threshold value of 80 m³/h.

In times of water scarcity or droughts, all case countries restrict water use. In some countries, restrictions are determined according to the hierarchy of water users (Netherlands, Cyprus, Mexico, Spain, and France). This can take the form of prioritising only according to sectors, or, as is the case in the Netherlands and Cyprus, also within sectors, e.g. prioritising higher value crops. In Guadalquivir river basin, Spain, irrigation and other agricultural water uses are ranked third after the water supply to urban areas (incl. minor industries) and environmental flows restrictions. Irrigation faces major restrictions compared to other water users, according to the different thresholds established in the Drought Management Plans. In water scarce times, only Mexico prioritises agriculture use over domestic supply, while the Netherlands focuses on flooding defences; in all other cases drinking water is prioritised over other uses. Romania is the only case study assessed that has never needed to activate its Restriction Plans; this is because of the high capacity of reservoirs in the country. Historically, agriculture uses the biggest part of the Australian water. In the past whenever there was a conflict between rural and urban use, the urban users (households, industry and commercial use) were given the advantage. However, since 2004 there has been a push to implement a new regime: if urban water uses increase they can only get the water from new sources (ex. recycling, new storms dams) or from buying it from the rural sector. Romania does not have a hierarchy of water users per se, only a mandate that domestic supply is prioritised over other users.

Water Trading

Australia, Spain and Mexico have turned towards using water markets to trade water entitlements and allocations, although this system is most developed in Australia.

In the Guadalquivir RBD, seasonal sales have occurred between irrigation communities as well as with the water company. Although an ad-hoc expert group was set up -post by the Spanish MoE (Arrojo et al., 2008), no significant public evaluation of the water markets was carried out (neither qualitative nor quantitative, nor regarding the environmental, social and/or economic aspects). The main concerns regarding the water seasonal sales allocation process in the Guadalquivir RBD have been a lack of evaluation on the effects of the water markets, including an analysis of external costs, a lack of transparency, and complexity of the water rights system. However, it is expected that water markets will increase in the Guadalquivir RBD both inter-basin and intra-basin, in order to “adjust” the problems of the over-allocation of water rights.

On the other hand, Australia has considerable experience in water trading. Trading is mainly done between irrigators from season to season. Water entitlements are rarely traded. The market prices for buying/selling water entitlements are published to provide greater transparency to the tender process. The main buyers of water during the 2007/08 droughts were horticulturalists. Without water trading, it is likely that many long-lived horticultural assets would have been lost. The main sellers were dairy producers. When water prices were high, their allocation sales generated income that was used to purchase additional fodder.

Water trading has helped individual irrigators (buyers and sellers) manage and respond to external drivers (including seasonal water availability, changes in commodity prices and input costs, government water policies, and social trends) by allowing more flexible production decisions. That flexibility improved cash flow, debt management and risk management. At the moment there are considerable transaction costs when trading on the MDB water market, the lowest at 2.5% of the value of trade and the highest at 21% of the value of trade. However, a lot of effort has been made the last couple of years to lower these transaction costs.

There is also a limited amount of trading in allocations in the Lerma-Chapala Basin. The government tries to stimulate trading with economic incentives, but in reality trading is only used as a last option, for example when the aquifer is becoming too low to be exploited by the farmers. In that case they sell their land with all the water attached to it. Unlike Australia, there are hardly any sales of seasonal allocations. Additionally, water trading is not supposed to be between irrigators, rather between farmers and cities, as the domestic water supply has big problems to cope with not enough water. Trading does occur frequently between irrigation units of the same district. Legally it is restricted but it is overlooked by the authorities. Illegal trading also has the potential to exacerbate problems in the area with illegal boreholes.

5.1.1.2 Aim of water pricing policies

To recall the Water Framework Directive, the three main aspects of Article 9 are cost recovery, the polluter pays principles and incentive pricing. The case studies show that so far all of the European countries are working to achieve full cost recovery with a focus on financial costs rather than environmental and resource costs but the aspects of polluter pays and incentive pricing has not yet achieved enough attention, as should in the table below.

Table 6 Main aim of water pricing policy according to MS Expert representatives

	Cost recovery	Polluter Pays	Incentive pricing
Australia	x		
Cyprus	x		x
France	x	x	
Mexico	Partly		
Netherlands	x		
Romania	x	x	
Spain	x	x	x

With the exception of Romania and the Netherlands, none of the case study countries have achieved (nearly) full financial cost recovery. Romania considers itself to fully cover the financial costs of water management, as only the central supply system is taken into account and no new capital costs are foreseen.

In Spain, for example, no significant advances towards (financial, environmental and resource) cost recovery have been made. Increases in operation costs are fully paid by the farmers through the Irrigation Communities, but investment costs are partially (60-90%) subsidised. In Cyprus, the level of cost recovery for irrigation infrastructure depends on whether it is owned by the state or by associations; state controlled infrastructure only has a cost recovery of 40%. Policies in France show that while policies have been geared towards cost recovery objectives, it appears that there are large capital costs differences across basins and irrigated areas, creating a large range of capital costs recovery, between 15% and 60%.

Environmental and resource costs have mostly not been taken into account with respect to cost recovery, although the Government of Cyprus has stated that environmental and resource costs are included in the calculation of cost recovery levels. National water pricing experts from the National Water Administration maintain that Romania has fully taken environmental and resource costs into account and has achieved full cost recovery. In accordance with the national methodology, internal environmental costs, expressed as costs for monitoring, are covered by the wastewater charge, while resource costs are covered in so far as that there are none (no opportunity costs due a lack of water scarcity problems); however, external environmental costs are currently not included in the methodology but are planned in the second river basin planning cycle. In France, the Water Agency abstraction tax on water use by irrigators aims to internalise environmental and resource costs (by increasing the tax by 80% between 2007 and 2012), but the level of environmental cost recovery is quite low. The Water Agency tax differentiates according to the water resource scarcity (abstraction from balanced or unbalanced zones). The Netherlands states a nearly 100% (financial) cost recovery for water services in the Netherlands. Environmental and resource costs are estimated and internalised based on (cost of) measures currently installed to prevent and mitigate negative environmental effects. The allocation to sectors and cost recovery in sectors requires assumptions, though it is argued that there are no significant cross subsidies between sectors.⁵² No further evidence has been found on the total costs that should be allocated to agriculture.

In Spain, environmental and resource (opportunity) costs are not being considered yet; moreover, desalinated water in eastern Spain is being subsidised for irrigation uses. In Australia, the eventual goal is to move towards upper bound pricing, including a price for externalities, but at the moment environmental and resource costs are not taken into account. In Mexico, river basin authorities are not yet fully recovering the investment and operational costs, nor are they currently discussing environmental and resource cost recovery. It is very hard for the authorities to even put aside some allocations for environmental purposes (farmers strike and block the road), let alone create a system where users pay full costs (financial and environmental).

Within water pricing policy, the case study countries show a wide range of prices for water used for agriculture purposes, as highlighted by the table below. Compared to other sectors, the prices for agriculture water use is much lower in all countries analysed.

⁵² For further reading, see van der Veeren et al. (2005)

Table 7 Water price by sector

	Agriculture	Industry	Domestic
Australia	0.09€/m ³ (0.12 AUD/m ³)	0.09€/m ³ (0.12 AUD/m ³)	1.46 €/m ³ (1.93 AUD/m ³)
Cyprus	Between 0.7€/m ³ (tertiary treated effluent) and 0.17€/m ³ (individual farmer); price levels under review at the moment	0.19€/m ³	0.56 – 0.77 €/m ³
France (Adour-Garonne)	<p>Over the 2009 irrigation campaign, the average abstraction tax levied by Water Agency was 0.007€/m³ in the entire Adour-Garonne RB. This tax ranges from 0.004€/m³ to 0.008€/m³.</p> <p>(Farmers abstracting own water only pay an abstraction charge to the Water Agency and bears costs for infra themselves)</p> <p>Collective irrigation systems / water supplied (variety of systems):</p> <ul style="list-style-type: none"> a) Average price for water supply (pressurised): 0.10 – 0.15 €/m³ b) Additional (average) tariff for recharge network (<i>axes de réalimentation</i>): 0.015 €/m³ 	0.75 – 1.1 €/m ³	Total price in 2008: 3.40 €/m ³ (drinking water component 1.42 €/m ³ , 1.45 €/m ³ for sanitation, 0.362 €/m ³ Water Agency taxes and 0.17 €/m ³ VAT.
Mexico	Prices (from 2004) differ depending on the crops and location; they range from 0.022€/m ³ (0.028USD/m ³) for grains to 0.32€/m ³ (0.42 USD/m ³) for strawberries.	No info	0.35€/m ³ (0.49 USD/m ³)
Netherlands	<p>Price for surface water (water levels and maintenance of watercourses and dams) to regional Water Board: 59.71 €/ha in Zeeland annually</p> <p>Provincial groundwater tax in Zeeland: exemption when below 20,000 m³ abstraction - Most farmers are exempted</p>	0.8 to 1.64 €/m ³	1 – 2 €/m ³
Romania	0.00071€/m ³ for water; total cost is between 0.002€ to 0.247€/m ³ depending on amount of electricity used.	0.57€/m ³	0.57€/m ³
Spain	0.0262 €/m ³ for water supply to the irrigation area	1.75 €/m ³	1.47 €/m ³

In Cyprus and Romania, water prices are the same throughout the country, i.e. there are no regional differences in the price for water. The other case studies do not take a uniform approach to water pricing and there can be significant differences in the price farmers pay for water. France and the Netherlands have strong regional difference in water pricing as local agencies are responsible for setting prices. Different water

prices (surface water) in the Netherlands follow from the history and guiding principle of Water Boards⁵³ and regional characteristics, e.g. farmers situated close to urban areas could benefit from lower prices as Water Boards can recover costs for their services from a larger group of beneficiaries. In France, the water price can vary significantly depending on the characteristics of the (collective) supply system (depreciation of investments) and the service delivered. This applies both for water tariffs and design. In Mexico the main differentiation is between the agricultural sector on the one side and households and industries on the other side, as the agricultural sector is not paying any water charges. In Australia, depending on the season and the water inflow in the local dams prices will differ highly as scarcity dictates the price in the water market. In Spain, there are certain differences between the basins, the regions and the irrigation districts.

With the exception of the Netherlands (surface water) and certain collective irrigation systems in France, prices for irrigation are volumetric. In the Netherlands (surface water), prices are area-based (hectare), with very low rates of water metering compared to other countries using volumetric prices. Surface water is generally abundantly available in the Netherlands. Irrigated agriculture in certain areas in the Netherlands (western part) is made possible through the mobilisation of large volumes of freshwater (flushing) keeping chloride contents in surface water bodies below defined threshold values. The agricultural sector benefits from these operations, while limited information exists on the actual required volumes to continue current agricultural practices. At the same time, these freshwater inlets and water level management is also needed for dike protection so agriculture is not the sole beneficiary. Spain has a mixed scheme with a high ratio of area-based prices, and slowly increasing volumetric-based prices, in particular in those areas where irrigation improvements have taken place. Without water metering, volumetric prices are not possible.

In general, the share of water pricing in total irrigation costs is still low in most of the countries. This issue was especially highlighted by France, Romania, Cyprus, Spain and Mexico, where electricity costs represent a much higher share of irrigation costs. For example, in Romania the price for water is only 0.0071€/m³ but the total price can vary between 0.002 and 0.247€/m³ due to electricity needs. Collective irrigation systems (in France) supplying water under pressure include energy costs and investments for transport and distribution in the tariffs, resulting in higher water prices for these farmers. Moreover, the share of irrigation compared to total production costs can also be low, e.g. in, Cyprus and Spain the total share is around 7%. On the other hand, in France and Romania the share of irrigation costs compared to total production costs is 20% and 28%, respectively.

⁵³ Interest – payment – say principle. Water Boards have multiple tasks in water quantity and quality management. Associated costs are recovered from the beneficiaries. Farmers pay a water system levy based on hectares. Also landowners (property value) and nature need to pay for the services rendered by Water Boards (flood protection, water quantity management, ...).

5.1.1.3 Main factors influencing water pricing and allocation policies

There are a number of positive and negative factors influencing water pricing and allocation policies. Due to local conditions, the same factors may affect these policies differently or some factors may be more specific to individual river basins.

One of the most important factors influencing the ability of water pricing and allocation policies to lead to sustainable water use is metering. Cyprus, France and Romania have wide-spread metering, which is a pre-condition for volumetric pricing as well as for monitoring and controlling water allocation permits. Examples from Australia, Spain, the Netherlands and Mexico indicate that insufficient or non-existent metering makes water pricing and allocation difficult to enforce and control. A lack of monitoring capabilities does not allow for proper control of agriculture areas to prevent construction of illegal boreholes (Mexico). Both Cyprus and France pointed to a lack of necessary resources to effectively execute control activities.

Water use efficiency programmes and general awareness raising campaigns were often cited as having a positive effect on water pricing and allocation. Examples from Australia, Cyprus and France indicate that farm advice activities show a clear impact. Especially in Cyprus, efficiency programmes have been attributed to the significant decrease in agricultural water use over time. On the other hand, water efficiency programmes have also had an inverse effect on water saving, the so-called rebound effect⁵⁴. For example, in Mexico government investments in restoring aquifers, increasing agriculture productivity, and improved irrigation techniques led to increased water use. In Spain, efficiency programmes have led to increases in irrigation area and to an intensification of land and water use. In the context of the I-adapt project⁵⁵ which aims to provide a specific, actionable plan for combating desertification through the use of emerging technologies, piloted in the Greek Pinios River Basin, the increase of efficiency measures led to (or was followed by) an increase in irrigated land because of existing subsidies for cotton. There are a number of potential reasons for this (Pfeiffer and Lin, 2010):

- More efficient irrigation systems typically cause the crop production function to shift upward. Although more efficient irrigation enables a farmer to achieve the same yield with less water, the farmer could decide to apply the same water volume as before to achieve higher yields. Higher yields are coupled to higher rates of evapotranspiration, thus total consumptive use is increased.
- Irrigators may adjust their behaviour by applying more water per acre or by expanding the irrigated area. Efficient irrigation technologies enable farmers to obtain higher yields than before on lower quality soils, thus enabling expansion.
- More efficient irrigation technologies can decrease the marginal cost of water application, which can induce a farmer to switch to more water intensive, higher value crops.

These negative results from efficiency programmes could be avoided by attaching criteria related to net water savings at farm level, e.g. paying for improved irrigation techniques if total water use is reduced⁵⁶.

⁵⁴ The rebound effect refers to an increase in consumption which may occur as an unintended side-effect of the introduction of policy, market and/or technology interventions aimed at environmental efficiency improvements (Bios, et al, 20011).

⁵⁵ See <http://i-adapt.gr/>. The project was carried out in cooperation with this service contract.

⁵⁶ This is a case in Romania, where irrigation projects funded under the rural development programmes are only accepted if 10% savings can be achieved.

The price of water itself can also have a positive as well as a negative impact on water use behaviour. For example, in Cyprus the cost of groundwater is very high, which acts as a deterrent for use. Because it is so expensive, groundwater is only used for high value crops and on high water efficient farms. On the other hand, high groundwater prices in Spain have led to increased illegal use of water, which hampers proper implementation of allocation policies. Cyprus and France also heavily tax over-abstraction of permits with the theory that such high prices encourage less water use. Conversely, in Cyprus the price of surface water is low, to decrease the incentive to extract and use water illegally. While this may be beneficial to reduce illegal activity and support allocation policies, it does not support incentive pricing. If the share of water prices in the total irrigation costs is low, as reported in Cyprus, Romania, France and Spain, other factors have a higher influence, e.g. electricity costs, on water use behaviour.

Poor climatic conditions/droughts have allowed the agriculture sector (e.g. France, Cyprus and Spain) to take more radical actions such as changes in behaviours, bans or restrictions. These changes can be maintained as permanent and reduce water stress under normal conditions. Here, real-time monitoring and strict controls of water levels in small rivers allow almost real-time response to adapt abstraction volumes (France).

One river basin specific hindrance to water allocation is the late announcement of water use restrictions in the Adour-Garonne River Basin in France. Restrictions or allocation plans that are published after planting are likely to have no or only limited impact on farmer's decisions because planting of water intensive crops has already taken place and farmers need to irrigate in order to ensure capital returns.

In the Netherlands, the historical setup of water management bodies and pricing systems negatively impacts policies. For example, the costs of administration by the Water Boards are spread over different beneficiaries who pay flat rates based on per hectare use and property. Similar services or activities by Water Boards (and costs thereof) can result in different tariffs for farmers depending on regional characteristics (e.g. urban areas where costs are shared by many actors).

Finally, the water trading system and allocation permitting system in Australia can be used as a good example to learn from. Allocation of permits was not properly controlled and with too many permits allowing water use, it is not possible to reduce water use in drought years.

5.1.1.4 Main impacts of water pricing and allocation policies

5.1.1.4.1 Direct effects

Based on the summaries below, climatic conditions have a stronger direct impact on water use compared to water pricing or allocation policies, although this depends on the river basins. As direct effects of water pricing and allocation are largely specific to the river basin, they summarised for each case study:

- Water trading in Australia has only influenced water use to a limited extent (<10%). Reductions in water use are mostly due to the drought.
- Due to the Water Use Improvement Project in Cyprus, an estimated 75 Mm³/year is saved due to widespread efficient irrigation technologies. Water pricing has had no real direct impact, as the share

of irrigation water costs in the total production costs in agriculture is very low, indicating a rather low price elasticity of demand. Change in cropping patterns during drought events have been more a result of water shortages and reduced water allocations.

- In France water pricing has not lead to any direct reduction in water use, nor has it impacted a farmer's crop choice or reduced application rates; this is because water prices are low relative to the total production costs coupled with high prices for cereals. Rather, climatic conditions are predominantly influencing volumes for irrigation water. However, water allocation policies directly affect farmer's water use when water use is restricted.
- No direct impacts were registered in Mexico regarding water pricing or allocation as the system is largely not functioning.
- In general in the Netherlands there is a lack of information about the quantities used for irrigation or evolution of water demand in agriculture and irrigation. Water pricing and allocation is currently not designed to promote sustainable water use or steer farmer's decisions (e.g. crop choices). Farmers rather (will) have to adapt to the (gradually) lowering availability of freshwater in the area, which is (only partly) reflected in water policy: more stringent rules on water abstractions (e.g. in the province of Zeeland).
- With the elimination of the electricity subsidy in Romania, the tariff farmers pay for irrigation more than doubled (electricity costs make up between 65% and 99% of total irrigation costs depending on the location of the farm from the water source) and the irrigated area was reduced by around 75%. In addition, it is expected that production of grain will have decreased substantially with farmers shifting to crops like rice or culture seeds. There is currently no data available on whether total agriculture area decreased as well.
- In Spain low water pricing, an allocation policy pushing agricultural water demand, and high potential revenues if farmers irrigate, have led to increased irrigation through expanding irrigation area and non-authorised water abstraction. Main direct effect is an increase of the percentage of water exploitation. However, the increased cost of energy has reduced water use by 14% because the total cost of irrigation increased by 28%.

5.1.1.4.2 Indirect effects

In addition to some direct effects, water pricing and allocation policies can indirectly impact farmers in terms of socio-economic conditions and their surrounding environment. The table below outlines these effects for each case study basin.

Table 8 Indirect effects of water pricing and allocation policies

Socio-Economic		Environmental
Australia	<p>No impacts on farm income due to flexibility of water markets</p> <p>Buying back of entitlement negatively impacts efficiency due to loss of pressure in system, which creates a "swiss cheese" effect</p>	The intended impact of buying back of entitlements for environmental flows is to improve the health of the river; no studies have been carried out yet to confirm.
Cyprus	No impact on farm income	No significant impacts

Socio-Economic		Environmental
France	No significant impacts from water pricing Significant loss of income from water allocation in times of droughts	No significant impacts
Mexico	Loss of income due to high electricity prices. Other socio-economic effect is mainly because of the drought (because of overexploitation).	No impact on the deterioration of the environment.
Netherlands	No significant impacts from water pricing. The cost of water is no significant part of the total production costs for farmers. Certain farmers benefit from (artificial) freshwater status (and access to water) of lake Volkerak-Zoom	The blue algae problem during summer period in the lake Volkerak-Zoom illustrates the pressure from agriculture and water management policy on water bodies. It is anticipated that the only solution to tackle this environmental problem might be to move away from the freshwater status of the lake (return to natural status).
Romania	Significant impact on farmer income due to loss of electricity subsidy	No significant impacts
Spain	Loss of income due to water pricing. Monthly allocation forecasts help farmers to preview the risks of planting-benefits/losses. Increased efficiency and automatisisation improves farmer's life, but also reduces labour/jobs, e.g. as irrigation can be started/stopped via mobile phones.	Significant impacts due to illegal abstraction

In places where regional water use dropped in Australia, it did not lead to a proportional reduction in the value of agricultural production because water moved to those who value it most. Changes in production practices, e.g. dryland farming opportunities, substituting water with other inputs like fodder and increasing on-farm water use efficiency, maintains the value of agricultural production. Comparisons of trade patterns and key socio-economic indicators revealed no noticeable link between patterns of water trading in or out of a region and changes in population, employment in agricultural or weekly household income. The practice where the government was buying water rights from 'willing sellers' has been blamed for the 'Swiss cheese' effect in irrigation districts where it is purchasing entitlements. The term 'Swiss cheese' refers to what happens when some entitlement holders along an irrigation channel sell their entitlements and stop irrigating. The effect of this is to create 'holes' in irrigation areas, reducing the efficiency of delivering water down that channel, stranding assets and increasing the maintenance costs and delivery fees for the entitlement holders who remain.

In Cyprus, the water pricing system has had almost no negative micro-economic effects. There is no quantitative information available regarding indirect economic effects or environmental effects of the water pricing policy. Some sources state that experts fear the farmers could switch to unregistered groundwater

abstraction if irrigation water prices increase; However, the low percentage of water costs in relation to overall production costs and to the net benefits of crops indicate that the above scenario is unlikely.

In France, water pricing policies has not lead to any significant changes in farm income. Rather, the water allocation policy that reduces or completely bans agriculture water use in water scarce times negatively impacts farmer income significantly. Capital intensive crops put pressure on farmers in terms of large investments requiring irrigation to obtain minimum return. In water shortage times, farmers adapt by limiting the irrigated acreage but us the same volumes of water to the reduced area. More than ½ of the lost irrigated area in France has now been transformed to less water demanding crops but this is due more with unfavourable climatic conditions than policies. However, while irrigation results in higher total costs on farms dominated by monocultures in (like maize), the production costs per ton are lower for irrigated maize compared to non-irrigated maize due to significantly higher yields.

In Mexico, poor farmers who can't afford to pump groundwater abandon agriculture land and migrate.

In the Netherlands, since the cost of water is not a significant part of the total production costs for farmers, there are no socio-economic impacts. For capital intensive (often water intensive and dependent) crops (bulb farming, fruit farming, orchards), individual farmers tend to opt for – expensive - tailored solutions (water supply with trucks, individual rainwater reservoirs, water conservation at the farm level) as drought related damage can have more significant impacts on their income. Other farmers move away to more salt tolerant crops or even move production to other regions in the Netherlands. With respect to environmental impacts, the blue algae problem during summer period in the lake Volkerak-Zoom illustrates the pressure from agriculture and water management policy on water bodies. It is anticipated that the only solution to tackle this environmental problem might be to move away from the freshwater status of the lake (return to natural status).

In Romania, a decrease in yield due to the elimination of irrigation because of high electricity costs negatively impacts farmer income. Potential for significant abandonment of agriculture fields on terraces 150 meters above the water source but no studies thus far. Environmental impacts are low as water is pumped from reservoirs and significant water reserves in the reservoirs reduce the risk of low environmental flows.

In Spain, increases in water prices decrease agricultural income but do not lead to water savings. Shift towards more productive crops increases GVA generated by the agriculture sector. The environmental conditions of water bodies does not improve as there is no increase in environmental flows as no real water savings are expected Also, groundwater bodies are failing to achieve good quantitative status because of significant exploitation of groundwater bodies due to illegal abstraction

5.2 Actions at EU level

5.2.1 Introduction

Water Pricing aims to encourage a system in which all users contribute an adequate share to the recovery of the costs of water services and where adequate prices result in efficient water use. However, as shown in Part A there are quite some gaps in the implementation of a water pricing system, also because of influences from EU policies (see section 5.3).

This section investigates the main EU level policies that impact water pricing in agriculture in order to identify potential synergies and conflicts with the three main requirements of WFD Article 9, namely cost recovery, the polluter pays principle, and incentive pricing. The following policies are at nexus of water and agriculture policy and potentially affect water pricing:

- The current implementation of the Water Framework Directive (summary of findings from the results from chapter 3)
- The Common Agriculture Policy
- The Communication on Water Scarcity and Droughts
- Nature protection policies, e.g. Birds and Habitats Directive
- The White paper on Adaptation to Climate Change
- Cohesion Policy

The results of this analysis, as well as the conclusions from case studies investigating water pricing in selected river basins, will feed into EU level policy recommendations for water pricing.

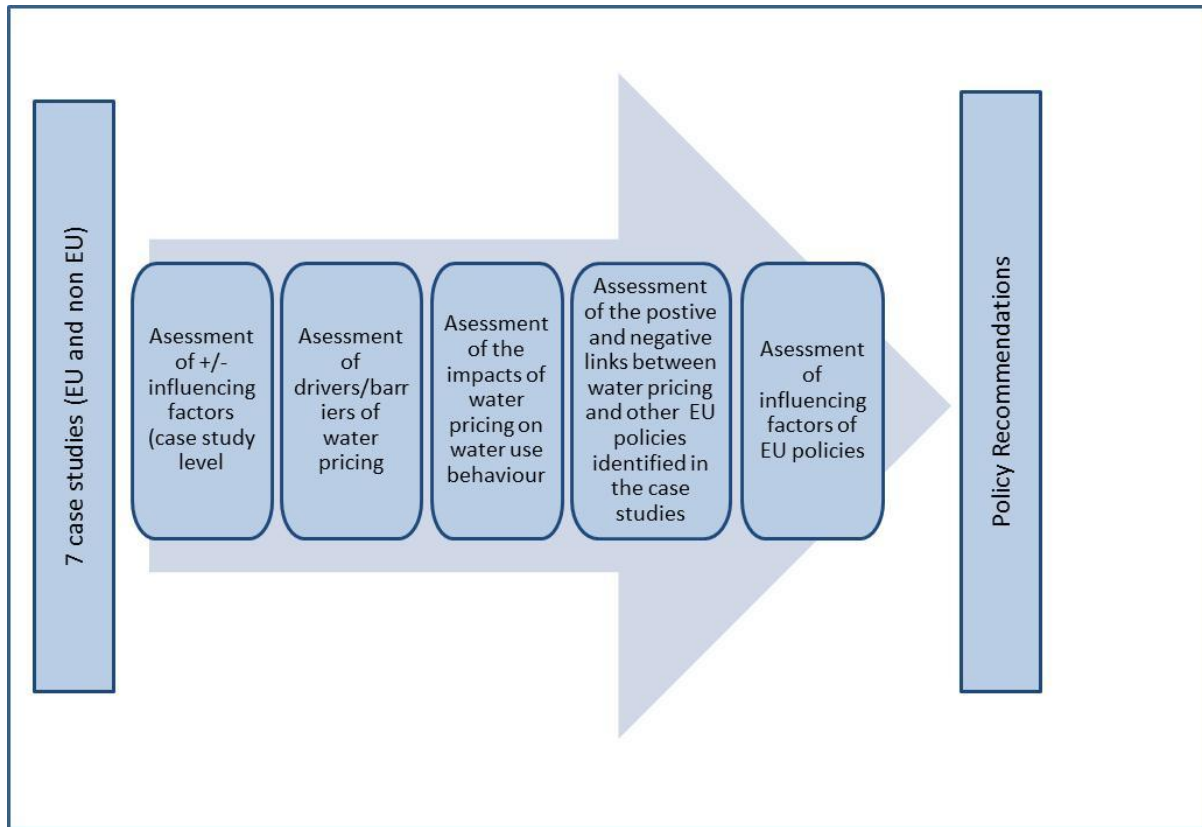
5.2.2 Methodology

Relevant EU policies were screened regarding: i) is water pricing mentioned, ii) is there an incentive to set up water pricing mechanism, and iii) does the policy contain mechanism/funding that supports or distorts water pricing mechanism.

The screening and analysis of EU policies is necessary in order to identify potential supporting and harming mechanisms to implement a proper and effective water pricing.

How the screening and analysis of EU policies fits with the project in general:

Diagram 7 : Link between screening of EU policies and the project



5.2.3 EU policies linked to Water Pricing and Water use

5.2.3.1 The current implementation of the Water Framework Directive (summary of findings from chapters 2, 3 and 4)

As set out in the second chapter, the main incentive for a proper water price policy comes from the WFD and its implementation. However, the overview of water pricing policies in the EU as well as the case studies showed that the implementation of Article 9 has had mixed results.

Generally, there appears to be a lack of incentive elements in the pricing of direct abstractions. Some Member States allow exemptions for agricultural water use or irrigation specifically, also in water stressed areas e.g. in Southern Europe. The level of the water price (excluding private on-farm costs) appears to be modest (well below 0.01 €/m³ in many cases), though some Member States have introduced higher tariffs, especially for specific water resources where availability is low. A limited number of implemented tariff systems include no incentives for water savings as quantities of water use have no relation with the amounts to be paid.

Overall, there is still a lack of cost recovery. Chapter 2 explained the WFD meaning of cost recovery and identified the two main types of costs to be recovered, notably 'financial' (i.e. full supply costs) and 'environmental and resource' costs (i.e. full cost recovery). There is an incomplete cost recovery in a significant share of EU Member States. The large investment in irrigation infrastructure (also modernisation)

is often subsidised which comes down to insufficient capital cost-recovery. For at least 30% of the MS, O&M costs for the provision of water are only partly recovered.

Some Member States argue that (an unspecified share) of environmental and resource costs are recovered (e.g. UK, the Netherlands, France, Belgium (Flanders), Germany). This (partial) internalisation (of resource costs) is generally realised through water abstraction fees; however these are generally low. It is of note that no clear evidence could be identified on the (allocation of) environmental and resource costs related to agriculture as a water user and associated cost recovery levels.

Generally there is a lack of methodologies on how to fully address environmental and resource costs and how to equitably distribute this costs to different water-using sectors. Further work is needed in order to fulfil the requirements for full cost recovery under WFD. Some MS are in the process to improve the evaluation and internalisation of ERC (e.g. Cyprus, Spain).

On the other hand, the polluter-pays-principle has been partially integrated into water policy through sewage taxes. However, diffuse pollution remains a problem and there are no easy solutions to deal with the associated costs. Finally, the case studies clearly indicate that water pricing is not incentivising sustainable water use. Rather, other factors play a role in reducing water use, for example drought conditions, water saving technologies but only to some extent (as discussed in section 5.1.1.3), and awareness programmes. High prices, whether they are a result in water price or electricity, do not necessary result in water savings but rather a shift in crop production to higher value crops or loss in profit. This is, however, highly dependent on the situation of the river basin.

5.2.3.2 The Common Agriculture policy

5.2.3.2.1 Main objectives

Under the two pillars of the Common Agricultural Policy (Pillar 1: direct payments; Pillar 2: Rural development), farmers receive different payments. The incentive function of water pricing schemes may be influenced by these payments (see further details below):

Pillar 1 links direct payments to farmers to the compliance with existing legislation. This so called “Cross Compliance” (Council Regulation No 73/2009) is seen as an important step towards protecting European Waters on a broader scale and towards applying the PPP to farmers. Since 2005, all farmers receiving direct payments must respect Cross Compliance standards in two ways:

- First, they must respect the Statutory Management Requirements, which relate to specific provisions of 18 EU Directives and Regulations. The standards relate to the protection of the environment, public, animal and plant health, and animal welfare. With regard to water management, the most important directives covered by Cross Compliance are the Groundwater Directive (80/68/EEC), the Nitrates Directive (91/676/EEC)⁵⁷, Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna, Council Directive 2009/147/EEC on the conservation of wild birds and to some extent the

⁵⁷ Please note that only in seven MS (Austria, Denmark, Finland, Germany, Luxembourg, the Netherlands and Ireland) the whole territory

is covered by an Action Program (see Art 3.5 of the Directive). In all other cases only specific nitrate vulnerable zones are designated.

Sewage Sludge Directive (Directive 86/278/EEC), which will also be part of the River Basin management plans under the WFD.

- Second, all agricultural land and especially land which is not used for production purposes should be kept in Good Agricultural and Environmental Condition (GAEC). In general, GAEC's focus is on the protection of soil and its positive side-effects on the reduction of diffuse pollution. It is up to the individual MS to define minimum GAEC requirements, which may differ depending on local conditions. Since the CAP "health check"⁵⁸, new standards focusing on the protection and management of water have been introduced. Since 1 January 2010, MS have to ensure compliance with authorisation procedures in cases where the use of water for irrigation is subject to authorisation and by 1 January 2012, they have the obligation to establish buffer strips along water courses.

Pillar 2 aims to place agriculture in a broader context, which also takes into account the protection of the rural environment, the quality of produced food, and the attractiveness of rural areas to young farmers and new residents. The Rural Development Regulation ((RDR) Regulation (EC) No 1698/2005), co-financed by the European Agricultural Fund for Rural Development (EAFRD) and MS, brings together a number of policy measures under a single instrument. It provides financial support under the framework of 37 measures. The various policy measures are organised into three axes with each axis targeting one of the three main domains (objectives) of intervention (European Commission, DG Agriculture, 2006) and a fourth axis called LEADER. MS are required to allocate a minimum proportion of the EAFRD budget to each of the domains, thus ensuring a balance between the axes of rural development (Art. 17 of Regulation 1698/2005).

5.2.3.2.2 [Link to water pricing and water allocation](#)

As already mentioned in the second chapter, certain subsidies that existed in the past had the effect of changing the input/output cost ratio of a product, allowing a farmer to produce a certain type of crop, even if a high water price would have prevented such an activity or made it less profitable. This mainly historical distortion was clearly flagged up in the cases of Spain and France, but also in the context of the I-adapt case study in Greece subsidies for cotton limited the incentive coming from water pricing. Although it should be kept in mind that the main reason for the ineffectiveness of water pricing in these Member States (and others) should be found in an incorrect or incomplete application of the water pricing principles of the WFD. In the following section we look into this issue more in detail⁵⁹.

Pillar 1

Since the major changes in the 2003 CAP reform, almost all payments under Pillar 1 have been decoupled from production. The possibility to maintain a certain level of coupling for certain productions (e.g. maximum 25% coupling for cereals) was available to the Member States especially to support agriculture in marginalised areas. Experience gained in the application of the single payment scheme together with the evolution of the market situation showed that schemes kept outside the single payment scheme in 2003 could in 2009 be integrated into that scheme to promote more market-oriented and sustainable agriculture.

⁵⁸ For details see <http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2009:030:SOM:EN:HTML>.

⁵⁹ Please consider also the more detailed report on this issue Interwies et al., 2006.

Indeed, the 2009 Health Check removed most of the remaining coupled payments (in particular for cereals) through a 3-year transition period, i.e. by the end of 2011 (Regulation 73/2009).

According to a study by Agrosynergie, 2010⁶⁰ the part of aid that has remained coupled after the 2003 reform was not sufficient to prevent a decline in areas/production compared with the level of coupled aid in place before the reform. For certain sectors, the choice of keeping partially coupled aid has not been sufficient to maintain growers' interest in production compared with other choices (i.e. durum wheat, maize, protein crops, seeds) or trends have been affected by other factors that are more relevant than the maintenance of coupled aid (i.e. hops, protein crops, beef and sheep/goat meats). Only for some oil seeds (sunflower and soya), flax and hemp, tobacco and processing tomatoes the maintenance of a part of coupled aid has made it possible to keep growing crops and slow down the reduction in domestic supply.

In this general context the production decreased and the reform appears to have encouraged an extensification of Community agriculture but mostly in countries not facing water stress. In particular, the reform has brought about an increase in fodder crops in some Member States (Germany, Sweden, Austria, Ireland, Netherlands), as well as an increase in fallow land (Spain, United Kingdom, Finland) despite the elimination of the set-aside instrument. Finally, there was an increase in pasture and grazing land in Spain, Denmark, Finland, Sweden, Netherlands and Portugal.

It should be noted that these remaining coupled payments will now be decoupled by the end of 2011 and moved into the Single Payment Scheme (SPS). However, partially coupled direct payments for cotton in Bulgaria, Greece, Spain and Portugal are proposed to be maintained in the proposal for the CAP 2013+. The proposed support is slightly decreasing as compared with the current support (compare article 90 of Reg 73/2009 and article 44 of proposed regulation).

More interesting is that according to the above mentioned study the basic stability of surfaces and production is closely related to the international price boom and the abolition of mandatory set-aside. According to Agrosynergie (2010) this latter factor has led to returning land previously set-aside to production, and to mitigating the effects of decoupling. In addition to this, it has to be mentioned that water prices normally do not follow international prices, which also limits the potential impact towards incentive pricing. If crop prices raise and water prices remain stable it is obvious that there is little incentive to reduce water use. On the opposite, in the case of decreasing crop prices, high water prices could have a stronger impact.

In 2010, Member States had to establish a GAEC that ensures compliance with authorisation procedures in cases where the use of water for irrigation is subject to authorisation. This is expected to have a positive impact on water pricing mechanisms as it should reduce illegal abstraction because of the risk of double sanction.

⁶⁰ The full study can be downloaded at http://ec.europa.eu/agriculture/eval/reports/decoupling/exec_sum_en.pdf

Pillar 2

The second pillar of the CAP has several objectives, as set out earlier. These objectives directly or indirectly can support water pricing mechanisms as follows (see also Interwies et al., 2006):

- A framework of around 37 measures can be used for protecting and enhancing water resources in agriculture. The main relevant measures are: training of farmers, use of advisory services, modernisation of agricultural holdings (e.g. improvement of water efficiency), agri-environmental measures (RDR article 39) (crop rotation, catch crops, improved management of the pesticides,...), support for the application of mandatory measures stemming from the implementation of the Water Framework Directive (WFD) (RDR Article 38).
- These payments can set an incentive to farmers to establish higher environmental standards than those set out under Cross Compliance. Often the financial costs of water services are partly covered by Rural Development payments (or others) used for infrastructure investments. This reduces the burden of cost recovery (financial costs) for farmers. However, as set out in (Dworak et al., 2009) the saved money is sometimes used to expand the irrigated area, leading to no overall savings if these irrigated areas do not lead to a reduction of irrigated areas elsewhere.

The rural development incentive mechanism, however, differs from the WFD mechanism: CAP incentive payments (especially agri-environment) establish a system whereby environmentally friendly practices are rewarded (positive incentive), WFD water pricing schemes should create a system that discourages environmentally harmful practices (negative incentive) in a similar way to cross-compliance. These two approaches should thus be complementary. It is stressed that cross-compliance is not intended to serve as a substitute for poor implementation by the MS of the specific enforcement provisions of the concerned legal instruments.

The CAP 2013+

On 18 November 2010 the Commission tabled a Communication on "The CAP towards 2020" which outlines options for the future CAP and launches the debate with the other institutions and with stakeholders. Following this communication the Commission tabled legal proposal for a new CAP on the 12 October 2011⁶¹.

According to this proposal, the following elements are highly relevant for water:

- A green component, going beyond the requirements of cross-compliance, is proposed to be introduced into the system of direct payments. Thirty percent of direct payments would be tied to this greening component, turning a substantial part of first pillar payments into payments for delivering ecosystem services. In particular, "Greening has the potential to improve the retention of soil carbon and grassland habitats associated with permanent grassland, deliver water and habitat protection through the establishment of ecological focus areas, and improve of the resilience of soil and ecosystems through crop diversification.
- The role of farm advice is proposed to be strengthened. Thus, the scope of the Farm Advisory System would be broadened to cover among others actions related to the protection of water. This could be used to help farmers to become more efficient and by that to better cope with higher water prices..

⁶¹ http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/index_en.htm

- The existing GAEC according to which farmers have to comply with national abstraction rules would remain. This is an important element to tackle illegal abstraction, as farmers doing so would lose some or all of the direct payments, as well as possible payments received in the context of agri-environmental commitments, and would have to pay penalties for breaking the national law. The Water Framework Directive and the Directive on the sustainable use of pesticides are proposed to be included into cross-compliance once these Directives are implemented by all Member States and the obligations directly applicable to farmers have been identified.
- As regards rural development, *ex ante* conditions would have to be fulfilled prior to the adoption of the programmes. One such condition is the existence of a) a water pricing policy and b) an adequate contribution of the different water uses to the recovery of the costs of water services.

One of the "priorities" of rural development policy would explicitly include improving the EU farm sector's water-efficiency. As in the current programming period, support for technical infrastructure investments (including irrigation facilities) would be maintained. This might help in situations where cost recovery rates are not 100%. However, it is important to note that only investments leading to a reduction of previous water use by at least 25% would be considered as eligible expenditure in the old Member States ("EU-15"). Derogation would be possible in the new MS on condition that the investment would have no negative impact on the environment.

It is important to note that this proposal will be subject to discussions in the Council and the European Parliament.

5.2.4 Beyond the case studies - EU policies with the potential to affect Water Pricing

5.2.4.1 Communication on Water Scarcity and Droughts

5.2.4.1.1 Main objectives

Over the past thirty years, droughts and water scarcity have dramatically increased in number and intensity in the EU. Taking this into account the European Commission published a Communication on Water Scarcity and Droughts in 2007. This Communication outlined the main challenges surrounding water scarcity and droughts in the European Union and identified seven policy options for tackling the main challenges. The aim of these options is to move towards a water-efficient and water-saving economy by improving water demand management. To ensure water demand management is prioritised over water supply management, a water hierarchy has been set (from water saving to water pricing policy and alternative solutions). Additional water supply infrastructures should be considered as an option when other options have been exhausted, including effective water pricing policy and cost-effective alternatives. Water uses should also be prioritised: it is clear that public water supply should always be the overriding priority to ensure access to adequate water provision.

5.2.4.1.2 Link to water pricing and water allocation

The Communication outlines seven policy options to tackle water scarcity and droughts. Six out of them support and hamper water pricing elements:

- Putting to right price tag on water. This option gives an incentive to set up water pricing in line with the WFD. The goal of this action is to support water tariffs based on a consistent economic assessment of water uses and water value, with adequate incentives to use water resources efficiently and an adequate contribution of the different water uses to the recovery of the costs of water services. It also supports compulsory metering programmes. All three (Cost recovery, incentive pricing polluter pays) water pricing elements are covered.
- Allocating water and water-related funding more efficiently. This policy option has two goals that indirectly support water pricing: improving land-use planning and financing water efficiency. Rewarding water-efficiency helps in compensating water prices for those who try to farm in a sustainable manner and as such it would improve the acceptance by the farmers of the principle of water pricing. As seen in the case studies, allocation of water, coupled with a metering system, is a crucial prerequisite for water pricing. Several basins (FR, NL, CY, ES) have already developed an allocation hierarchy. This policy would expand this approach across Europe.
- Water related funding supports the uptake of water saving and water efficiency measures. However, following the principles set out in Art 9 WFD (cost recovery and the consideration of socio-economic aspects of a basin), this funding should not be used to lower existing cost recovery rates, but should be located to regions with difficult socio-economic conditions covering mainly investment costs. Thereby the focus should be on investments which achieve high savings as well as on support for shifting to water saving farming practices.
- Considering additional water supply infrastructures. In regions where all water-loss prevention measures have been implemented according to the water hierarchy, new water supply infrastructure may be a solution. While this does not necessarily distort water pricing, it is important that full cost recovery, including environmental and resource costs, are taken into account in new construction.
- Fostering water efficient technologies and practices. The goal is to promote water saving and reducing water wastage across all sections, including developing standards and legislation to support such technologies. This option does not distort water pricing but it does provide an indirect incentive to set up water pricing, as water efficient technologies alone cannot reduce water use. Regions focussed on water savings may be incentivised to take a step further and introduce higher water pricing to promote more water savings.
- Fostering the emergence of a water-saving culture in Europe. This action focuses on awareness-raising involving all actors in the water sector by information (including labelling), education, and training. Similar to above, this option does not distort water pricing but it does indirectly provide an incentive to set up water pricing. The Adour-Garonne case study notes that 1€ paid to the Water Agency as a water abstraction tax results in 3 to 4€ of support from the Agency for the agricultural sector (in terms of aid for the operation of low water (recharge) systems, operational advice or rational water use). Additionally, in 2011, the Adour-Garonne Water Agency will provide 1 M€ financial support to foresee a weekly advice for irrigation (pilotage de l'irrigation); experts estimate an annual 10% potential water savings related to this initiative or 70-80 Mm³.
- Improve knowledge and data collection. The goal is to integrate water scarcity and droughts information into WISE and develop agreed indicators for assessing water resources. It does not influence or incentivise water pricing systems, but it allows to achieve a better understanding of the cause-impact relationship and to close the information gaps between water abstractions, water consumption and allocated water.

Within the water hierarchy for EU action, water pricing in the field of water scarcity and droughts policy is a high priority, second only to water saving. As such the Communication on Water Scarcity and Droughts clearly creates incentives to set up water pricing systems in the EU.

5.2.4.2 Nature conservation policies

5.2.4.2.1 Main objectives

EU Nature conservation policy is implemented by two main pieces of legislation: the European Parliament and Council Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds (named herein after Birds Directive) and the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (named herein after Habitats Directive). These two Directives aim to provide protection for listed species and habitats and to create a 'coherent European ecological network' of sites – called Natura 2000 – to enable the maintenance or restoration of natural habitat types and the habitats of species at favourable conservation status (Art. 3, Habitats Directive).⁶²

The Birds Directive requires that Special Protection Areas (SPAs) be established for listed bird species and for regularly occurring migratory species of birds. The Habitats Directive similarly requires Special Areas of Conservation (SACs) to be designated for listed plant and animal species, and habitats. Together, SPAs and SACs make up the Natura 2000 sites. SPAs and SACs areas can overlap. It is co-financed through the Commission's LIFE Nature Programme⁶³ (set up in 1992 to develop EU environmental policy) and other Community financial instruments.⁶⁴ (Naumann, 2007)

The aim of the **Habitats Directive** is to contribute to the maintenance and protection of biological diversity (biodiversity) in the European Union through the conservation of wild plants and animals as well as natural habitats. The Directive established the European ecological network "Natura 2000" in order to ensure habitat and species protection.

The objective of the **Birds Directive** is to provide for the protection, management and control of naturally occurring wild birds and their nests, eggs and habitats, as well as to regulate the exploitation of these species within the European Union. It serves to ensure that all wild birds receive basic protection from trapping and killing; that sufficient habitat is protected for wild birds, especially to assure the survival of threatened and migratory species; that large-scale or non-selective means of taking birds are prohibited and that the sale or commercial exploitation of most species is prevented. To this extent, Member States are required to enact special conservation measures to ensure that wild birds and their habitats, in particular Annex I species, are protected. These include the designation, management and control of Special Protection Areas (SPAs) and prohibiting certain harmful activities (e.g. in agriculture or forestry). Besides

⁶² Report from the Commission on the implementation of the Directive 92/43/EEC on the conservation of natural habitats and of wild fauna

and flora [SEC(2003)1478: page 8]

⁶³ The new Financial Instrument for the Environment, the so called "LIFE+" (for the period 2007-2013), has entered into force with the publication of the Regulation in the Official Journal L149 of 9 June 2007. (For more detailed information see: <http://ec.europa.eu/environment/life/funding/lifeplus.htm>).

⁶⁴ Naumann, S., 2007. Convergence with EU Nature Protection Policies. Short guide for ENP Partners and Russia. Ecologic Institute. European Commission: Brussels.

creating SPAs, Member States shall maintain habitats, restore destroyed biotopes and create biotopes for naturally occurring wild birds.

5.2.4.2.2 Link to water pricing and water allocation

There are no apparent links between the Habitats Directive and the Birds Directive and water pricing. However, it can be said that a number of indirect links exist to support sustainable water use. The Habitats and Birds Directives explicitly mentioned in the WFD in the context of establishing a river basin management plan⁶⁵, and Member States are required to register and monitor all protected areas and to achieve their respective objectives by 2015.⁶⁶ Similarly the Habitat and Birds Directive are essential for sustainable water protection.⁶⁷

Article 6 of the Habitats Directive makes provision for the establishment of necessary conservation measures in SACs. Article 6(1) defines necessary measures as “*a series of measures required to maintain or restore the natural habitats [...]at a favourable status*”; furthermore, these measures have to correspond ‘*to the ecological requirements of the natural habitat and species*’ (as listed in Annex I and II). As such, water can only be abstracted in Natura 2000 sites if it does not adversely affect the site’s ecologic integrity; the management of water use in an area must take into account environmental flows to ensure habitat for aquatic species. Conservation measures can take at least two forms: appropriate administrative or contractual measures or appropriate management plans. Regarding the former, there are a number of water management measures, including changes in flow management, measures to address water quality issues and, importantly, measures to reduce water abstraction. Allocation plans can play an important role by taking into account different water users, including the environment, to ensure sustainable water use in Natura 2000 areas. In the past, the environmental impact of abstraction was not clear, which has hampered the ability to reduce water abstractions. Under the Habitats Directive, it is only needed to show that land use activities cause ‘no signification impact’, thus uncertainties surrounding the impact of water use are a reason to reduce abstraction at Natura 2000 sites (Parliamentary Office of Sciency and Technology, 2006). As such, the Directive strengthens the need to account for environmental water use in allocation plans.

The Habitats Directive and the Birds Directive are drafted such that Member States can derogate from provisions stated in these Directives if doing so would “prevent serious damage in particular to [...] water”⁶⁸, thus preventing harmful mechanisms conflicting with the WFD. Article 6 also lays down the conditions for plans or projects that may be implemented despite a negative assessment for the Natura 2000, due to a lack of alternatives and to ensure considering public interest, Member States are required to take appropriate compensatory measures to ensure that the overall coherence of the Natura 2000 network is protected (Arts

⁶⁵ WFD: Annex V No 1(v) and Annex VI, Part A.

⁶⁶ Scheuer, S, 2005, Water in EU Environmental Policy Handbook – A critical analysis of EU Environmental Legislation. European Environmental Bureau: Utrecht. Available under: http://www.eeb.org/publication/policy_handbook.html [last accessed 01.09.2011]

⁶⁷ European Commission, 2007, Accompanying document to the COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL ‘Towards Sustainable Water Management in the European Union’ First stage in the implementation of the Water Framework Directive 2000/60/EC. [COM(2007) 128 final]. European Commission: Brussels.

⁶⁸ Habitats Directive, Art 16 (1b); Birds Directive Art 9 (1a).

6 (3) 6 (4)). In the case that these Natura 2000 sites are water based, this requirement may create synergies with the “polluter pays” principle of the WFD.

5.2.4.3 Adaptation policies

5.2.4.3.1 Main objectives

Addressing climate change requires both the reduction of greenhouse gas emissions (GHG) (i.e. take mitigation action) and secondly adaptation actions to deal with the unavoidable impacts. The framework for adaptation to climate change is set in the 2009 White Paper on reducing the EU’s vulnerability to the impact of climate change⁶⁹. The framework is designed to evolve as further evidence becomes available. It will complement action by Member States and support wider international efforts to adapt to climate change, particularly in developing countries.

The objective of the EU’s Adaptation Framework is to improve the EU’s resilience to deal with the impact of climate change. The framework will respect the principle of subsidiarity and support overarching EU objectives on sustainable development. The EU’s framework adopts a phased approach. The intention is that phase 1 (2009-2012) will lay the ground work for preparing a comprehensive EU adaptation strategy to be implemented during phase 2, commencing in 2013. Phase 1 will focus on four pillars of action: 1) building a solid knowledge base on the impact and consequences of climate change for the EU, 2) integrating adaptation into EU key policy areas; 3) employing a combination of policy instruments (market-based instruments, guidelines, public-private partnerships) to ensure effective delivery of adaptation and 4) stepping up international cooperation on adaptation. For phase 1 to be a success, the EU, national, regional and local authorities must cooperate closely.

5.2.4.3.2 Link to water pricing agriculture and water allocation

Although water availability is recognised as a main issue for which adaptation measures are needed, water pricing is not directly mentioned. The EU is currently in phase 1 of the EU Adaptation framework, which will lay the ground work for a comprehensive EU adaptation strategy to be implemented during phase 2 (commencing in 2013). More specific actions are expected as part of phase 2 of the EU adaptation strategy. However, several indirect links to water pricing as part of actions to be taken in Phase 1 are included, and these are elaborated in the next paragraphs.

Phase 1 will focus on four pillars of action with the first pillar being “building a solid knowledge base on the impact and consequences of climate change for the EU”. A specific action here is: *“The need for more quantified information on the costs and benefits of adaptation.”*

Including water pricing measure as part of the adaptation measures to overcome a lack of water availability, means we should have a good idea on the cost and benefits of this measures. Furthermore, the Adaptation Strategy mentions that priority should be given to adaptation measures that would generate net social and/or economic benefits irrespective of uncertainty in future forecasts (no-regret measures).

⁶⁹ COM(2009) 147 final – White paper “Adapting to climate change: Towards a European framework for action”

The second pillar of phase 1 is employing a combination of policy instruments (market-based instruments, guidelines, public-private partnerships) to ensure effective delivery of adaptation. Examples of MBIs mentioned in the Strategy are for example “incentive schemes for protecting ecosystem services or for projects enhancing the resilience of ecosystems and economic sectors in the form of Payments for Ecosystem Services (PES)”. Such payments clearly complement water pricing incentives. Due to the low water prices in Europe, the PES are expected to have a stronger impact on water use behaviour and thus on achieving environmental objectives.

The third pillar of phase 1 focuses on integrating adaptation into EU key policy areas including the increase of resilience of agriculture. This leads to several incentives which may be indirectly related to water pricing in agriculture. Relevant actions here are:

- Ensure that measures for adaptation and water management are embedded in rural development national strategies and programmes for 2007-2013
- Consider how adaptation can be integrated into the 3 strands of rural development and give adequate support for sustainable production including how the CAP contributes to the efficient use of water in agriculture

Both aspects can be achieved by payments to farmers which influence water pricing.

5.2.4.4 EU Cohesion Policy

5.2.4.4.1 Main objectives

The EU Cohesion Policy seeks to reduce regional disparities in terms of income, wealthier and opportunities. EU regional policy is financed by three main funds, which can be used under some or all of the regional policy objectives:

- European Regional Development Fund (ERDF)
- European Social Fund (EDF)
- Cohesion Fund

The ERDF and the Cohesion Fund are more important with regards to water management compared to the ESF. The ERDF aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. It finances direct aid to investments in companies to create sustainable jobs; infrastructure linked notably to research and innovation, telecommunications, environment, energy and transport; and financial instruments to support regional and local development and to foster cooperation between towns and regions. The Cohesion Fund is aimed at Member States⁷⁰ whose Gross National Income (GNI) per inhabitant is less than 90% of the Community average. It serves to reduce their economic and social shortfall, as well as to stabilise their economy. The Cohesion Fund finances activities under the following categories: trans-European transport networks and the environment.

⁷⁰ Bulgaria, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia. Spain is eligible to a phase-out fund only as its GNI per inhabitant is less than the average of the EU-15.

Funding for regional and cohesion policy for 2007-2013 amounts to €347 billion - 35.7% of the total EU budget for that period – or just over €49 billion a year. All cohesion policy programmes are co-financed by MS, bringing total available funding to almost €700bn.

5.2.4.4.2 Links to Water Pricing and water allocation

The table below lists types of activities under the WFD that could be funded via Cohesion Policy and Structural Funds.

Table 9 Links between Cohesion policy and the WFD

Cost item		Funding options		
		ERDF	ESF	Cohesion Fund
Framework for management and administration	Administration of River Basin Authorities			
	Strengthening of RBAs	X	X	
	Technical capacity-building for RBAs	X	x	
	Setting up a stakeholder network and managing the participatory processes by RBAs		x	
	Communication/information material and publications for participatory processes managed by RBAs			
	Scientific studies, inventories, mapping	X	x	
	Awareness-raising campaigns		x	
Operation and monitoring	Monitoring systems and risk analysis	X		
	Pilot demonstrations			
	Flood risk management	X		
	Vegetation restoration			
	Erosion control	X		
	Water-saving solutions for agriculture			
	Water-saving solutions for industry	X		
	Water-saving solutions for end-users			
	Pollution control			
Infrastructure	Adapting existing water infrastructure	X		X
	New infrastructures for the management of water resources	X		X
	Improvement of water networks	X		X
	Wetland restoration	x		
	Equipment acquisition	X		

Source: WWF EU Funding Handbook, 2005 in EC, 2006, p.17

While the Cohesion policy and its funds do not specifically mention water pricing or provide an incentive to set up water pricing, the activities/projects funded both support and distort water pricing elements:

- Water infrastructure programmes are aimed at providing water users with water of adequate quality and ensure supply and can be used to finance water efficiency. With the introduction of the WFD, these

projects must also be beneficial for the status of water resources unless they meet the exemption conditions, including the mitigation of damage. While water infrastructure projects can be carried out in line with the environmental objectives of the WFD, adapting existing water infrastructure, financing of new water infrastructure and improving water networks distorts full recovery of financial costs related to maintenance and capital costs. By providing partial subsidies to expand reservoirs and supply networks, water users do not make an adequate contribution to the recovery of the costs of water services. However, as Article 9 stipulates, “Member States may [.....] have regard to the social environmental and economic effects of the recovery. Since Cohesion funds focus on economically challenged areas, reduced cost recovery is still in line with the WFD.

- Activities funded under “Administration and Management” indirectly support incentive pricing. However, the Cohesion funds finance awareness-raising campaigns, which can help to increase understanding of water needs in the agriculture sector and reduce water use. Additionally, the capacity building and stakeholder network activities improve administrative competences, which could in turn aid local agencies in water management and setting water prices that support water savings. The link, however, is relatively weak.

Given that the Cohesion funds finance capacity building and administrative management, there is the potential for the funds to support Member States in the implementation of Article 9. Scientific studies could be financed investigating methodologies for setting environmental flows and including environmental and resource costs into cost recovery calculations. Furthermore, through financing inventories and mapping the funds could support river basins in monitoring and control activities that have the potential to reduce over-abstraction.

5.3 Identified links to EU level policies

The efficacy of water allocation and pricing policies to achieve their objectives is not only influenced by certain prerequisite conditions and drivers, they are also influenced by sectoral policies. Evidence from the case studies shows that the ability of water allocation and pricing policies to meaningfully affect water use behaviour is partly hindered by historical agriculture policies; this is especially the case in Cyprus, France and Spain.

There is evidence from literature that certain crop choices of farmers were to some degree influenced by the subsidies/payments provided to support the growing of these crop species (e.g. Gutiérrez/Gómez 2009; Lorite/Arriaza 2009). At the same time, the effectiveness of a water pricing policy in terms of water savings is strongly related to the choice farmers make with regard to whether they grow water-intensive or non-water-intensive crops. In Cyprus, certain types of crops are supported by payments not related to the area but to the crop. More explicitly, Cyprus chooses to grant such direct payments to citrus fruits (Community Funds) and to bananas, deciduous trees, olive trees, table grapes and fodder (State Aid and Complementary National Direct Payments)⁷¹ (Department of Agriculture – personal communication). Therefore, the effectiveness of water pricing with regard to water savings could be hampered by EU and national payments

⁷¹ It must be noted here that only 60% of olive trees, 6% of the grape stocks and about 10% of arable crops (i.e. irrigated fodder) are irrigated during the summer months (Department of Agriculture – personal communication).

to support water-intensive crops. Similarly, before the 2003 CAP reform, France decided to grant higher payments to irrigated crops (maize in particular) compared to non-irrigated crops, thus providing incentives for farmers to choose irrigated (maize) cultivation. This incentive has been significantly reduced by the partial decoupling in 2006 (for France). The CAP health check resulted in a total decoupling for most cultivations already in 2010.

It is of note that historical support payments and higher margins have made it possible for farmers to further invest and modernise irrigation infrastructure. It is argued that this evolution also explains the high level of abstractions for irrigation in the French case study area. The area of irrigated agriculture (maize/sunflower) has decreased in the last decade⁷², though evidence suggests that water abstractions have not decreased in the same proportion. Maize appears to be still favoured by farmers and they chose to intensify irrigation on a smaller arable area. This decision is then mainly inspired by sales prices for maize and high yields of irrigated maize, while the water prices seem to be too low to balance higher application rates.

In Spain, there has been extensive research into the impact CAP payments have on the agriculture sector, including water use. In Spain, CAP payments are mainly addressed to irrigated agriculture, rather than rainfed, especially for the category of Pillar 1 “Other payments”, and coupled payments still represented 15% of total Pillar 1 in 2009 (Becarés et al., 2010).⁷³ Lorite and Arriaza (2009) report different effects of decoupling in the Guadalquivir valley, depending on the crop type: for crops with high water productivity (e.g. cotton, beet, garlic, olive), consumption of water and agrochemicals decreases due to the reduced income, while for low water-productive crops such as winter cereals and sunflower, these reductions did not take place. These changes in farmer behavior with regard to water management would lead to increases in irrigation water productivity for cotton and beet using deficit irrigation practices, with less environmental impact and a larger guarantee of sustainability. In the *Campiña Baja* of Guadalquivir, partial decoupling under the current water pricing setup (marginal cost of water approaching zero) does not necessarily induce significant changes in the total irrigated area for competitive crops, i.e. olive (so far, constrained with production quotas and availability of irrigation facilities), cereals and industrial crops (sunflower, beet and cotton), with land reallocation from cereals to industrial crops (MMA, 2007). This latter phenomenon however reverts if full decoupling is considered. On the other hand, legumes are replaced by horticultural crops. However, these results cannot be generalised as they are dependent on local conditions, including soil characteristics and agronomical suitability, production patterns and farmer behavior towards risk and management complexities.

The impact of CAP reform on water demand was reported similarly as for the extension of irrigated area. No significant differences can thus be derived from the partial and full decoupling scenarios introduced in 2003. Constraints on farmers' choices are related to water availability, rather than to its price, and allocation is made according to benefits, risks and management of crops. Variations on water demand were reported to be less than 6% between scenarios. Comparing simulated scenarios for Agenda 2000, CAP 2003 Reform and Total Decoupling, in the Guadalquivir, Gutiérrez and Gómez (2009) found that as decoupling is higher, the extension of irrigated land is reduced and, therefore, decoupling subsidies decreases irrigation. Nevertheless, this reduction of irrigated land does not have a similar effect on the level of water

⁷² <http://www.eau-adour-garonne.fr/page.asp?page=3315>

⁷³ For further reading, please see the extended description of the Guadalquivir case study in annex 4.

consumption, which is maintained. Higher dependence on market prices would then result in an agrarian model that is less land-intensive and more water-intensive.

Despite not inducing significant effects on the demand of water, effects of decoupling are relevant regarding farmers' response to changes in water prices. Decoupling itself does not save water, but enhances economic incentives to save water (and other inputs). MMA (2007) also reports a neutral effect of the CAP 2003 reform in Campiña Baja on water use, and a higher farmers' sensitivity to economic incentives, like input (e.g. water) prices

In a survey involving EU-15 and non-MS farms, Giannocaro and Berbel (2011) however reported significant differences in farmer's decision under different CAP scenarios regarding use of water, with an intention of slight reduction in water use on the farm in case of removal of CAP payments and instruments (CAP scenario by 2020), as well as a long-term invariant pattern to maintain current use of water, with intention of slight increase. CAP role however appeared to be non univocal and strongly case-specific (e.g. depending on subsidies, farm size, farmers' age, farm location). A common pattern of impact thus cannot be established as regional differences matter both on site-specific structural and institutional conditions (Blanco Fonseca, 2009)

Through the second pillar of the CAP, the EU cofinances specific investments for farmers to better address environmental requirements in their operations. Eligible investments, defined at national or regional level aim to reduce pollution from agriculture, pressure from water abstractions, maintain biodiversity or decrease soil erosion. In France the programme supports investments in metering equipment or specific water saving equipment to reduce the pressure from abstractions. In Romania, measure 125 allows for the modernisation of irrigation equipment to increase efficiency and reduce energy consumption; in order to avoid putting additional pressure on the environment, beneficiaries must prove that the project results in a decrease in water use and waste water discharge by a minimum 10%. However, rural development policies in Cyprus have had no impact on water policies, as irrigation-related measures have not been funded through such programmes. Although not all MS use the 2nd pillar to modernise irrigation facilities, rural development plans can be supportive and help to achieve environmental goals.

Other EU policies, however, may positively influence future water pricing policies, such as the Water Scarcity and Droughts. In Cyprus the objectives of this Communication was taken into account for the setting of water pricing policies in light of the current Art. 9 revision (Hadjipanteli 2011); however, none of the other case studies reported any link between the implementation of WFD Article 9 and the Communication on WS&D. Infrastructure subsidies from Rural Development and Cohesion Policy Funds potentially pay for large investment costs, which otherwise would have to be borne by the farmers. In the case of rural development, it should be noted though that, for investments aiming at modernisation of the agricultural holding such as irrigation equipment, the public contribution is limited to 40% of the total amount to be financed. 60% of the investment is borne by the farmer. Such subsidies are in line with Art 9 WFD requirements because MS can justify a deviation from adequate cost recovery because of social, environmental and economic effects of the recovery.

5.4 Conclusions

The seven highly diverse case studies undertaken in this study have highlighted the successes and pitfalls of agricultural water allocation and pricing policies. With the implementation of Article 9 in its early stages, with some Member States still poised to make revisions, the results of case study analysis highlight a few key conclusions.

With respect to the objectives of Article 9, most of the case studies indicate that there is still a considerable lack of cost recovery, both financially and with respect to environmental and resources costs. In terms of financial cost recovery, while operation and maintenance costs are being recovered in the MS reviewed, capital costs remain a challenge. Central water management facilities and new constructions for dams and reservoirs, for example, are still subsidised by the State and thus represent a form of indirect support for irrigation activities. Furthermore, the case studies have not demonstrated that environmental costs were fully taken into consideration. Romania is one of the only case studies where the government considers that environmental and resources are covered; however, while internal costs have been taken into account, externalities still need to be addressed. Cyprus is currently working to include such costs in future water pricing calculations, but it is clear from the case studies that guidance on cost recovery, especially methodologies to include externalities, would be highly useful.

Beyond cost recovery, none of the case studies have achieved incentive pricing. Reasons behind this are various; the conditions set up in Article 9 itself might play a role. Given that Member States are able to adjust incentive pricing for local conditions, the extent to which water pricing levels are actually able to induce sustainable water use has not been proven. The low share of water prices in overall production costs, highlighted by the Cyprus, France, Romania and Spain case studies, indicate that current water pricing policies are not geared towards incentive pricing. Rather, the cases of Romania and Spain highlight the more significant role electricity prices play in water use. Both countries but especially Romania saw decreases in water use due to marked increases in electricity prices. In addition, higher prices, whether they are a result from the price of water or electricity, do not necessarily result in water savings but rather a shift in crop production to higher value crops; this is to ensure that margins remain the same. A shift towards higher value crops or profit losses is more dependent on the geographic and socio-economic situation of the river basins than on water prices themselves; poorer farmers are not as easily able to change production and not all high value crops can be grown in a region. A major gap still remains in some of the case study countries regarding the charging of groundwater abstraction, mainly for private users. The lack of water fees for groundwater is still found in Cyprus and France and some areas of the Netherlands. Water pricing for self-abstraction needs to be introduced in basins with highly exploited groundwater reservoirs or even basins experiencing some scarcity. Without fees there is no incentive to use less water.

Effective approaches to water management and allocation in the agriculture sector, especially regarding abstraction in scarce areas, rest on the ability to monitor and control water use activities. The most helpful tool in ensuring a transparent understanding of water use in a basin is metering. Metering is not only a precondition for monitoring and controlling of abstraction permits, it is also necessary for implementing volumetric pricing. As some countries are still struggling with gaining a complete overview of abstractors, e.g. Cyprus and Spain, the installation of metering is a key factor to ensure a legal framework. The case studies

of Cyprus, France and Romania have confirmed the positive impact metering has on water use and promoting water savings through volumetric pricing.

However, metering is not the only tool needed to combat illegal abstraction: sufficient budget and capacity for monitoring and control is also highly important. Additionally, heavy charges should be levied against over/illegal abstraction; this has proved beneficial in Cyprus. However, the monitoring systems in both Cyprus and Spain still need to be strengthened in order to best complement water allocation in their basins.

In especially water scarce times, the practice to restrict water use is included in all of the water allocation policies found in the case study areas. These restrictions have been found to significantly impact farmer incomes. As highlighted by the French example, there is a need, however, to notify farmers as early as possible regarding these restrictions to enable them to change their cropping patterns/behaviour. With respect to water hierarchies, the case studies show some best practice examples of including the environment as a water user. Additionally, both Romania and France have managed to incorporate the concept of minimum ecological flow in their water allocation designations. This has especially shown to be useful to limit abstractions and to control allocations in the designated water stressed areas in Adour Garonne, France. The mandatory implementation of these concepts, i.e. environmental flows and environment as a water user, should be analysed further within the CIS process with respect to their beneficial roles in water allocation decisions.

A key result of the case study analysis is that programmes targeting technological improvements have had mixed results. Water efficiency programmes have a high potential to complement water allocation and pricing policies but they need to be done right. Consideration has to be made regarding the potential rebound effect; increased efficiency should not lead to the same water use levels or increased water use coupled with the expansion of irrigated areas. The water savings criteria found in Romania, where 10% water savings must be achieved if using rural development funding to modernise irrigation systems, should be a standard found in all Member States. Such an approach is currently proposed within the latest CAP reform proposal (25% water saving). This criterion enables Member States to unlock the potential of efficiency programmes and achieve water saving goals, thus avoiding rebound effects.

The amount of effort spent on awareness raising programmes has been found to be effective, both with respect to water savings and with respect to acceptability from farmers. On the one hand, farmers are more aware and more informed regarding the importance of water for the environment, and on the other hand, changes in water related policies are more accepted due to increased transparency. A number of the case studies countries mentioned that farmers are accepting towards water management decisions, for example in Cyprus, France and Spain.

Experiences in water trading in Australia are helpful for countries considering water trading. Key elements for a successful water trading scheme are: unbundling the water access entitlements, install metering so control is possible, put aside sufficient environmental allocations, apply a unit share structure instead of volumetric entitlements, and make license registers mandatory. Furthermore, there are currently several research

projects on-going (EPI Water⁷⁴) analysing marketing schemes, but it is too early to include their findings in this report.

While the efforts taken in the Member States with respect to water allocation and pricing have shown some success factors and also mixed outcomes, these policies do not stand alone. A few of the case studies highlighted the past impact CAP payments have had on production and its link towards water use. Although most of the coupled payments are no longer available, their long history has resulted in unsuitable, i.e. high intensive water use, crops still being grown in water scarce areas today. Continued scarcity problems along with the positive factors and drivers mentioned above will hopefully lead to a reversal in production choices in the future.

What these conclusions all show is that water pricing and allocation policies alone cannot function without support. A combination of water pricing, water saving technologies and awareness programmes/farm visits/guidance will more likely lead to change in water use behaviour.

⁷⁴ See <http://www.feem-project.net/epiwater/>

6 Conclusions and Recommendations

Aim and approach of the study

After a theoretical part on the different concepts behind water pricing and water allocation policies and what these imply for the agricultural sector, an overview has been given of the baseline situation across the EU, clearly showing the broad diversity regarding water allocation and water pricing policies towards the agricultural sector. The overview has been compiled from various publicly available literature sources. Member States had the opportunity to validate the draft presentation of collected information. The key tendencies and principles in water pricing and allocation in agriculture across the EU have been presented at the Water pricing conference in Warsaw mid September 2011. A second consultation round has been organised and some further modifications were done.

Seven case studies (river basins) within the EU as well as in third countries have been analysed in detail to assess successes and pitfalls of their policies: Cyprus, Spain (Guadalquivir), France (Adour-Garonne), Romania (Buzau Ialomita), Netherlands (Scheldt), Australia (Murray-Darling) and Mexico (Lerma Chapala). The highly diverse case studies undertaken have highlighted the successes and pitfalls of agricultural water allocation and pricing policies.

Water allocation policies

Generally, the **right to abstract or use water** is initially issued by a public authority through the granting of authorisations, licenses or permits. Water allocation to individual farmers and/or plots is carried out by different actors at different administrative levels. The rationale behind the initial allocation can consider the availability of water resources, the aim of the abstraction (use), environmental needs and other uses and the water source. Authorisation procedures and formalisation differ according to the quantity of water abstracted (in some MS licences are only needed above a certain threshold) or the pumping capacity. Time periods or duration of permits or authorisations can differ significantly between Member States.

In times of water scarcity or droughts, the practice to **restrict water use** is included in all of the water allocation policies found in the case study areas. In some Member States, restrictions are determined according to the hierarchy of water users (e.g. Netherlands, Cyprus, Spain and France). This can take the form of prioritising only according to sectors (e.g. prioritising domestic supply above agriculture) or, as is the case in the Netherlands and Cyprus, also within sectors (e.g. prioritising higher value crops). In some cases the environment is included as a separate sector.

Abstraction rules can be more stringent in areas qualified as suffering from chronic water shortage e.g. in France. Some interesting mechanisms have been identified, such as the innovative 'organismes uniques' in France or the strict rationing procedure in Cyprus. These restrictions have been found to significantly impact

farmer incomes. As highlighted by the French example, there is a need to notify farmers as early as possible regarding these restrictions, in order to enable them to change their cropping patterns/behaviour.

Both Romania and France have managed to incorporate the concept of **minimum ecological flow** in their water allocation designations. This has especially shown to be useful in order to limit abstractions and to control allocations in the designated water stressed areas in the Adour-Garonne RB (France). The mandatory implementation of these concepts, i.e. environmental flows and environment as a water user, should be analysed further within the CIS process with respect to their beneficial roles in water allocation decisions.

Australia, Spain and (to a lesser extent) Mexico have turned towards using **water markets** to trade water entitlements and allocations. The system is the most developed in Australia where water trading has helped individual irrigators (buyers and sellers) manage and respond to external drivers (including seasonal water availability, changes in commodity prices and input costs, government water policies and social trends) by allowing more flexible production decisions. That flexibility improved cash flow, debt management and risk management. However, in both Australia and Spain the pressure on the ecosystems has risen, due to problems with over-allocation of water rights.

Experiences in water trading in Australia are helpful for MS considering water trading. Key elements for a successful water trading scheme are: unbundle the water access entitlements, install metering so control is possible, put aside sufficient environmental allocations, apply a unit share structure instead of volumetric entitlements and make license registers mandatory. Furthermore, there are currently several research projects on-going (Cap & Trade, EPI Water) analysing marketing schemes, but it is too early to include their findings already in this report.

Water pricing policies

With respect to the objectives of Article 9, the baseline overview and the case study analysis indicate that there is still a considerable lack of **cost recovery**, both financially and with respect to environmental and resource costs (ERC). The level of cost recovery reflected in the water tariffs across the EU is highly different. Non-water stressed MS typically report the highest level of financial cost recovery. For at least 30% of the MS, O&M costs for the provision of water are only partly recovered. Capital costs (investments) are even more often (at least partly) subsidised by the state/regions. Central water management facilities and new constructions for dams and reservoirs, for example, are still subsidised by the State and thus represent a form of indirect support for irrigation activities.

ERC do not yet form a central element in pricing policies. Romania is one of the only case studies where the government considers that ERC are covered; however, while internal costs have been taken into account, externalities still need to be addressed. Cyprus is currently working to include ERC in future water pricing calculations, but generally it is clear from the case studies that guidance on cost recovery, especially methodologies to include externalities, would be highly useful.

It is difficult to make overall conclusions on water pricing policies, considering the **large variability in both tariff design as well as price level**, not only between MS but also inter- and intra-RBDs. Generally, the incentive in the water pricing mechanism to manage water sustainably is weak; however, a number of good practices could be identified.

Volumetric tariffs, which have the greatest potential to fulfil cost recovery and incentive functions, are generally used for self-supply and increasingly for water provision throughout the EU. However, **tariff levels are low to very low** (often below 0.01 €/m³ and - where prices were available - much lower compared to other sectors). Moreover, an **important share of water abstractions** for agriculture in the EU, even in water stressed areas, is **not priced yet**. Specifically, more than one third of the Member States has no tariff system for individual abstractions of farmers (or irrigators) and in this way does not recover any ERC for these abstractions. This lack of water pricing needs to be addressed in basins with highly exploited groundwater reservoirs or even basins experiencing some scarcity. For without fees there is no incentive to use less water.

A number of MS take the **scarcity** of the water resource and/or the volumes abstracted into consideration for their pricing scheme. Some MS **penalise** quantities abstracted above certain quota by charging a much higher price or, on the contrary, **favour** the use of alternative water sources by charging cheaper tariffs for treated effluent. In some MS, **area based** pricing systems can lead to an unfavourable situation where water intensive crops pay less compared to other crops.

Reasons behind the lack of incentive pricing are various. The conditions set up in Article 9 itself might play a role. Given that Member States are able to adjust incentive pricing for local conditions, the extent to which water pricing levels are actually able to induce sustainable water use has not been proven. The **low share** of water prices **in overall production costs**, highlighted by the case studies of Cyprus, France, Romania and Spain, indicate that current water pricing policies are not geared towards incentive pricing. Rather, the cases of Romania and Spain highlight the more significant role electricity prices play in water use. Both Member States - but especially Romania - saw decreases in water use due to marked increases in electricity prices.

In addition, higher prices, whether they are a result from the price of water or electricity, do not necessarily result in water savings but rather a **shift in crop production** to higher value crops; this is to ensure that margins remain the same. A shift towards higher value crops or profit losses is more dependent on the geographic and socio-economic situation of the river basins than on water prices themselves; poorer farmers are not as easily able to change production and not all high value crops can be grown in a region.

Closely linked to this issue, another key result of the case study analysis is that programmes targeting technological improvements have had mixed results. **Water efficiency programmes** have a high potential to complement water allocation and pricing policies but they need to be set up carefully. For example, in Spain efficiency programmes have led to increases in irrigation area and to an intensification of land and water use. The water savings criteria found in Romania, where 10% water savings must be achieved if using rural development funding to modernise irrigation systems, could serve as a standard for all Member States. Such

an approach is currently proposed within the latest CAP proposal. This criterion enables MS to unlock the potential of efficiency programmes and achieve water saving goals, thus avoiding rebound effects.

Effective approaches to water management and allocation in the agriculture sector, especially regarding abstraction in scarce areas, rest on the ability to **monitor** and **control** water use activities. The most helpful tool in ensuring a transparent understanding of water use in a basin is **metering**. Metering is not only a precondition for monitoring and controlling of abstraction permits, it is also necessary for implementing volumetric pricing. As some countries are still struggling with gaining a complete overview of abstractors, the installation of metering is a key factor to ensure a legal framework. The case studies of Cyprus, France and Romania have confirmed the positive impact metering has on water use and promoting water savings through volumetric pricing.

However, metering is not the only tool needed to combat **illegal abstraction**: sufficient budget and capacity for monitoring and control is also highly important. Additionally, heavy charges should be levied against over/illegal abstraction; this has proved beneficial in Cyprus. However, the monitoring systems in both Cyprus and Spain still need to be strengthened in order to best complement water allocation in their basins.

While the efforts taken in the Member States with respect to water allocation and pricing have shown some success factors and also mixed outcomes, these policies do not stand alone. A few of the case studies highlighted the past impact CAP payments have had on orienting production choices towards water-consuming crops and their link towards water use. Although most of the coupled payments are no longer available, their long history has resulted in high intensive water use crops still being grown in water scarce areas today. Continued scarcity problems along with the policy changes of recent years (e.g. CAP reforms of 2003 and 2009) and those still to come (e.g. CAP post 2013) should lead to a reversal in production choices in the future.

Recommendations to EU river basins for establishing agricultural water pricing

Based on the case study comparisons and the EU level policy analysis, the following policy recommendations can be made with regard to water pricing and allocation policy.

Overall issues

It should be noted that allocation and pricing schemes alone will not be able to reach the target of sustainable water use, especially due to issues related to the low price elasticity of demand. If e.g. crop cultivation is completely impossible without irrigation and if heavy investments have been made, irrigation will not easily be abandoned, even if water use is heavily charged. In the terms of an economist: the lower the price elasticity of demand, the lesser the change in behaviour will be resulting from a marginal price increase.

The share of the water cost in farmer's production costs also affects the elasticity of water demand. The higher the percentage represented by the water cost, the higher the elasticity tends to be. When the water cost only represents a negligible portion of the budget, the income effect will be insignificant and demand inelastic (and the opposite).

To summarise, if water is too cheap, there is no economic incentive to save it; if it is too expensive, the social impacts will be severe (mostly on small-scale farms); and if the price increase is only very small, the effect will also be negligible (i.e. the elasticity is low). General statements on the recommended position of the water price cannot be made, as elasticity varies with temporal and spatial characteristics which are case specific (crop choices, weather forecasts, technological standards, other restricting factors, ...).

Economic instruments should be supported by other policy instruments in a **well-balanced mix** of command and control, social and economic policy measures and with regard to regulations in related policy fields such as the CAP and EU Cohesion Policy to promote the sustainable use and conservation of water resources. Further, in many areas a more systemic change - often called a paradigm shift - is needed. The driving forces for water scarcity are the evolution of demand for the goods and services provided by land. Such a paradigm shift has to focus on these aspects, strengthening sustainable production and consumption patterns.

The current role of economic instruments such as water pricing is clearly underdeveloped. Implementation gaps, differences in the legal systems, lack of guidance and methodological gaps are the main reasons (see also results from the CIS workshop in on WFD-economics in Liege 2010)⁷⁵. The **CIS process** could close the implementation gaps by providing more guidance and practical help on how to implement an effective water pricing policy. A first step to do so would be to set up a new economic group that includes experts from various sectors including agriculture. This could, besides handling other issues in other sectors, ensure that clarification of implementation issues is achieved before the second cycle fully starts (e.g. 2013) by developing common definitions and methodologies (e.g. environment and resource costs).

⁷⁵ http://www.circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/implementation_conventio/workshop_economics/wfd-economics-workshop-o/_EN_1.0_&a=d

In terms of research, the issue of **market-like mechanisms** should be further investigated. Such mechanism may be beneficial, but there is a risk that a number of local monopolies are created. Compared to the drinking water sector, irrigation has a different market form. On the supply side there are potentially more players (wastewater, rainwater, surface, desalinated and ground water suppliers), but also the demand side varies with the crop demand of water. The case of Australia has shown that with a decoupling of the network payments and a liberalised water supply payment some water savings have been achieved. However this issue needs to be investigated further in detail, as the issue of liberalisation is discussed very critically in the EU.

Well-founded agricultural water allocation and pricing policies could contribute significantly to the objectives laid out in the WFD, while at the same time causing beneficial side-effects in mitigating water scarcity and droughts and adapting to changing water supply caused by anthropogenic climate change. In the long run, the agricultural sector would support itself by promoting a more sustainable use of its most important production input resource. The design of a fair water allocation and pricing scheme for the agricultural sector is difficult, as it should meet several criteria. A fair scheme should be acceptable to both the agricultural sector and society, minimise negative impacts on farm income and give incentives to save water and recover a larger share of costs including external costs. Therefore, it is important that allocation and pricing policies take into account **local and regional circumstances** regarding (history of) water use and water rights, water availability, farm sizes and crops grown, possible alternative crops and marketing channels, alternative technologies to save water or change irrigation techniques and existing subsidies.

Water allocation, water pricing and water trading only work within a well-established framework based on **environmental flow regimes**. Such environmental flow regimes are currently only established in a few basins (e.g. Australian, Romanian and French cases). It is highly recommended to set up thresholds on a basin level for each stretch of the river in the next cycle of RBMPs. For transboundary basins, this clearly calls for close coordination in order to come to an agreement. The work on developing appropriate methodologies to define such flows should be carried out in a specific working group on environmental flow regimes within the CIS process. This group should discuss the issue in a broader context including related aspects such as irrigation, hydropower, saline intrusions and flood protection.

In order to ensure the protection of groundwater resources it is essential that the abstraction rates from groundwater are sustainable and follow the WFD-requirement set out in Art 4.1.b (ii).

Water allocation

Particularly in water-scarce basins, water allocation is a driving factor for the economy as it prioritises water use according to a hierarchy of sectors or uses within sectors. Over-allocation of water permits poses significant threats to the ecosystem health of a catchment area. It is important that the allocation is **controlled** and the final water use at farm level is regularly **monitored**.

It is generally advisable for RB authorities to relate authorisations or permits to the local circumstances and impact of the water abstraction. Abstraction rules can be more stringent in areas qualified as suffering from (chronic) water shortage; however, it is important that these water use restrictions are communicated before

farmers have made decisions on the use of (water intensive) crops to be effective. Restrictions and bans resulting from allocation decisions are usually made after farmers have already planted certain crops (e.g. maize in mid-April to mid-June) and are likely to have no or only limited impact on short term farmers' planting decisions. Planting decisions are largely motivated by early year forecasts or information on the availability of water resources, the economic results of the past year or other resources (e.g. maize irrigation demands more manpower).

The pitfalls of inefficient water allocation policies should be avoided by taking the following potential actions within each RB and at EU level:

- Set up an allocation system that is based on **environmental flows and sustainable groundwater use**. This allocation system should be governed under the competent authorities set up under Art 3 of the WFD. **Guidance** is needed at EU level for calculating and implementing meaningful flow regimes at river basin level but also more locally. Further guidance might be needed on how to organise a process that identifies priorities and balances out regional shortages. This work should be organised within the above recommended CIS working group on environmental flows.
- Improve the understanding of the **value of water** for the economy of the area (and outside the RBD) across the full production and consumption chain, e.g. by combining methods calculating total water use, such as the life cycle analysis (LCA) or water footprint assessments (WFA), with economic valuation methods (taking also opportunity costs into account).
- Over-allocation should be avoided through a comprehensive permitting system that is not burdensome in terms of **administration costs** and that provides a clear overview of water abstraction. Allocation should be based on a current precipitation and runoff rate and not be based on historical averages. To avoid non-authorized abstraction, this permitting system should not only be regularly checked internally through the **enforcement** system, but also through an **external auditing** process that can check and “certify” the performance of the system.
- The allocation system should include a water use **hierarchy**. This hierarchy should be differentiated among the different sectors (e.g. households before agriculture and tourism) but also within the sector, where it could be based on economic motivation (e.g. high value crops first). The environment should be included as a user to ensure sustainable water use in the basin. Such an allocation hierarchy has to follow a comprehensive and transparent approach which allows all stakeholders to gain the same picture of issues of concern. During both scarce and non-scarce times, allocation systems should be based on a water balance and water quantities assigned to each use, including environmental flows. Besides an overall allocation hierarchy, there is also the need for specific, transparent “emergency allocations” for different potential scarcity situations/years. Both hierarchies need to be established on the sub-basin level but in many cases also on the transboundary level in order to ensure that up and downstream countries are served in an equal way.
- The allocation system should allow **short to medium term adjustments** (every year to three years). An allocation system that remains stable for several years might have the effect that the restriction on water use could become too low and the reductions in abstraction would not be sufficient to meet good status. In other cases, a long term fixed quota might result in water savings above the needs defined by the good status. This would lead to additional costs (in general or for a specific sector), as such restrictions would either limit production (e.g. agriculture, industry) or trigger expensive technical water saving measures with no additional environmental benefit.
- **Online monitoring** could be used to adjust the predefined allocation rights to real conditions, ensuring that flows are guaranteed. This could potentially also enable quicker notifications of water use restrictions to enable farmers to adjust their cropping decisions.
- Since Member States already have water allocation systems in place, it is important to analyse the **existing governance structures** for strengths and weaknesses. In general, administrative or information gaps between water abstractions, water consumption and allocated water should be identified to lead to a better understanding of overall water abstraction pressures on water bodies.

Water pricing - cost recovery

As shown in several case studies, the recovery of operational and maintenance costs for irrigation systems is often achieved and farmers bear these costs. However, capital costs (investments) are often (at least partly) subsidised by the state/regions (e.g. by using cohesion, rural development or national funds for modernisation purposes). Such subsidies reduce the level of costs borne by farmers, but this might be justified by the social and economic situation of a region. Furthermore, it should be noted that public funding only covers part of the investment (e.g. 40% in the case of rural development). Bigger investments, such as reservoirs, are still substantially subsidised through government budgets. There is no doubt that such investments have often multiple purposes and do not only serve farmers' irrigation needs. However, it often remains unclear which share of investment costs can be allocated to the different users.

Environmental and resource costs (ERC) do not yet form a central element in pricing policies in EU Member States. This can be explained by the fact that the internal/external environmental costs and resource costs of water supply networks are still not fully understood and practical implementation rules are lacking.

The following recommendations can be made to achieve adequate cost recovery, including taking into account environmental and resource costs:

- **Financial costs** of the water supply network need to be calculated and **spread across water using sectors**, including irrigation, to ensure adequate financial cost recovery.
- An **enhanced coherence** between relevant policies should be implemented requiring that EU and national funding for the modernisation of irrigation is a) coupled to gains in water saved and b) these gains are returned to the environment and not used to extend the irrigated area/water volumes used by change of crops. While the first issue might be easy to implement (e.g. inclusion of an efficiency percentage in the funding rules⁷⁶), the second issue is more difficult to achieve as funding is often linked to specific areas or projects. Environmental flows are a prerequisite for ensuring that modernisation of irrigation systems does not inadvertently increase/maintain pressures on water resources. This aspect is of particular importance within the next financial perspective of the EU as RD provides the possibility to financially support farmers seeking to invest in irrigation.
- The Strategic Environmental Assessment Directive 2001/42/EC and Environmental Impact Assessment Directive 85/337/EEC require assessments of the environmental impact of respectively rural development programme and investments such as large irrigation projects. However, there are no requirements concerning a Climate Change assessment. Moreover, financial/socio-economic cost-benefit assessments are only mandatory when applying for e.g. Cohesion funding.

In order to ensure that those investments are made which are sustainable, subsidies for improving irrigation should be linked to mandatory cost-benefit and climate impact assessments. Thereby benefits should not only be considered from an income point of view, but also from an environmental perspective.

- Research activities should be expanded into methodologies and approaches regarding the environmental and resource costs of water infrastructure. The CIS process should consider advising MS on such methodologies and approaches they can use to calculate cost recovery including E&R costs in accordance with Art 9 WFD. This would also increase transparency and comparability within the issue.

⁷⁶ This is included in the proposed future rural development regulation (see article 46(3) http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/com627/627_en.pdf)

Water pricing - incentive pricing

The primary aim of water pricing is to stimulate a more efficient use of water, by making users aware that water is a resource that can be scarce and that protecting water quality and ensuring water availability goes with a cost. However, incentive pricing also can avoid new water use when coordinated with allocation policy and in basins that are still not over-allocated. As shown in a number of case studies of Chapter 4, but also as set out as in many other studies (see I-adapt, FAO, 2004b; Dworak et al, 2010), incentive pricing as provided in the WFD does not work yet. Because the share of water prices in the total irrigation costs is low, other factors have a higher influence on water use behaviour, such as fertiliser or energy costs.

For a pricing scheme to deliver the optimal level of cost recovery and to ensure a sustainable use of water resources through incentives and investments in water saving technologies, the water pricing design options such as the **tariff structure and price level** are crucial success factors.

Volumetric pricing has to be considered as one of the most effective tariff structures with regard to actually providing incentives for water saving. Well designed volumetric tariffs have the greatest potential to fulfil cost recovery and incentive functions, but possibly have the greatest negative impacts on farm income or food prices compared with other tariff structures.

For volumetric pricing, **metering** devices are necessary, which are complex to install and monitor. Metering could be made mandatory as it is a prerequisite for a) proper monitoring to fully know how much water is abstracted, and b) proper controlling of the abstractor. Metering can face rejection by farmers because of additional costs and additional controls which are not accepted. A shift to metered systems may be difficult, especially in specific situations with area-based systems, or no history of metering (as water has simply been available for agriculture), or other circumstances. Several options are possible to increase the level of metering, e.g. confirming it as mandatory through the WFD implementation and consider including it in GAEC or CAP payments. However, metering is not easy in all cases, e.g. in situations where there is abundant water availability instead of abstractions, gravity-fed systems (quantity to individual farmers?) or from a cost-perspective (difficulty of approximation of quantities for groups of farmers in certain situations).

Second, a volumetric tariff reflecting the **true value of water** on a unit base would increase water prices for farmers and in cases where water use is already highly efficient, rising water prices on a volumetric basis could have negative economic impacts.

It is important that all elements of the water pricing policy are **balanced**. If a particular water source is under high stress, it may be advisable to set a relatively high price compared to other water sources. However, it is important that the prices for all water sources integrate an incentive to use water sustainably and at the same time **prevent illegal use** (primarily from groundwater abstraction) by allocating sufficient resources to monitoring and control. In order to address illegal water usage properly, it is important to ensure an adequate capacity of the River Basin Authorities (RBA) to deal with the control of illegal water usage, improve the control with technology, and to install an adequate size of penalty being higher than the benefit of the farmer by irrigation with non-authorised abstracted water. Illegal abstraction should be addressed through **surveys of existing boreholes** and strict **monitoring** to avoid the emergence of new, non-authorised self-

abstraction. Penalise non-authorised water usage by applying fines coherent with the potential economic benefits from the non-authorised water abstraction. Start with those farms that abstract greater water volume, and therefore contribute more to the depletion of the resources, or with major environmental impact. It is also necessary to seal or remove non-authorised water intakes and monitor that the farmer is not using other non-authorised sources. Additionally, it would be advisable to publicise the penalties and the closing of wells so that the example will caution potential offenders. The costs of monitoring and enforcement can be expensive – one approach found in the Member States (RO) is to pay for monitoring activities through the money gained from wastewater charges. In this context it might be worth to prove if there are other bodies having higher penalty power. If so a coordination and cooperation of efforts should be envisaged.

Increasing water prices at a level where they set incentives is necessary. This should be introduced **gradually** over several years, so as to give time to farmers to adapt. Further, such price increases are mostly not accepted by any water user and might result in social problems, with improvements in the environment therefore being highly uncertain (see OECD, 2006b). Too high water prices could contribute to driving farmers out of business, leading to agricultural land abandonment. This in turn could result in the loss of cultural landscapes (which should be taken into account in land use planning and which potentially decreases the amenity value and other cultural services delivered to human population) and negative environmental rebound effects (e.g. increased soil erosion, loss of biodiversity, or decrease in landscape maintenance).

In order to avoid these potentially negative effects and to deliver ecosystem services, **payments for ecosystem services** (PES) could be considered as a complement to incentive pricing. Such payments should be seen as payments for a certain set of ecosystems services such as carbon storage, creation of places to improve biodiversity, the creation of wetlands, or for cultural heritage. In other words payments for ecosystem services programmes are an effort to “get the incentives right” by sending accurate signals to both providers and users that reflect the real social, environmental and economic benefits that environmental services deliver. Furthermore, PES allows achieving environmental objectives that go beyond the threshold of the polluter-pays-principle (e.g. as set out under the environmental legislation and cross compliance) to provide environmental services (i.e. the provider-gets-principle).

In the context of the TEEB (The Economics of Ecosystems and Biodiversity)⁷⁷ study two types of PES can be seen:

- Agri-environmental payments as set out under the RD regulation where farmers are compensated for the income forgone and/or additional costs. The effectiveness of the existing system could be enhanced in two ways: a) the additional costs and loss of income could be compensated at the level of 100% in as many cases as possible (currently not the case); b) Member States should avail more of the possibility to use transaction costs when implementing agri-environmental measures.

⁷⁷ <http://www.teebweb.org/LinkClick.aspx?fileticket=vYOqLxi7aOg%3d&tabid=1019&language=en-US>

- The creation of new markets for ecosystem services. There is no doubt that in the creation of such a market the key challenge is in creating a mechanism for valuing (or at least measuring) a service where none currently exists (e.g. a market for biodiversity).

Both approaches can be seen as complementary to each other and to the polluter-pays-principle and water pricing. More generally only one tool will not solve all problems and we should definitely rely on a combination of different tools to achieve our objectives. Further Agri-environmental measures should be accompanied by training and provision of information (see article 29(4) of proposed rural development regulation for 2014-2020)⁷⁸.

As there is quite a knowledge gap on how all these mechanisms (PES, PPP and incentive pricing) can be combined in an optimal way, it is highly recommended that these approaches are further detailed and discussed in the context of a specific research project that brings together economic and legal aspects related to such a new PES scheme.

⁷⁸ http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/com627/627_en.pdf

References

- Agrosynergie (2010): Evaluation of market effects of partial decoupling, available at http://ec.europa.eu/agriculture/eval/reports/decoupling/exec_sum_en.pdf
- Asian Development Bank (ed.) (2008): Water Rights and Water Allocation – Issues and Challenges for the Region.
- Bachev, Hrabrin (2010): Agricultural water management in Bulgaria. Unpublished. <http://mpira.ub.uni-muenchen.de/24535/>
- Becarés, J.; Carricondo, A.; Peiteado, C. (2010). ¿Quién contamina cobra? Relación entre la política agraria común y el medio ambiente en España. SEO/BirdLife y WWF España. Available at: http://assets.wwfspania.panda.org/downloads/informe_wwf_y_seo_relacion_pac_y_medio_ambiente_quien_contamina_cobra.pdf
- Berbel J./Manos B./Viaggi D. (2009): Estimating demand for irrigation water in European Mediterranean countries through MCDM models, Water Policy, 11, pp. 348-361.
- Berbel, J./Calatrava, J./Garrido, A. (2007): Water Pricing and Irrigation: A Review of the European Experience.
- Berbel, J./Gómez-Limón, J. A. (1999): The impact of water-pricing policy in Spain: an analysis of three irrigated areas. In: Agricultural Water Management 43 (2000) 219-238.
- Berbel, J./Gutierrez, C. (2004): Sustainability of European Irrigated Agriculture under Water Framework Directive and Agenda 2000, EUR 21220, Office for Official Publications of the European Communities, pp. 213-218. Luxembourg.
- BIO Intelligence Service (2011), Water saving potential in agriculture in Europe: findings from the existing studies and application to case studies, Final report prepared for European Commission DG ENV
- Blanco Fonseca, M. (2009). Water Framework Directive and agriculture: decision support system to assess irrigation sustainability in southern Europe. EAERE 17th Annual Conference Proceedings: 1-15 . European Association of Environmental and Resource Economists.
<http://publications.jrc.ec.europa.eu/repository/handle/111111111/13971>
- Brooks, R./Harris, E. (2008): Efficiency gains from water markets: Empirical analysis of Watermove in Australia. In: Agricultural Water Management 95 (2008) 391-399.
- California Department of Water Resources/U.S. Bureau of Reclamation 2010: 2010 Water Transfers Program Summary.
- Centraal Bureau voor de Statistiek. (2010). Milieurekeningen 2009 (Environmental Accounts of the Netherlands 2009). CBS, Den Haag/Heerlen, <http://www.cbs.nl/NR/rdonlyres/68DCDF0D-76C6-458F-B3EC-073E8447DF13/0/2009c174pub.pdf>

Chalmin, P. & Bureau, D. (2007), Perspectives agricoles en France et en Europe. La documentation française. Paris, 2007.

CHG (2011a). Information compilation for the DG ENV studies on water & agriculture regarding the Fuente Palmera Irrigation Community. Compiled and provided by the Guadalquivir RBA.

Colby, B. G. (1990): Transactions costs and efficiency in Western water allocation. In: American Journal of Agricultural Economics 72(5), pp. 1184-1192.

Common Implementation Strategy Working Group 2.6 WATECO (2003): Common Implementation Strategy for the Water Framework Directive (2000/60/EC), Guidance Document No 1: Economics and the Environment – The Implementation Challenge of the Water Framework Directive.

Common Implementation Strategy Working Group 2B, Drafting Group ECO1 (2004): Information Sheet on Assessment of the Recovery of Costs for Water Services for the 2004 River Basin Characterisation Report (Art 9). Final Version, 5 May 2004.

Common Implementation Strategy Working Group 2B, Drafting Group ECO2 (2004): Information Sheet on Assessment of Environmental and Resource Costs in the Water Framework Directive. June 2004.

Corominas, Joan (2011c): La recuperación de costes en las cuencas andaluzas: divergencias con la DMA. In: animando a la participación ciudadana en Andalucía: los planes de gestión de cuencas y la Directiva Marco del Agua. Málaga, 28 January 2011.

Deutsche Vernetzungsstelle (2010): Öffentliche Güter und Gemeinwohlleistungen der Landwirtschaft. Spezial 1 2010. Bonn.

De Fraiture, C./Perry, C. (s.d.). Why Is Agricultural Water Demand Irresponsive at Low Price Ranges? The impact of existing water management practices on the effectiveness of agricultural water pricing as a demand management tool

Dworak et al. (2007): EU Water Saving Potential. Final report. Berlin. Report for the European Commission - DG Environment.

Dworak, T./Berglund, M./Thaler, T./Fabrik, E./Miguel Ribeiro, M./Laaser, C./Matauschek, M./Amand, B./Grandmougin, B. (2010a): Assessment of agriculture measures included in the draft River Basin Management Plans. Report for the European Commission - DG Environment.

Dworak, T./Schmidt, G./De Stefano, L./Palacios, E./Berglund, E. (2010b): Background Paper to the conference "Application of EU Water-related Policies at Farm Level". Louvain-la-Neuve. Report for the European Commission - DG Environment.

Easter, K. W./Rosegrant, M. W./Dinar, A. (1998): Markets for Water: Potential and Performance. Boston.

Ecologic (2007). EU Water saving potential (Part 1 - Final report and Part 2 – Case Studies), Berlin

Elnaboulsi, J.C. (2009): An Incentive Water Pricing Policy for Sustainable Water Use. Environmental and Resource Economics 42 (4), pp. 451-469.

ENTEC 2010: Managing scarce water resources – Implementing the pricing policies of the WFD. Final Report. London. Report for the European Commission - DG Environment.

European Commission (2000a): Communication from the Commission to the Council, the European Parliament and the Economic and Social Committee - Pricing policies for enhancing the sustainability of water resources. COM (2000) 477 final, Brussels, 26 July 2000. Brussels.

European Commission (2000b): Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive).

European Commission (2007a): Communication from the Commission to the European Parliament and the Council on addressing the challenge of water scarcity and droughts in the European Union. COM (2007)414 final. Brussels.

European Commission (2007b): Green Paper on market-based instruments for environment and related policy purposes. COM (2007) 140 final. Brussels.

European Commission (2010): Second Follow-up Report to the Communication on water scarcity and droughts in the European Union. COM (2010)228 final. Brussels.

European Commission (EC), DG ENV data, 2010. MS responses to the DG ENV questionnaire on The Third Follow-up of the Communication on water scarcity and droughts

European Environment Agency (2005): Market-based instruments for environmental policy in Europe. EEA Technical Report No 8/2005. Copenhagen.

European Environment Agency (2009): Water resources across Europe — confronting water scarcity and drought. EEA Report No 2/2009. Copenhagen.

FAO (ed.) (2003): Preparing National Regulations for Water Resources Management Principles and Practice. FAO Legislative Study No. 80. Rome.

FAO (ed.) (2004a): Economic Valuation of Water Resources in Agriculture – From a sectoral to a functional perspective in Natural Resource Management. FAO Water Report 27. Rome.

FAO (ed.) (2004b): Water charging in irrigated agriculture, available at <http://www.fao.org/docrep/008/y5690e/y5690e00.htm>

García García, J./Romero, P./Botía Ordaz, P./García, F. (2005): Análisis económico del cultivo de almendro en riego deficitario controlado (RDC). In: Fruticultura Profesional, nº 154. pp. 43-50.

Garrido, A. (2006), Using Good Economic Principles to make Irrigators become True Partners of Water and Environmental Policies. OECD, Water and Agriculture: Sustainability, Markets and Policies, OECD Publishing.

doi: 10.1787/9789264022577-5-en.

- Giannocaro, G.; Berbel, J. (2011). Analysis of intended farmer's response to CAP scenarios: environmental considerations. Paper prepared for the 122nd EEAR seminar "Evidence-based agricultural and rural policy making: [methodological and empirical challenges of policy evaluation](http://purl.umn.edu/99419)", Ancona. <http://purl.umn.edu/99419>
- Gómez-Limón, J.A./Riesgo, L. (2004): Irrigation water pricing: differential impacts on irrigated farms. *Agricultural Economics* 31 (1), pp. 47-66.
- Grandmougin, B./Matthei, V./Kervarec, F./Strosser, P./Dworak, T./Fleischmann, N./Thaler, T. (2009): International comparison of the implementation of the WFD in EU Member States. ACTeon & Ecologic, Report prepared for the Dutch Ministry of Transport, Public Works and Water Management, unpublished.
- Gutiérrez, C. ; Gómez, C.M. (2009). Efecto de la política agraria sobre la política del agua. In Gómez-Limón, J.A.; Calatrava, J.; Garrido, A.; Sáez, F.J.; Xabadia, À. (Eds.). *La economía del agua de riego en España*. Fundación Cajamar.
- Bouscasse, H. ; Brändle, J. ; Dworak, T. ; Lenoci, J. ; Kozma, E. ;Strosser, P. (2009). Scenarios of water demand management – Impacts at regional level -ENV.D.2/ETU/2007/00097r- Case study report: Danube-Tisza Interstice (Hungary)
- Hellergers, P. J. G. J./Perry, C. J. (2006): Can Irrigation Water Use Be Guided by Market Forces? Theory and Practice. In: *Water Resources Development*, Vol. 22, No. 1, 79–86.
- Hernández, N./ Llamas, M. R. (eds.) (2001): *La economía del agua subterránea y su gestión colectiva*. Fundación Marcelino Botín y Ediciones Mundi-Prensa, Madrid.
- ICWE, (1992): *The Dublin Statement on Water and Sustainable Development*. Dublin.
- Interwies, E./Dworak, T./Görlach, B./Best, A. (2006): *WFD and Agriculture Linkages at the EU level*. Final Paper about Incentive water pricing and cost recovery in the WFD - Elements for linking EU Agricultural and Water Policies. Report for the European Commission – DG Research.
- Interwies, E./Kampa, E./Görlach, B. (2005): *Economic Instruments and Water Rights*. Background Paper to the international Workshop "Integrated Water Resources Management: Course for North Africa".
- Jordan, J. L. (1999): Externalities, water prices, and water transfers. In: *Journal of the American Water Resources Association* 35(5), pp. 1007-1013.
- Klaphake, A./Scheumann, W. (2001): Politische Antworten auf die globale Wasserkrise – Trends und Konflikte. In: *Politik und Zeitgeschichte* 48-49.
- Kraemer, R. A./Interwies, E./Kampa, E. (2002): *Tradable Permits in Waterresource Protection and Management - A Review of Experience and Lessons Learned*. In: OECD (ed.)(2002): *Implementing Domestic Tradable Permits: Recent Developments and Future Challenges*. Paris.
- Lorite, I.J.; Arriaza, M. (2009). Efectos de la reforma intermedia de la PAC sobre las decisiones de los regantes. Un caso práctico de una moderna zona regable andaluza. In Gómez-Limón, J.A.; Calatrava, J.; Garrido, A.; Sáez, F.J.; Xabadia, À. (Eds.). *La economía del agua de riego en España*. Fundación Cajamar.

Massarutto, A. (2005): Water pricing and full cost recovery of water services: economic incentive or instrument of public finance? Paper presented at the 11th International Sustainable Development Research Conference, Helsinki.

Mattheiss, V.; Le Mat, O., and Strosser, P. (2009). Which role for economic instruments in the management of water resources in Europe? In search for innovative ideas for application in the Netherlands. Report for the Dutch Ministry of Transport, Public Works and Water Management.

Meinzen-Dick, R. (2007): Beyond Panaceas in Water Institutions.

Meinzen-Dick, R./Mendoza, M. (1996): Alternative Water Allocation Mechanisms - Indian and International Experiences. *Economic and Political Weekly*, No. XXXI, pp. 25-30.

Molden, D./Oweis, T./Steduto, P./Bindraban, P./Hanjra, M. A./Kijne, J. (2010): Improving agricultural water productivity: Between optimism and caution. In: *Agricultural Water Management*, pp. 528–535.

Molle, F./Berkhoff, J. (2007): Water Pricing in Irrigation: Mapping the Debate in the Light of Experience. In: Molle, F./Berkhoff, J.(eds.)(2007): *Irrigation Water Pricing*.

MMA (2007). Impacto de la Reforma Intermedia de la Política Agrícola de la Unión Europea y oportunidades para la aplicación de la Directiva Marco del Agua en la Campiña Baja de Córdoba. Serie de Informes de Economía de Agua, núm. 9. Grupo de Análisis Económico. Ministerio de Medio Ambiente

OECD (2010a) Sustainable management of water resources in agriculture.

OECD (2010b): Agricultural Water Pricing: EU and Mexico.

OECD (ed.) (2002): Transition to Full-Cost Pricing of Irrigation Water for Agriculture in OECD Countries. Paris.

OECD (ed.) (2006a): Water Pricing for Agriculture between Cost Recovery and Water Conservation: Where do we stand in France?. In *Water and Agriculture: Sustainability, Markets and Policy*. Paris.

OECD (ed.) (2006b). *Water and Agriculture: Sustainability, Markets and Policies -Conclusions and Recommendations*, available at <http://www.oecd.org/dataoecd/19/1/36290097.pdf>

OECD (ed.) (2009): Managing Water for All - an OECD perspective on pricing and financing.

OECD (ed.) (2010a): Notes on financing water resources management – Background report for the OECD Expert Meeting on Water Economics and Financing, 15-17 March 2010. Paris.

OECD (ed.) (2010b): Water Prices for Agriculture - Remarks made by Angel Gurría, Secretary-General. OECD International Advisory Committee of Expo Zaragoza 2008.

OECD (ed.) (2010d): Agricultural Water Pricing: Australia.

OECD (ed.) (2010e): Environmental Effectiveness and Economic Efficiency of Water Use in Agriculture: The Experience of and Lessons from the Australian Water Reform Programme.

OECD (ed.) (2010f): Agricultural Water Pricing: United States.

OECD member country questionnaire responses on agricultural water resource management (2010). (See <http://www1.oecd.org/dataoecd/7/31/44763686.pdf>)

Öko, Inc. (2001): Agricultural Water Management Policies in Bulgaria, Hungary, Romania and Slovakia.

Olivier, A. (2007): Pricing water services: economic efficiency, revenue efficiency and affordability. OECD Expert Meeting on "Sustainable Financing for Affordable Water Services: From Theory to Practice", Paris 14 –15 November 2007.

Pfeifer, L. and Lin, C. (2010): Does Efficient Irrigation Technology Lead to Reduced Groundwater Extraction?: Empirical Evidence. Paper presented at the Agricultural and Applied Economics Association 2010 AAEA. CAES. And WAEA Joint Annual Meeting, Denver, Colorado, 25-27, 2010

Qureshi, M. E./Shi, T./Qureshi, S. E./Proctor, W. (2009): Removing barriers to facilitate efficient water markets in the Murray-Darling Basin of Australia. In: Agricultural Water Management 96, pp. 1641–1651.

Rădoane, M., and Rădoane, N. (2005): Dams, sediment sources and reservoir silting in Romania. Geomorphology 71, p. 112-125

Raftelis, G. A. (1993): Comprehensive Guide to Water and Wastewater Finance and Pricing. Boca Raton.

Rosegrant, M. W./Binswanger, H. P. (1994): Markets in tradable water rights: Potential for efficiency gains in developing-country water resource allocation. World Development 22(11), pp. 1613-1625.

Ruijs, A./Zimmermann, A./v.d. Berg, M. (2008): Demand and distributional effects of water pricing policies. Ecological Economics 66 (2-3), pp. 506-516.

Saunders, R./Warford, J. J./Mann, P. C. (1977): Alternative concepts of marginal cost for public utility pricing - problems of application in the water supply sector.

TEEB – The Economics of Ecosystems and Biodiversity for National and International Policy Makers (2009). available at www.teebweb.org

Thaler, T. (2010). Water pricing policies in agriculture to limit demand. Hungary, April 2010. Workshop background paper.

The Regional Environment Center for central and Eastern Europe (2001). Environmental taxes in an enlarged Europe

Tsar, Y. and Dinar, A. (1997): On the relative efficiency of alternative methods for pricing irrigation water and their implementation. World Bank Economic Review 11, pp.243–262.

UNESCO (ed.) (2009): Outcome of the international expert's meeting on the right to water. Paris.

Valensuela, D. (2009). Les modes de tarification et de distribution de l'eau pour l'agriculture dans le bassin Méditerranéen: Synthèse technique. Office International de l'Eau.

van Dijk, C.W. and Ruijs, A. (2009). Economische sturingsinstrumenten voor de watervraag - Effectiviteit en Efficiency. Report prepared for Waterdienst, the Netherlands.

Ward, F./Michelsen, A. (2002): The Economic Value of water in agriculture: concepts and policy applications. Water Policy 4(2002), pp. 423-446.

Ward, F./Pulido-Velazquez, M. (2009): Incentive pricing and cost recovery at the basin scale. In: Journal of Environmental Management 90, pp. 293-313.

World Bank (1993): Water Resources Management - A World Bank Policy Paper. Washington, DC.

World Bank (2006): Reengaging in Agricultural Water Management - Challenges and Options. Washington, DC.

World Bank (ed.) (1997): Water Allocation Mechanisms - Principles and Examples. Washington, DC.

World Bank (ed.) (2000): Pricing Irrigation Water: A Literature Survey. Policy Research Working Paper 2449. Washington DC.

World Bank (ed.) (2004): Cost Recovery and Water Pricing for Irrigation and Drainage Projects. Background report for Directions in Development. Reengaging in Agricultural Water Management: Challenges, Opportunities, and Trade-Offs. Washington DC.

World Business Council for Sustainable Development (2008): Facts and Trends – Water, Version 2.

WWF (2007): Allocating Scarce Water - A WWF primer on water allocation, water rights and water markets. Surrey.

Yoder, R. (1994): Locally managed irrigation systems: essential tasks and implications for assistance, management transfer and turnover programs. Colombo.

Zekri, S./Easter, W. (2005): Estimating the potential gains from water markets: a case study from Tunisia. In: Agricultural Water Management 72 (2005) 161–175.

<http://www.eau-adour-garonne.fr/page.asp?page=3315>

<http://www.emwis.org/topics/waterpricing/water-pricing-some-eu-countries>

<http://www.heffingen.be/landbouw>

Offices		www.arcadisbelgium.be
Antwerp - Berchem Posthofbrug 12 B-2600 Berchem T +32 3 360 83 00 F +32 3 360 83 01	Hasselt Eurostraat 1 – bus 1 B-3500 Hasselt T +32 11 28 88 00 F +32 11 28 88 01	Ghent Kortrijksesteenweg 302 B-9000 Ghent T +32 9 242 44 44 F +32 9 242 44 45
Brussels Koningsstraat 80 B-1000 Brussels T +32 2 505 75 00 F +32 2 505 75 01	Liège 26, rue des Guillemins, 2ème étage B-4000 Liège T +32 4 349 56 00 F +32 4 349 56 10	Charleroi 119, avenue de Philippeville B-6001 Charleroi T +32 71 298 900 F +32 71 298 901
ARCADIS Belgium nv/sa BTW BE 0426.682.709 RPR BRUSSELS ING 320-0687053-72 IBAN BE 38 3200 6870 5372 SWIFT BIC BBRUBEBB		Main office: Brussels Koningsstraat 80 B-1000 Brussels

