OECD Studies on Water

A Framework for Financing Water Resources Management

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BETTER POLICIES FOR BETTER LIVES

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Please cite this publication as:
OECD (2012), *A Framework for Financing Water Resources Management, OECD Studies on Water*, OECD Publishing.
http://dx.doi.org/10.1787/9789264179820-en

ISBN 978-92-64-17981-3 (print)
ISBN 978-92-64-17982-0 (PDF)

Series: OECD Studies on Water
ISSN 2224-5073 (print)
ISSN 2224-5081 (online)

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Foreword

Water resources management is a key function of governments around the world. Governments need to ensure that available water resources are used in ways to meet economic and social objectives, and this task is becoming increasingly complex as the intersection of water policies with other policy areas (such as energy and agriculture) increases. In many countries, however, water resources management is hampered by a lack of financing and capacity that restricts countries' abilities to effectively harness water resources for economic growth and prosperity. Water resources management covers a wide range of functions, from the "hard" end of construction, operation and maintenance of water infrastructure to the "soft" end of the design, implementation, monitoring and enforcement of water policy. All this requires resources, without which governments will be increasingly frustrated in the effective management of their water resources.

Relatively little attention has been paid to the financing of the broader water resources management functions of governments. This is in stark contrast to the issue of financing for water supply and sanitation, which has been the subject of much international debate over the past decade. Key questions on the broader topic of financing water resources management include: What functions does water resources management cover? What are the public and private benefits of water resources management? Who are the beneficiaries of water resources management and how much should they pay? What instruments can governments use to recoup some of the costs of water resources management? These and other questions are addressed in this report.

This project was initiated in the context of the OECD Horizontal Water Programme, which brings together the expertise from across the OECD and articulates the OECD response to the water challenge. The first phase of the OECD Horizontal Water Programme (2007-2008) focused on water services, namely drinking water supply, sanitation, and water for irrigation. A series of studies, synthesised in the report *Managing Water for All* (OECD, 2009), explored in particular policy issues related to financing and pricing of water services. The second phase (2009-2010) provided for additional work on the economic benefits of drinking water supply and sanitation services. In addition, a series of workshops and studies on water resources management was initiated, focused on information needs, multi-level governance arrangements, coherence among key policies, and financing. The third phase (2011-12) has explored in more details the reform of water policies, with particular attention to economic and governance issues, culminating in the report *Meeting the Water Reform Challenge* (OECD, 2012c). The next phase (2013-14) will focus on selected instruments (economic instruments for water allocation) and challenges (urban water, groundwater management, nitrogen flows).

Further information on the OECD Horizontal Water Programme can be found at *www.oecd.org/water*.

Acknowledgments

This report draws on contributions by many experts, who participated in a brainstorming meeting in May 2009 in Paris, a consultation in September 2009 at the Stockholm World Water Week, in an OECD Expert Meeting on Water Economics and Financing in March 2010 in Paris, and in the EU Water Initiative Finance Working Group. The OECD Working Party on Biodiversity, Water and Ecosystems supervised its progress. Special thanks are due to Jonathan Fisher (UK), Josefina Maestu (UN-Water), Mike Muller, Pierre Strosser, and James Winpenny. Alan Hall, advisor at the Global Water Partnership and chair of the EU Water Initiative Finance Working Group, has been a source of intellectual and material support in the initial stages of the project.

This report relies on country case studies drafted by teams of experts associated to governments in Australia, Brazil, China, the Czech Republic, France, Israel, Korea, Mexico, the Netherlands, Spain, Sweden and the UK. R.P.S. Malik (IWMI) and Guy Pegram (Pegasys) led the drafting of case studies on India and South Africa respectively. A case study on Uganda, initially developed with support from Palle Lindgaard (UCC-Water) is not referred to here, as the report covers OECD countries and BRICS. Additional input was provided by Eric Buhl-Nielsen (PEM Consult) and ACTeon (led by Pierre Strosser).

At the OECD Secretariat, the project on Financing Water Resources Management was initiated by Roberto Martin-Hurtado, who also organised the Expert Meeting and prepared the first draft of this report. Xavier Leflaive took over the management of the project in January 2011 and prepared the final draft, with support from colleagues in the OECD Water Team (Gérard Bonnis, Kathleen Dominique, Tatiana Efimova, Alexandre Martoussevitch). Nadine Rocher, Barbara Aiello and Šárka Svobodová provided administrative support. The project has been supervised by Anthony Cox, Head of the OECD Horizontal Water Programme.

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Acronyms

BOD	Biochemical Oxygen Demand
BRICS	Brazil, Russia, India, China, South Africa
BRIICS	Brazil, Russia, India, Indonesia, China, South Africa
CA	Cooperative Agreement
CAP	Common Agricultural Policy
CEA	Cost-effectiveness analysis
COD	Chemical Oxygen Demand
GWP	Global Water Partnership
MDG	Millennium Development Goal
O&M	Operation and maintenance
PES	Payment for Ecosystem Services
PPP	Polluter Pays principle
SFP	Strategic Financial Planning
SRF	State Revolving Fund
TSS	Total Suspended Solids
WFD	Water Framework Directive
WRC	Water Restoration Credits
WRM	Water resources management
WSS	Water supply and sanitation

Executive Summary

There is a clear and pressing need for governments around the world to strengthen the financial dimension of water resources management. Back in 1978, the OECD Recommendation of the Council on Water Management Policies and Instruments specified the main objectives of water management: to protect water resources against pollution and excessive use; to preserve the water environment and ecology; to safeguard and improve the hydrological cycle in general; and to provide adequate water supply, in quality and quantity, for domestic, industrial and agricultural purposes, account being taken of long-term demands. Recent analysis of water governance arrangements in OECD countries flagged lack of finance as a major and recurrent gap in water policies.

The financial gap stems from several factors. First, markets fail to recognise many of the benefits of water resources management and so tend to under-provide essential water-related services. Second, the private and public benefits of water management can be blurred in some situations, making it difficult to clearly identify the beneficiaries from the provision of services. Third, beneficiaries of water-related services do not usually pay the full cost of the provision of such services or may free-ride; and vice versa: potential private financiers may not benefit from the services, and so have a reduced incentive to provide the service.

This report provides governments with a framework to assess and strengthen the financial dimension of water resources management. It proposes a set of four principles to frame financing strategies for water management, with a specific focus on the potential role of economic instruments. It highlights implementation issues, which have to be addressed in a pragmatic way. It outlines a staged approach that governments might wish to consider in order to assess the financial status of their water policies and to design robust financial strategies for water management. Case studies illustrate selected instruments and how they can be used to finance water resources management.

Four challenges for water management

The OECD *Environmental Outlook to 2050* identifies four main challenges that must be addressed through improved management of water resources:

1. Increased competition between water users (farmers, energy suppliers, industries, households, ecosystems) intensifies to access the resource.
2. Untreated wastewater from cities (primarily in non-OECD countries) and effluents from agriculture deteriorate water quality in several regions.
3. The number of city dwellers and the value of economic assets at risks of floods increase.
4. The number of city dwellers without access to water supply has increased over the last two decades. The situation is even direr as regards sanitation.

Policy responses to address these challenges will require finance to administer more complex water policies, to rehabilitate, operate and maintain existing assets, and to invest in new infrastructure. Innovation can lower some of these costs, by reducing water demand and by promoting low cost policies or technical options. But access to the public purse will continue to be challenging as government budgets are likely to remain very tight and an emphasis on fiscal consolidation prevails.

Case studies confirm that in a number of countries (both OECD and non-OECD), water resources management fails to access the funds required to achieve policy objectives. For instance, in Europe, lack of finance has delayed the implementation of the EU Water Framework Directive in a number of countries. In other parts of the world, the Millennium Development Goal on sanitation will not be achieved, in particular because the sector fails to attract the public and private funds that are essential to ensure increased access to sanitation services.

Four principles to finance water resources management

While recognising the diversity of local conditions and policy priorities, water resources management financing can rely on four principles. The first two have formed the cornerstone of environment policy in many countries. The last two are less well-established.

1. The ***Polluter Pays*** principle creates conditions to make pollution a costly activity and to either influence behaviour (and reduce pollution) or generate revenues to alleviate pollution and compensate for welfare

loss. This principle is efficient to the extent that it internalises the external costs of pollution.

2. The ***Beneficiary Pays*** principle allows sharing the financial burden of water resources management. It takes account of the high opportunity cost related to using public funds for the provision of private goods that users can afford. A requisite is that private benefits attached to water resources management are inventoried and valued, beneficiaries are identified, and mechanisms are set to harness them.

3. ***Equity*** is a feature of many policy frameworks for water management. It is often invoked to address affordability or competitiveness issues, when water bills, driven by the first two principles, may be disproportionate with users' capacity to pay.

4. ***Coherence*** between policies that affect water resources can usefully be considered a fourth principle. Agriculture, land use, or energy policies can severely increase the cost of water management. Factoring water in and reforming allocation of public moneys in these policies can be more cost effective than mobilising additional funding in the water sector.

These four principles provide a framework within which governments can address the financing issue for ensuring effective water resources management. In practice, as is demonstrated by the experiences discussed in this report, the principles tend to be unevenly applied by countries. In addition, the interaction of the principles can be problematic. For instance, when the equity principle is invoked to diminish the cost paid by polluters, second or third best solutions to pollution challenges that result can sometimes crowd out more effective policy options (such as the use of pollution charges).

The added value of economic instruments

Economic instruments such as abstraction and pollution charges, water pricing, and user charges have a critical role to play in financing water resources management, and their design and implementation can be guided by the four principles above. In addition to generating revenues that can augment public budgets and assist in financing water resources management, their use can have ancillary benefits. For example, economic instruments can promote water efficient practices in households, farms, and industry, help value the benefits of watershed services, and create incentives to explore low-cost options for water users and water managers (*e.g.* protecting catchment areas instead of treating polluted waters downstream). Abstraction and pollution charges, water pricing and user charges can generate revenues that can augment public budgets and be channelled to water management.

A number of economic instruments rely on the voluntary participation of users, thus influencing water governance. For instance, when carefully designed to comply with the first two principles mentioned above, payments for ecosystem services can generate financial flows, and engage stakeholders in water management. Trading mechanisms can in principle enhance the cost-effectiveness of water policies by allocating water where it creates most value, or by reducing pollution where it is cheapest. Accompanying measures are needed to ease the transition to new allocation modalities.

Empirical evidence suggests that close attention needs to be paid to the design of economic instruments, the way they interact with other instruments, and the institutional and governance structures within which they operate.

Implementation issues

Several issues have to be addressed to strengthen the financial dimension of water management. They need to be considered in a pragmatic way, on a case by case basis.

How can costs of water management be reduced? Opportunities to reduce water management costs abound, including by improving the operational efficiency of service providers, or exploring low cost options (*e.g.* several countries report a bias towards funding new hardware, instead of properly operating and maintaining existing ones, or relying on ecosystems; green infrastructures such as floodplains or wetlands can be more cost effective than built ones). Tapping such opportunities can reduce financial needs as well as increase the capacity of the sector to raise funds.

Should revenues from water-related taxes be earmarked for water expenditure? Earmarking can undermine overall economic efficiency, if earmarked resources could have been allocated to activities that create more value for the society. However, earmarking can secure funding, in particular in contexts when competition is fierce to access the public purse (a point already made in the 1978OECD Recommendation of the Council on water management policies and instruments).

What is the role of the private sector? Private investors can finance some of the upfront costs related to water infrastructures (storage, or distribution, for instance). The use of private operators can also enhance the efficiency of water service delivery. These options will only materialise when robust financial strategies and business models secure stable revenue flows. The OECD has developed tools to do just that, which governments may wish to consider (including the OECD Principles for Private Sector Participation in Infrastructure, the OECD Checklist for Public Action, and guidance on Strategic Financial Planning for water supply and sanitation).

How to value water services? Economic instruments work best when private benefits attached to water resources management are properly inventoried and valued, and the beneficiaries are identified. A variety of valuation methods is available. Lessons need to be learned on how to combine them and plug them in policy making.

Governance, an unresolved issue

Effective governance for water resources management is increasingly challenging and costly due to the increasing interaction of policy areas that have been previously addressed in policy "silos"(in particular, energy and agriculture). WRM also tends to cut across several territorial jurisdictions (from local to basin and transboundary level). Co-ordination costs in such a policy environment are inevitably increasing as the need to effectively involve stakeholders in the design and implementation of water management policies takes both time and resources.

Effective governance for water resources management also entails the effective management of public expenditures. This requires action to allocate public funds to the highest value use, to build capacity, and to enhance transparency, which has plagued water management financing.

Financing should be factored in very early in the water policy design/ reform process, to make sure *i)* every opportunity to lower the cost of water management is considered; *ii)* appropriate financial resources are available to finance investment, operation, and maintenance of water related infrastructures and services; and *iii)* water administrations are sufficiently funded to deliver.

Adequate data is a prerequisite. Little is known about the costs and benefits of water resources management, and about the contribution of different user groups to its financing. Information and data gaps hinder the deployment of cost effective policies and measures.

A staged approach for moving forward

The sequence below derives from the principles and policy considerations sketched above. It can help review and strengthen the financial dimension of water resources management. It can be organised at different geographical scales (local, basin, national, transboundary), and responses may vary according to the level under consideration.

- Ensure that sectoral policies and initiatives that have implications for water use are coherent and considered in conjunction with water management policies.

- Define and inventory the public good components of water management and seek to value them where possible.
- Inventory and value the private benefits of water management. A variety of valuation methods is available and can usefully be used in combination.
- Identify beneficiaries, and allocate the financial burden across beneficiaries. The four principles above provide a framework on which to build. Previous work has established that social objectives are better attained through well designed, targeted social measures.
- Consider a range of instruments to harness beneficiaries. Economic instruments can play a prominent role, in combination with other instruments, when carefully designed under appropriate institutional and governance structures.
- Seek to raise commercial finance. The capacity to attract commercial finance for particular aspects of water management (such as infrastructure development and the delivery of water services) will depend on the robustness of the institutional and regulatory framework, including business models in place (who pays for what).

The sequence above can support the development of a strategic financial plan for water resources management. The OECD has advocated Strategic Financial Planning for water supply and sanitation. Extended to water resources management, strategic financial planning, conceived as an iterative process, can help in several ways. First, it anticipates financing needs in the medium term. Typically, it considers operation and maintenance costs on top of investment costs, when new infrastructures are built. Second, it matches policy ambitions with financial resources. For example, when the costs of achieving policy objectives prove very high, one option is to reformulate these objectives (such as by adjusting quality objectives to different uses; stretching out implementation schedules; or downgrading water security for selected users, which will involve trade-offs). Another option is to consider alternative financial options, and allocate more financial resources.

Strategic financial planning can also strengthen ownership from users, when developed in the context of a policy dialogue on water management. This is particularly essential as several decisions (on the public good dimension of water management, on the value of benefits, on equity), while informed by economic analyses, remain essentially political. An informed policy dialogue on water resources management, based on hard facts and figures, is the way forward. It provides a platform to factor in the financial dimension, at the very early stages of water policy reforms.

Chapter 1

Why is financing water resources management an issue?

As societies made progress overtime in securing access to water, the subject progressively slipped away from the public agenda, at least in OECD countries. In the second half of the 20th century, rapid demographic and economic growth put increasing pressure on the water resource, both in terms of quantity and quality. As a response, many OECD countries have made significant efforts in the last three decades to clean up rivers – mostly by treating wastewater from urban and industrial centres. Water scarcity has always commanded attention in more arid countries, like Spain and Mexico, but countries that once perceived themselves as water-rich – such as Canada, New Zealand or the United Kingdom – are progressively realising their increasing vulnerability as population and economic growth takes place in areas with relatively low rainfall, where there is currently limited water storage capacity, and exposed to changing hydrological patterns. Managing "too much water" is also a major concern – indeed, flood management is highlighted in most recent Environmental Performance Reviews of OECD member countries.

Faced with the economic downturn, several OECD members consider water management as a potential new engine for growth. On the one hand, governments acknowledge that the costs of inadequate water management are becoming higher, from a financial perspective, but also in terms of lost development opportunities, compromised health and environmental damage. The recent US Intelligence Community Assessment on Global Water Security (National Intelligence Council, 2012) points out that water shortages and pollution from now through to 2040 are likely to harm the economic performance of important trading countries. Economic output will suffer if countries do not have sufficient clean water supplies to generate electrical power or to maintain and expand manufacturing and resource extraction. Water problems will also hinder the ability of countries to produce food. On the other hand, water plays a central role in OECD's Green Growth Strategy because well-managed water systems can generate huge benefits for our health and our economy (see OECD, *Water and Green Growth*, forthcoming, 2012).

Some countries have already shown the way forward. In 2008, several recovery packages included investment in water infrastructure. Korea's green growth strategy explicitly considers water as a driver for economic, social and environmental performance. Australia has increased its Growth Domestic Product (GDP) by around AUD 220 million in 2008-09 with ambitious reforms to establish a water trading system in the Murray-Darling basin and through reallocations of water used in agriculture – despite a severe drought.

The public debt crisis makes water financing an even more pressing issue: if water can drive growth, who should/can pay to make sure all water users (cities, farmers, but also energy suppliers, industry, and the environment) have access to the water they need, in terms of both quantity and quality?

This report aims to help water policymakers and water managers to strengthen the financial dimension of water resources management. There is a major shortage of policy analysis and guidance as regards sustainable financing of water resources management. *Water Financing and Governance* (Rees *et al.*, 2008), published by the Global Water Partnership (GWP), is one of the few reports addressing this issue; it places particular emphasis on the links between multi-level governance and financing. In the context of the EU Water Framework Directive (WFD), the WATECO working group provided guidance on the use of economic analysis in the implementation of the WFD.

This report is another step in building knowledge and guidance on this policy area. The first section sets the scene, taking a medium term perspective on water management. The second section proposes a frame to consider financing water resources management. It identifies three principles and related issues, which policy makers might wish to assess the financial dimension of their water policies and to strengthen it. The next section compiles recent developments on the use and the relevance (and limitations) of economic instruments to lower the costs of water management and generate revenues to cover these costs. Finally, a set of related issues are explored, such as governance and the role of the private sector. The concluding section sketches a staged approach which can guide a review of the financial dimension of ongoing water management practices. It can inform a policy dialogue on financing water resources management, the ultimate way to manage reform in this area.

Future challenges regarding water resources management

The state of water systems is affected by both human activities and environmental change. Today the key human drivers include population, income growth and economic activities; urbanisation generates particular opportunities (lowering the per-capita cost of access to infrastructure) and challenges (the sheer number of people without access to water supply and sanitation services; additional needs for infrastructure to control floods…).

To date, economic growth and population dynamics have affected water more than climate. But, in the second half of the century, the impacts of climate change are likely to compound water-related challenges. For instance, in the case of agriculture, the anticipated increased incidence and severity of flooding could mobilise sediment loads and associated contaminants and exacerbate impacts on water systems, while more severe droughts may reduce pollutant dilution, thereby increasing toxicity problems. Whatever the impacts on water systems, the task of achieving water quality objectives in agriculture will become more difficult in the coming years as a result of climate change (OECD, 2012b).

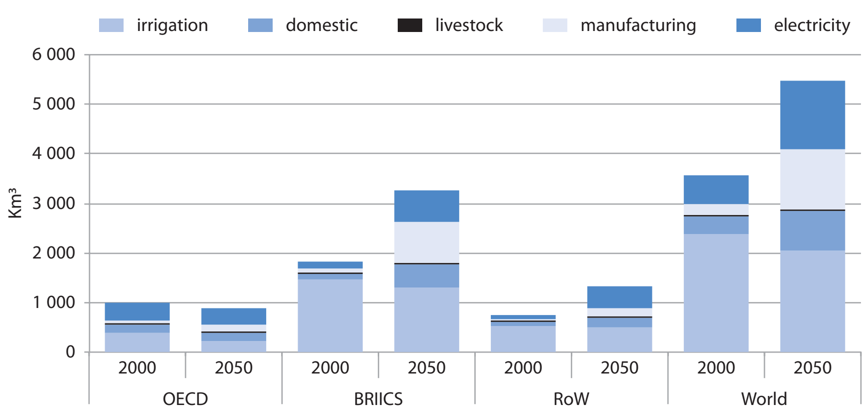
The *OECD Environmental Outlook to 2050* (OECD, 2012a) identifies four sets of interconnected challenges related to water management.

Water quantity

The Outlook Baseline scenario projects that by 2050, 3.9 billion people, over 40% of the world's population, are likely to be living in river basins under severe water stress. These people will have very little room of manoeuvre to adjust to uncertain water availability.

Figure 1.1. **Global water demand**

Baseline scenario, 2000 and 2050



Note: This graph only measures "blue" water demand and does not consider rainfed agriculture. The country groupings BRIICS and RoW are explained in OECD (2012a), Table 1.3.

Source: Environmental Outlook Baseline; output from IMAGE. OECD (2012a), *Environmental Outlook to 2050*, OECD Publishing, Paris. DOI: *http://dx.doi.org/10.1787/9789264122246-en*.

Water demand is projected to increase by 55% globally between 2000 and 2050. The increase in demand will come mainly from manufacturing, electricity and domestic, leaving little scope for increasing water for irrigation. Water resources management will need to manage this increasing competition between water users.

In many regions of the world, groundwater is being exploited faster than it can be replenished and is also becoming increasingly polluted. The rate of groundwater depletion more than doubled between 1960 and 2000, reaching over 280 km^3 per year. In places, this situation places cities and agriculture at risk. More sustainable approaches need to be implemented, from water savings to augmenting security and tapping alternative sources of water.

Water quality

Continued efficiency improvements in agriculture and investments in wastewater treatment in developed countries are expected to stabilise and restore surface water and groundwater quality in most OECD countries by 2050.

The quality of surface water outside the OECD is expected to deteriorate in the coming decades, through nutrient flows from agriculture and poor wastewater treatment. The consequences will be increased eutrophication, biodiversity loss and disease. For example, the number of lakes at risk of harmful algal blooms will increase by 20% in the first half of this century.

Micro-pollutants (medicines, cosmetics, cleaning agents, and biocide residues) are an emerging concern in many countries.

Access to water supply and sanitations services

The number of people with access to an improved water source increased by 1.8 billion between 1990 and 2008, mostly in the BRIICS group (Brazil, Russia, India, Indonesia, China and South Africa), and especially in China. However, globally, more city dwellers did not have access to an improved water source in 2008 than in 1990, as urbanisation is currently outpacing connections to water infrastructure.

More than 240 million people (most of them in rural areas) are expected to be without access to an improved water source by 2050. The Millennium Development Goal for improved water supply is unlikely to be met in Sub-Saharan Africa. The situation is even more daunting given that access to an improved water source does not always mean access to safe water.

Almost 1.4 billion people are projected to still be without access to basic sanitation in 2050, mostly in developing countries. The Millennium Development Goal on sanitation will not be met.

Water related disasters

Today, 100-200 million people per year are victims of floods, droughts and other water-related disasters (affected or killed); almost two thirds are attributed to floods. The number of people at risk from floods is projected to rise from 1.2 billion today to around 1.6 billion in 2050 (nearly 20% of the world's population). The economic value of assets at risk is expected to be around USD 45 trillion by 2050, a growth of over 340% from 2010.

Financing WRM: Expenditures and sources of finance

There are many responses to the challenges mentioned above, depending on local conditions. However, the appropriate responses will share several features: more attention will be paid to (ecologically sensitive) water storage, investment in water supply and sanitation, pollution control, and allocation issues.

This generates costs. These costs are not well known, as information is scarce and patchy. Partial information is available on infrastructure needs and on the costs of water resources management. OECD projections for annual investment in water supply and sanitation systems through to 2025 point to significantly high levels of investment requirements. In the OECD and Big 5 economies annual expenditures in the range of USD 770 billion are projected up to 2015 and over USD 1 trillion by 2025 (see OECD, 2006)[1].

Much of this spending in Europe and North America will be on maintenance, repair and replacement rather than on additions to existing networks, since water systems in many of these countries are now very old and in poor condition. Not least in OECD countries, environmental pressures will continue to grow, as will the expectations of the general public with respect to environmental protection and natural resource management. These factors are expected to add significantly to the costs incurred in the supply of water services and wastewater treatment.

There are reasons to believe that a similar trend applies to other water infrastructure needs, for irrigation, flood control, or water storage (see Box 1.1, as an illustration).

Policy responses to water-related challenges do not only entail investment. They require strengthened water governance as well. In particular, coherence between policy areas which impinge on water availability and quality (such as agriculture and food, land use and city planning, energy and climate) need to be ensured. The multi-level dimension of water policies only adds to this complexity: water has to be managed at local, basin, national and international levels; considerations and trade-offs will differ, depending on the level at which issues are addressed. Here again, various constituencies will be engaged in a complex architecture of water councils and related agencies. This complex web of decisions better relies on robust information, to monitor water use and consumption, water availability and status, the impact of climate change, and the financial flows related to water management.

It follows that water governance is costly. In addition to the political economy of collective action and transaction costs, Garrick and Hope (forthcoming, 2012) single out lock-in costs of path dependency and institutional capacities required for implementation as main drivers for these costs.

Box 1.1. **Benefits from investment in flood and coastal erosion risk management in England**

Floods have a devastating potential in England. Just in the summer of 2007, major floods caused damages estimated at GBP 3.2 billion, of which a significant share (especially for poor households) was uninsured. This estimate does not include stress on people and impacts on customers of infrastructure assets.

The government is devoting significant financial resources to decrease flood risks. Between 2003 and 2009, the government spent over GBP 900 million to reduce the risk of flooding for over 250 000 households. Most of the available funding was spent on improving existing flood defences or keeping them in good working order. But out of 29 million homes and other properties in England, 5.2 million remain at risk of flooding, with 490 000 properties at a significant risk of flooding from rivers or the sea. Infrastructure at risk includes critical national infrastructure assets, including 55% of pumping stations and treatment works, 28% of gas infrastructure, 20% of railways, 14% of electricity infrastructure and 10% of major roads. In 2035, under current trends there will be around 340 000 additional properties with a significant chance of flooding, mostly due to the increasing costs of managing risk in the face of climate change

The monetised benefits of recent expenditures in flood management show that on average, each pound spent generated eight pounds in long-term benefits. The ratio would be reduced only to 7:1 if expenditures were to increase at an annual average of GBP 20 million and would remain robust, at 4:1, even if expenditures were to increase at GBP 50 million per year. These benefit-cost ratios are considerably higher than those for other major (priority) public expenditures, especially for infrastructure investments such as transport and energy.

Source: Fisher, J., D. Johns (2010), *Funding Future Investment in Flood and Coastal Erosion Risk Management in England*, Background report for the OECD project on Financing Water Resources Management.

Because figures on costs are fragmented only, actual expenditures on water resources management give a sense of the financial challenge. Information from selected countries is compiled below, to illustrate how much is spent to manage water and how total expenditures break down for specific items. More detailed accounts of water management expenditures for Germany and Sweden are shared at the end of the chapter.

Expenditures on water management

Substantial financial resources are spent to pay for governance and management interventions, as well as for infrastructure interventions. This section compiles illustrations from selected OECD countries and BRICS (Brazil, Russia, India, China, South Africa), based on data collected for this project. More detailed information on Germany and Sweden are provided at the end of the section. The section gives a sense of the magnitude of water-related expenditures, of the share of some categories, and of the variety of national situations.

Table 1.1. **Main categories of water-related expenditures in selected countries**

	public sector expenditures for WRM	infrastructure-related	main infrastructure expenditures (as % of infrastructure-related expenditures)	governance-related	main governance functions
Brazil	2.2 billion	97%	pollution abatement (50%) storage and distribution of raw water (47%) ecosystem management (3%)	3%	research monitoring information management
China	10 billion	91%	water resources works flood control hydropower development soil and water conservation	9%	capacity development
Czech Republic	0.6 billion	80%	wastewater infrastructure flood protection environmental protection	20%	
France	29 billion	87%	sanitation (52%) drinking water supply (34%) soil and water conservation (7%) flood management (3%) miscellaneous, including scosystems (3%)	13%	general administration R&D basin authorities management

Note: Scope and definitions may vary across countries; see the text in this section for more precise information.

Source: Country case studies.

In Brazil, public sector expenditures for water management at federal level amounted to EUR 2.2 billion in 2009, with infrastructure-related expenditures representing 97% of those expenditures and governance-related expenditures only 3%. Since 2006, expenditures in water infrastructure have increased almost 8-fold, driven largely by the Economic Growth Acceleration Programme launched in January 2007. Since 2006, expenditures in water infrastructure have been almost equally divided between pollution abatement (50%) and storage and distribution of raw water (47%), with ecosystem management representing only about 3%. Expenditures in research monitoring and information management increased 20% between 2006 and 2007 and have since increased slowly, reaching EUR 26 million in 2009. Expenditures in other governance functions (such as co-ordination, planning, administration and enforcement) almost doubled between 2006 and 2007 but have since then decreased below the 2006 level, representing only EUR 15 million in 2009.

China spent around EUR 10 billion per year during the period 2004-08, for water resources works (40%), flood control (37%), hydropower development (7%), soil and water conservation (6%) and capacity development and other items (9%).

In the Czech Republic, total expenditures in water resources management exceed CZK 15 billion per year. A ballpark figure for governance expenditures can be estimated at 20% of the total, while wastewater infrastructure alone represents about 50%. Annual average operational expenditures of the river boards were CZK 3.7 billion for 2004-2008, with additional CZK 1.8 billion spent on investments. Administration costs for minor rivers was CZK 480 million in 2008, with investments amounting to an additional CZK 500-600 million per year. Repeated occurrence of catastrophic floods has prompted an increase in expenditures in flood protection expenditures, now reaching over CZK 1 billion per year, as well as in flood damage restoration (over CZK 800 million per year). Expenditures for navigation are about CZK 400 million per year. Investments for environmental protection are about CZK 0.5-1 billion per year. Around CZK 8 billion is spent every year on wastewater infrastructure to achieve EU targets – but this amount should drop after 2013.

In France, expenditures on water management amounted to EUR 29 billion in 2007. Most of this was for drinking water supply (30%; EUR 8.8 billion) and sanitation (45%; EUR 12.9 billion). Protection and cleaning of soils, ground and surface water accounted for 6% (EUR 1.8 billion), flood management for 3% (EUR 0.8 billion), and hydropower, waterways and aquatic ecosystems management together accounted for another 3% (EUR 0.8 billion). Governance-related expenditures can be estimated at around EUR 3.8 billion, or 13% of the total – with EUR 1.7 billion for general administration, EUR 1.2 billion for research and development, EUR 0.6 billion for local public basin authorities and EUR 0.3 billion for other management expenses. Public administrations spent EUR 5.4 billion in water management – representing 19% of total expenditures in water management, 5% of total expenditures in drinking water supply, 13% of total expenditures in wastewater, and 67% of total expenditures in other areas of water management. The annual estimated expenditures of the 6 water agencies in 2007-2012 are EUR 1.9 billion. The governance-related expenditures (knowledge, planning and governance) represent on average 18% – varying across water agencies from 11-27%.

Similarly, South Africa has a large stock of water storage and distribution infrastructure that requires significant, although relatively stable, expenditures in operations and maintenance. New investment programmes are carried out, but their lumpy nature implies that the year-on-year evolution varies greatly. Perhaps the most significant trend is the increase in water governance expenditures necessary to match the increasing complexity of water management. At the same time, there has been progress in reducing costs via optimised infrastructure operations and expenditure co-ordination at regional level.

Table 1.2. **Public expenditures in water management in South Africa**

billion rand

	2000-01	2004-05	2008-09
Governance	0.63	0.92	1.42
Water supply infrastructure (on-going)	0.90	1.00	1.05
Water supply infrastructure (capital)	0.20	0.19	1.95

Source: adapted from Pegram, G., B. Schreiner (2010), *Financing Water resources management – South African Experience*, EU Water Initiative Finance Working Group and Global Water Partnership.

Water management expenditures evolve over time. For industrialised countries, water governance is likely to increase rapidly, as more efforts need to be paid to integrative tasks. For instance, in the Czech Republic, achieving the EU WFD objectives of good status will require more extensive monitoring, drafting of catchment area plans, and enhanced international co-operation for managing transboundary rivers. In the Netherlands, for the period 2007-27, the additional costs of measures for EU WFD implementation have been estimated at EUR 2.9 billion and the investments in the complete package of measures total around EUR 7.1`billion, with management and governance costs representing around 11% of total costs (PBL, 2008).

At the same time, infrastructure costs are also likely to evolve, with some items increasing and others decreasing. In general, the share of operation, maintenance and renewal costs will likely increase (in relation to the share of new infrastructure). Climate change will also have an impact on water management expenditures.

Financing water management: Combining sources of finance

Some of the required policy responses make claims on public spending. This can be legitimate, when related to the provision of a public good, and/or in contexts where basic infrastructures need to be built (typically, in developing countries). In the current context of fiscal consolidation, the extent of such claims will only materialise when backed by robust valuation of benefits (see Box 1.2), the exploration of alternative financing schemes, and a search for low-cost options.

Box 1.2. **Multiple benefits of water management in France**

A partial picture offered by current estimates of the benefits of WRM in France illustrates that they take various forms. It suggests that they amount to several EUR billion per year.

A first order of magnitude is given by the annual turnover of commercial activities directly dependant on water resources, which are estimated to be EUR 9.6 billion – including EUR 3.5 billion related to natural mineral waters, EUR 2.8 billion to hydropower, EUR 2.2 billion related to fish and EUR 1 billion related to spas. Examples of more direct benefits are those of avoided flood damages in Paris through construction of lake-reservoirs (estimated to be EUR 300-700 million), and those of preserving bathing water quality in tourism resorts (estimated to be EUR 1 billion).

Estimates of future benefits from implementation of the EU WFD in France include those of reduced drinking water supply costs from avoided agricultural pollution (EUR 1.8 billion), with non-commercial impacts of achieving good quality status being estimated via contingent valuation surveys at EUR 1 billion.

Another example of (non-monetised) benefits is the increase in water quality in the river Seine generated by several decades of investments in wastewater treatment in the Paris agglomeration area, prompting significant reductions in concentrations of biochemical oxygen demand (BOD), ammonium and phosphorus and resulting in improved biodiversity (currently 32 fish species are listed, from 3 fish species in the 1960s). A final example is the potential of river navigation in the Nogent-Le Havre corridor to reduce CO_2 emissions from freight transport – the current configuration allows a reduction of 28% and an improved configuration would allow a further reduction of 55% of CO_2 emissions.

Source: Bommelaer, O., J. Devaux (2012), "Financing Water Resources Management in France", *Études & Documents* No. 62, January 2012, MEDDTL, Paris.

A variety of sources of finance are available. Bommelaer and Devaux (2012) inventory multiple financing bases used to meet targeted water policy goals in France:

- Billing drinking water, based on a fixed rate and the volume used; this combination supports the sustainable financing of the service and the amortisation of its investments, while being an incentive to use water efficiently. The water bill also supports urban sanitation, taxes on domestic pollution, basin governance, maintenance of the aquatic environments and the public waterways and production of knowledge.
- The electricity bill finances part of the storage infrastructure and its maintenance.
- The insurance policy for dwellings and vehicles is the main basis of the management and compensation for flood hazards.
- The tax on abstractions covers some expenses related to quantitative management.
- The national or local taxpayer contributes to the general administration of the system and to the public good dimension of water resources management, via public budgets (research, information systems, water policing, health, environment, risks, biodiversity conservation, etc.).

Table 1.3 identifies those who pay for water management in China.

Table 1.3. **Paying for water in China**

Variations by sub-sector

Sector of water management	Main institutions/groups involved in financing
Flood and drought control	Mainly by the government (including planning, investment and operations) *Flood control law* indicates combination of government funds and "rational payment by beneficiaries". Flood control in rivers and lakes and emergency responses funded by central government Flood protection in cities funded by city governments Flood protection of economic infrastructure (oilfields, railways, mines, telecommunications, …) funded by companies Drought control and disaster relief by government at different levels
Water supply and sanitation in cities	Water supply in urban areas self-financed by water operators (with some government subsidies) with pricing in form of cost plus and total cost accounting. Sewage treatment and pollution control mixed, combining "polluter pays" and government subsidies Water supply in rural areas jointly financed by farmers and government (central and local) – principle of "multi-level, multi-channel, diversified and multi-way financing". Several funds (poverty relief, welfare-to-work, small irrigation and water conservation, special fund for shortage). In the special fund, central government financing to poorer regions (west 60%, central 40%), in richer regions (east) only local government and farmers.

Table 1.3. **Paying for water in China**

Variations by sub-sector *(continued)*

Sector of water management	Main institutions/groups involved in financing
Irrigation	Large and medium systems largely funded by the state, with some water fees from farmers Small systems largely funded by farmers, with some government subsidies Example: water saving initiative: central 33%, local 25%, 42% loans and farmers
Water and soil conservation	Mainly financed by the state. Enterprises must adopt water and soil conservation measures, or pay competent authorities to carry out works

Source: DRC (2010), *Study on Investment and Financing of Water Resources Management in China*, Development and Research Centre of the Ministry of Water Resources.

The next section sketches a framework to balance these different options and to select appropriate sources of finance for water management.

Illustration No. 1. Water Management expenditures in Germany

In Germany, the programmes of measures (PoMs) and river basin management plans (RBMPs) requested by the European Water Framework Directive can provide good insights in both the costs of sustainable water resources management (with the aim of reaching the good status of water bodies) and financing sources. In Germany, the RBMPs have been established at the level of the Länder. The task of the competent authorities was to estimate how much the different measures would cost, and to identify financing options. Furthermore, authorities had to assess whether costs are proportionate and whether they can be financed by the end of the first RBMP (*i.e.* 2015). Table 1.4 indicates the yearly financial requirements for the whole implementation period of the WFD, from 2010 to 2027, for the German land Hesse. The average financial needs amount to EUR 130.5 million per year. The Baden-Württemberg land has differentiated the financing needs of the PoM according to point sources, agriculture related measures and hydro-morphology. As can be seen in Table 1.5, different financing sources exist for the different types of pressures. Total investment costs have been estimated at EUR 780 million, whereas ongoing costs amount to EUR 1.7 billion per year.

Illustration No. 2. Water Management expenditures in Sweden

In Sweden, there is a funding gap for water resources management. In the area of water governance, the programmes of measures published by the DWAs are very general, they do not identify specific actions for each water

Table 1.4. **Financing needs to reach good ecological status of water bodies in Hesse**

Yearly, for the period 2010-27 (in million EUR)

Position	Designation	2010-15	2016-27	Average financing needs per year
1	**Groundwater**	**24.0**	**19.5**	**21.0**
1.1	in water protection areas	1.2	4.3	3.3
1.2	outside water protection areas	22.8	15.2	17.7
2	**Surface water bodies – Hydromorphology**	**65.3**	**35.1**	**45.2**
2.1	Water bodies outside of federal waterways	59.6	30.7	40.4
2.2	Measures on federal waterways	5.7	4.4	4.8
3	**Surface water bodies – Substances**	**122.0**	**35.1**	**45.2**
3.1	Point sources	19.3	-	6.4
3.2	Diffuse sources (erosion of phosphorous)	16.0	35.5	29.0
3.3	Salty effluents	86.7	-	28.9
	Total costs	211.3	90.1	130.5

Source: Gräfe, A. (2009), *Finanzbedarf und Finanzierung*, Hessisches Ministerium für Umwelt, Energie, Landwirtschaft und Verbraucherschutz (Financing needs and financing sources, Ministry of the Environment, Energy, Agriculture, and Consumer Protection, Hesse). PowerPoint presentation available at *www2.hmuelv.hessen.de/imperia/md/content/internet/wrrl/ 4_oeffentlichkeitsbeteiligung/ offenlegung2008_bwpl_mp/informationsveranstaltungen/finanzbedarf _neu090324.pdf.*

body as required by the EU WFD due to lack of financial resources. In the last few years financial resources for fighting euthrophication have increased, but three of the six national environmental goals related to water will not be achieved until 2020, suggesting a gap for financing specific interventions. Information on expenditures and costs estimates has improved thanks to demands from the EU WFD.

The largest expenditure on water resources management corresponds to wastewater treatment – some SEK 7 billion. Total costs of water supply and wastewater treatment activities were SEK 14.3 billion in 2003 (including 25% VAT). Of the total 40% for drinking water supply and distribution and 60% for sewage systems and wastewater treatment – with capital costs accounting for 26% of the total. While there are not reliable estimates of overall expenditures in water governance in Sweden, estimates are available for some items. Co-ordination costs for SEPA were about EUR 25 million in 2008. In nominal terms, the expenditures of the national monitoring programme on inland waters have tripled between 1996-2008, from SEK 7 million to SEK 21 million. Sub-national authorities (such as county boards, water councils and municipalities) finance regional and local monitoring programmes which for all subjects (air, water and land) may add to SEK 130 million. Estimates of public funding for research in WRM are not available. Most of such funding is made available by 4 research councils with a combined budget of about SEK 7 600 million for different subjects. National research funds from SEPA for water were SEK 23 million in 2008. SEPA's expenditures to support law, economy and co-ordination work amounted to SEK 3.3 million and those central guidance on water regulations to SEK 4.2 million. Expenditures on the flood warning system operated by the Swedish Meteorological and Hydrological Institute are not available.

Additional expenditures exceed SEK 0.5 billion. Expenditures in liming lakes and water courses to reduce the effects of acidification were

Table 1.5. **Cost and financing information in Baden-Württemberg**

Type of pressure	Point sources	Agriculture	Hydromorphology (structure, continuity, minimal flow)
Cost information	– Municipal point sources: Yearly costs for sewage disposal: EUR 1.6 billion Total investment costs: EUR 400 million (EUR 200 million for wastewater treatment plants, EUR 200 million for treatment of rainwater) – Industrial point sources: little need for action, individual cases	EUR 97 million/year – composed of: – Compensation for market relief and cultural landscape (MEKA) – EUR 75 million/year – Regulation on protected areas and compensation (SchALVO) – EUR 22 million/year	Total investment costs: EUR 380 billion, composed of: – EUR 320 million (Land (35%) – EUR 111 million; Municipalities (27%) – EUR 85 million; Private (operator of hydropower plants) (38%) – EUR 122 million) – EUR 60 million for federal water ways
Potential financing sources	Sewage charges, support through the subsidy guidelines for water management, Municipal Environmental Fund → 40 million/year	Existing programmes are used for financing agricultural measures, complemented by specific advice: MEKA and SchALVO → EUR 97 million/year	– Structure: EAFRD, European Fisheries Fund, Municipal Environmental Fund, lottery funds, Ecological accounts → EUR 8 million/year – Continuity of hydropower plants: Application of the Renewable Energy Law – Federal water ways → EUR 10 million The rest will depend on negotiations between national ministries and the Land.

Source: adapted from Bley J. (2009), *Maßnahmenprogramm Wasserrahmenrichtlinie – Vorgehensweise in Baden-Württemberg*, Umweltministerium Baden-Württemberg (The Water Framework Directive programme of measures – methods in Baden-Württemberg, Ministry of the Environment, Baden-Württemberg), PowerPoint presentation available at *www.netzwerk-laendlicher-raum.de/fileadmin/sites/ELER/Dateien/05_Service/Veranstaltungen/2009/WRRL/Bley_TagungLandwirtschaftundWRRL_03_2009.pdf.*

SEK 209 million in 2008. Expenditures to reduce nutrient loads from agricultural land amount to about SEK 320 million per year. SEK 288 million per year correspond to EU CAP funding for creating buffer zones, applying catch crops and changing agricultural practices (such as manure handling). About SEK 30 million correspond to the "focus on nutrients" programme centred on on-farm advisory services.

Estimates of costs to achieve water policy goals related to the EU WFD suggest the need for additional expenditures in the order of SEK 4-5 billion. Under current patterns, this would be covered by a combination of 45% public budgets (mostly for governance costs), 45% users (mostly for wastewater treatment) and 10% EU transfers (agricultural measures).

A ballpark figure for additional water governance costs may be SEK 1.5-2 billion per year. This is a significant figure, which would probably mean more than doubling current expenditure levels. It is dominated by the administrative costs by sub-national agencies to implement the EU WFD. Just in the Skagerrak and Kattegat DWA district, total costs of administrative activities called for by the EU WFD, such as control and renewal of permissions, have been estimated to be SEK 2.1 billion in 2010-2015 – of which SEK 1 billion correspond to the municipalities. The Swedish Environmental Protection Agency expects to increase expenditures for water management associated with the WFD during the years 2010-2012 due to needs to update regulations and guidance documents, to co-ordinate the programme of measures, and to implement proposed measures. The central budget related to implementation of the EU WFD was SEK 148 million for 2008 and expected to grow to SEK 173 million in 2010, with management expenditures of the District Water Authorities and supportive staff at the county boards representing over 80% of the total. These expenditures relate only to "governance" aspects, such as mapping and co-operation (SEK 48 billion and 25 billion respectively in 2008) by the centrally-supported agencies. It is expected that monitoring costs will increase substantially – this might be funded by a combination of higher water prices and reallocation of environmental monitoring budgets by sub-national authorities. Costs of extended evaluation and improved sampling and analysis have been estimated at SEK 50-100 million.

Ecosystem management costs are SEK 320-350 million. Cost related to improved water source protection has been evaluated at SEK 70-100 million per year – these costs are currently co-funded by government budgets and a fee on drinking water. Costs of liming are estimated at SEK 150 million per year – to be covered by the national budget. SEK 100 million per year are needed for the restoration of 1 000 lakes.

Costs in wastewater treatment infrastructure are SEK 1.5-1.9 billion. Additional reductions in pollution loads from municipal wastewater treatment plants will increase costs by about 10% or SEK 800-1 000 million per year – to be fully covered by water charges. The cost of additional reductions in pollution loads from industrial facilities is estimated at SEK 250-400 million per year – to be fully funded by industry via direct investments or water charges. The costs of additional reductions from currently unconnected households are estimated at SEK 400-500 million – so far covered by the households.

The costs of additional nutrient reductions from agricultural land have been estimated at SEK 500-1 000 SEK per year for the next 10-20 years – so far these costs have been covered both by EU funds and by farmers via compliance with regulations.

Note

1. Figures in this area are hugely uncertain. A more recent OECD survey, using a different method, anticipates significantly different needs. See Annex B for more information.

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Chapter 2

Four principles for WRM financing

Traditionally the water sector has been dominated by plans to achieve certain water policy goals (whether in terms of water availability, water services or flood control) focused on building new infrastructures. Discussions on financing were limited to how much money governments should provide to build the infrastructure. Over time, the discussions have evolved, with an increasing emphasis on cost recovery from water users (both for drinking water supply and sanitation and for irrigation; but potentially also for hydropower, navigation and others). Article 9 of the Water Framework Directive in Europe is a prominent illustration of this issue. It states that "Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs, having regard to the economic analysis and in accordance in particular with the polluter pays principle".

Policy frameworks for financing water management around the world have in most cases evolved organically over time, although there are cases where there has been a dedicated effort to design a coherent policy framework (for instance in South Africa). They can be understood as constituted by the principles that define who should pay for water management and the mechanisms that allow to put those principles in practice. They increasingly acknowledge that meaningful participation of water stakeholders in the definition of the policy framework would help to get it right and facilitate its implementation.

These discussions can benefit from a set of principles or considerations on the pros and cons of alternative financing options. This section sketches such a policy framework.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

A case for public funding

Public funding is considered an essential component of water management financing due to the public good dimension of many aspects of water management. Infrastructure designed to deal with periods of water scarcity (reservoirs) and investments in flood management have a public good nature and tend to be under provided by private markets. This leaves a significant role for government (Shaw, 2005; Grafton, 2011). Similarly, in a developing country context, the stock of water-related infrastructure may be so low that public funding is required, at least until basic services are available and benefits accrue to user groups (which then could be harnessed to finance further developments).

The case for public funding is more tenuous if it aims at lowering the costs of water services for water users or at mitigating risks related to water investment. More targeted measures are usually more effective and efficient to do just that. Moreover, as stated by Rees *et al.* (2008), there are high opportunity costs in using scarce public resources to supply private goods to users who can afford them. This consideration has several consequences.

First, while alternative sources of finance need to be channelled, the size of public budgets for water must be commensurate with water policy objectives and the efforts needed to deliver their public good dimension.

Second, there is substantial scope for improving the allocation of public financial resources within the water sector. There are two issues here. One relates to cost-effectiveness in the use of financial resources, so that a given objective is achieved at minimum cost. Chapter 2 discusses this in more details. Another issue is to ensure that public expenditures are aligned with policy priorities. For instance, there is a risk that decisions at river basin level fail to take into account national policy priorities.

Finally, in many cases (sometimes hidden or implicit) public subsidies are actively working against water policy objectives. This is the case when the costs of using the resource (including environmental or opportunity costs) are not reflected in the price paid by users. This is also the case when subsidies originate in non-water policies. Examples abound in the agriculture and energy sectors: typically farmers in several OECD and non member countries do not pay the full price of electricity used to pump groundwater. Reforming those harmful subsidies should also be part of the water financing agenda: for instance, it could free public financial resources (which could then be used for water policies), generate more revenues to invest in water-related services and infrastructures, make water pollution more costly and create markets for water-efficient technologies and practices.

Financing water management deals with ensuring that public money is available to ensure the provision of the public good dimension of water services, and with identifying and channelling alternative sources of finance to cover the other dimensions of water policies. A set of principles can usefully guide policy decisions.

Two well-established principles: Polluter Pays and Beneficiary Pays

Many countries have included the Polluter Pays principle or the Beneficiary Pays principle (sometimes also formulated as a cost recovery principle) in their legislation or their general policy framework for environmental management, and often for water in particular. For example, the Polluter Pays principle (PPP) is a basic element of all European environmental policies. It is explicitly referred to in the EU Water Framework Directive (WFD), which establishes clear requirements concerning financing for water management in the EU member states. The OECD Council recommendation and the Guidelines for Water resources management Policies explicitly claim that they are "meant to supplement and strengthen and not in any way to weaken the Polluter Pays Principle" (see OECD, 1989).

In the European Union, the WFD specifies that Member States must ensure an adequate recovery of the costs of water services (taking into account the PPP), including environmental and resource costs. The different sectors (at least industry, households and agriculture) have to make an adequate contribution for covering the costs of the water services. However, lower cost recovery rates can be justified on social, environmental and economic grounds, as well as due to geographic or climatic conditions.

Although the WFD relates to the integrated management of water resources, there is no agreement on the definition of water services to which the cost-recovery principle applies (from a narrow definition of water services limited to drinking water and sewage to a wide definition of water services that include irrigation services, dams and impoundments for hydropower, flood protection infrastructure, etc.). In Germany, for example, only public water supply and wastewater removal is included in the definition.

The Polluter Pays principle

The Polluter Pays principle is most relevant for water policies.

The case of agricultural pollutions is emblematic. The overall economic, environmental and social costs of water pollution caused by agriculture across OECD countries are likely to exceed billions of dollars annually. No satisfactory estimate of these costs for all OECD countries currently exists. A comprehensive national study in the United Kingdom, however, has shown that, in 2007, the annual cost of agricultural damage to water systems (pollution of freshwater, estuaries and drinking water treatment costs) was around EUR 330 million (USD 460 million) (OECD, 2012b). Encouraging farmers to internalise their environmental costs through implementation of the Polluter Pays principle (PPP) can bring economic and environmental benefits.

Application of the Polluter Pays principle (PPP) is not widespread across OECD countries. Four main reasons account for this situation:

- Diffuse source pollution cannot be measured at reasonable cost with current monitoring technologies. Specific instruments can be used in that context, such as taxes on fertilisers or pesticides. Denmark, France, Norway, Sweden and the United States report such instruments in the OECD/EEA database on instruments used for environmental policy and natural resources management; in Denmark, the tax is based on mineral phosphorous in feed phosphates; in France, the general tax on polluting activities depends on the toxicity of the chemical substance. Experience with taxes on fertilisers suggests that they must form part of a general policy mix, as the tax may need to be levied at very high levels to be effective in reducing pollution (Fuentes, 2011).
- There is poor enforcement of water pollution regulations in many situations. Stricter enforcement of regulations can assist in meeting the Polluter Pays principle, and also lower the burden on government budgetary resources compared to some other policy instruments to address water quality issues (OECD, 2012b)
- Property rights, institutional and other barriers can prevent a thorough implementation of the Polluter Pays principle (OECD, 2012b). Fuentes (2011) notes an interesting illustration: in Spain, water prices must cover, but not exceed, the operating and capital costs from the operation of government-funded supply infrastructures (transport, storage and treatment)[1]; they can cover administrative costs as well, to the extent that they are directly related to the operation of these infrastructures. While the recovery of costs that results from the scarcity of water[2] is particularly relevant for a country with a semi-arid climate, scarcity and environmental costs cannot be included in water prices over and above operating and capital costs.
- Moreover, some externalities which affect aquatic resources are not related to current or measurable water uses. Bommelaer and Devaux (2012) list such cases: inherited orphan industrial pollution (ruins of war, sediments, sludge, dredging residues, etc.), rain pollution and air pollution fallout, leachate from quarries and mines, contaminated soil leaching, salting of roads and treatments of frontages of buildings,

etc. Putting a price on water cannot compensate for such pollutions, as this would transfer the cost of pollution to agents not responsible for the externality.

Water policies must factor in other legal or financial instruments: prohibiting toxic products, taxing the source of the polluting products, holding polluters responsible for internalising the costs of removing pollution, setting up funds earmarked for orphan pollutions, etc.

Benefits and beneficiaries of water resources management

Water resources management provides a large range of benefits of very different nature, starting with direct benefits received by water users. This first category of benefits encompasses the direct benefits received by water users such as farmers, energy producers and industrial facilities, as well as households. For economic sectors, direct benefits often take the form of increased economic production, but reduction in risks is also an important benefit.

Another type of direct benefit is that of biodiversity conservation and ecosystem protection. In Sweden, six out of 16 national environmental objectives are related to water (IVL, 2010), while in the European Union, achieving good ecological status of water bodies is the ultimate objective of the Water Framework Directive.

The benefits provided by water infrastructure projects have long been recognised. Dikes, levees and floodgates help to protect population centres from flood risks. Reservoirs and canals make possible to supply water to urban areas and agricultural lands. Wastewater treatment plants help to protect water quality in rivers and lakes. There are many examples of benefits estimates for water investment projects. In fact, cost benefit analysis was first applied to water projects in the US, mandated by the 1936 Federal Navigation Act and 1939 Flood Control Act. Over time, estimates of benefits have expanded to less traditional areas of the water agenda, such as river rehabilitation (see Box 2.1 on Israel).

The benefits of water infrastructure are site specific: they depend on the direct service provided (*i.e.* water supply, flood protection, water quality protection), the size of the population or economic activity affected, and the alternative options available to ensure equivalent services.

Water resources management also generates indirect benefits. Examples of those indirect benefits are the reduced costs of other productive inputs (such as agricultural commodities) and transport services faced by industrial producers. Another example is the reduced costs of consumer products (whether agricultural or industrial) bought by households. The macroeconomic impacts via those second-round benefits may well be the main indirect benefits provided by water resources management.

Much less is known about the benefits of water governance measures. The value of better information, improved planning, or more effective processes for negotiating and enforcing water policies is generally difficult to quantify. Rather

Box 2.1. **Benefits of river rehabilitation in Israel**

Israel's rivers have long been plagued by a range of problems. Most of the springs and flows were captured for water supply for drainage and agriculture. Sewage and solid waste were disposed to river channels. Rivers have become the "backyards" of most localities, serving as sites for the disposal of sewage and solid waste. But over the past two decades, river rehabilitation and recovery of the river's environmental and social function have taken an increasingly important place on the public agenda. The heightened consciousness of the importance of river rehabilitation has been catalysed by the recognition that alongside their function regulating flow, rivers have ecological, social and cultural value. The different benefits identified in Israel with river rehabilitation include:

- Ecological aspects: Conservation of nature, landscape and biodiversity. Prevention of water, soil and environmental pollution.
- Leisure aspects: Benefits derived from the existence of the river as a recreation and leisure site actively used by the public. Benefits derived from the development of intensive urban parks in the case of rivers which pass trough urban fibers. Preservation of open spaces and creation of green lungs. Development of recreation and tourist sites.
- Economic aspects: Benefits derived from the increased value of property adjacent to the rehabilitated river. Benefits derived from the protection of open spaces and infrastructure from floods. Benefits derived from the creation of employment and income sources.

Within the framework of the 2005 National Plan for River Rehabilitation uniform indicators were developed to present the benefits derived from the rehabilitation of the different rivers. The total benefits from river rehabilitation for 14 rivers were calculated to be 5 billion shekels (USD 1.3 billion). The benefits varied greatly by river, from 39 million shekel for the Southern Jordan to 1.5 billion shekel for the Yarkon. As a result, rehabilitation plans have been initiated and implemented by the National River Administration, the Yarkon and Kishon Authorities, in cooperation with drainage authorities.

Source: SVIVA (2010), *River Rehabilitation and its Economic Feasibility*, Israeli Ministry of Environmental Protection.

than trying to value the benefit provided by individual governance measures, it may be worth looking at the benefits that stronger water governance allows to reap. In a sense, water governance enables water stakeholders to enlarge the space of viable solutions that may result in the adoption of less costly solutions (from a society-wide perspective) than would otherwise be the case.

In many cases, the water resources management options that deliver the higher benefits per dollar spent are likely to be in the realm of water governance. They include monitoring and forecasting, dam operations protocols, drought management protocols, or enforcement of existing regulations. These measures do not need massive financial resources. They require sustainable revenues to cover regular costs (personnel, training, equipment).

Table 2.1 provides examples of benefits of water resources management and the corresponding beneficiaries. Careful analysis may reveal more beneficiaries of a particular intervention than initially thought.

Table 2.1. **Benefits and beneficiaries of water resources management**

Selected illustrations

Benefits	Beneficiaries
Avoided costs of supplying water from more expensive sources	Water utilities and households Industrial facilities Farmers
Avoided human and economic losses from floods	Households Industrial facilities Cities
Avoided catastrophic losses from drought (loss of perennial crops, fires)	Farmers, larger communities
Reduced costs of generating electricity thanks to hydropower	Power companies Electricity consumers
Savings in transportation costs from expansion of water-based transport	Water transport companies Producers and consumers of transported goods
Increased opportunities for recreation and revenue from recreation-based tourism	Households Tourism industry
Avoided costs of water treatment thanks to protected water quality	Water utilities and households
Avoided habitat degradation and biodiversity loss thanks to reduced water pollution and increased baseline flows	General population
Reduced incidence of water-borne diseases	Households Health system
Increased value of property thanks to improvements in water and riparian ecosystems	Households

The key feature of cost recovery mechanisms is that they are targeted at the beneficiaries of water management and should, at least in principle, reflect the private benefits that accrue.

Multi-purpose infrastructure highlights the value of adopting a beneficiary perspective. Multi-purpose dams generate a range of benefits – such as flood control, hydropower generation, securing water supply for agricultural and urban use, or recreation. They also point at two important and related challenges. First, reliable estimates of potential benefits are requisites to operate multi-purpose infrastructure in a way that maximises the benefits generated by the infrastructure. This is not always the case. For instance in India, dams are often operated to maximise water supply for farmers, while hydropower generation usually is a higher value use (Malik, 2010). Second, having the benefits estimates accepted by the stakeholders will provide a strong basis for allocating costs among beneficiaries. If the costs of flood control are readily assumed by the government under a public good rationale (as in Spain), there is a strong incentive for other stakeholders to inflate the estimates of flood control benefits and to reduce their own share of the costs.

How to cover the costs of providing water management functions that serve the public more generally is more problematic and this is generally met through allocations from public budgets (*i.e.* from general taxation). Some countries make specific budgetary allocations for water resources management as a whole. South Africa's policy framework details the payment mechanisms that can be employed to cover for different water management functions (such as water research). China's policy framework includes rules for allocating a portion of public budgets (at different levels, from national to local) to water funds.

Cost recovery in selected countries

Differences in the main principles advocated by specific countries and their implementation translate chiefly in differences in the share of infrastructure costs (investment, operation and maintenance) paid by public subsidies and by end-users of specific services (see Table 2.2).

Effective cost recovery rates vary widely among countries. Developed countries tend to rely more on user contributions than developing countries. Some countries, such as France and the Netherlands, fund almost all water management (in excess of 90%) from user contributions. In some cases, like Australia, the rapid evolution of water management needs has prompted an increase in the amount of public resources devoted to public management.

Cost recovery rates tend to vary for each water management sub-sector – for example, in Spain the rates are likely to be around 50% for water abstraction, 95% for distribution in urban systems and 85% for wastewater treatment.

Table 2.2. **Financing of water infrastructure costs in selected countries**

Estimates (%)

	Investment for water sector development		Operation and maintenance costs	
	Government	Water users and municipalities	Government	Water users and municipalities
Spain	70	30	50	50
France	50	50	0	100
Canada	75	25	50-70	50-30
Japan	100	0	0	100
US	70	30	50	50

Source: Dukhovny V., V. Sokolov and H. Manthrithilake (eds.) (2009), *Integrated Water Resources Management: Putting Good Theory into Real Practice: Central Asian Experience*, Tashkent, Uzbekistan.

Potential tensions between Polluter Pays and Beneficiary Pays principles

These two principles need careful implementation. Lax definition can lead to apparent contradictions. This is illustrated by flawed Payment for Ecosystem Services schemes, which can be a way to share the cost of pollution, in disguise. Hanley *et al.* (1998) discuss situations which could be portrayed as “Pay the Polluter Principle”: for instance, farmers who behaved in an ecologically responsible way can be penalised vis-à-vis others, if the less virtuous ones receive a larger incentive to change their behaviour. Similarly, Salzman (2005) highlights the perils of payment for ecosystem services, which, despite their high potential, can create moral hazard, rent-seeking behaviour, free-riding, or perverse incentives.

Payment for ecosystem services is only legitimate when the services are clearly defined and properly enhanced. Observers note that this is not always the case, and a number of payment for ecosystem services schemes should be considered as inadequate.

Two additional principles: Equity and Policy coherence

Some countries make reference to additional principles. Equity deserves particular attention, as does the coherence between related policies.

Equity and the issue of proportionate costs of water management

The Netherlands include solidarity as an overarching principle for water management. France has adopted the principle “water pays for water”, meaning that the water sector should not receive subsidies from government budgets but also that cross-subsidies within the water sector can be legitimate. These examples illustrate equity issues in water management financing.

Illustrations abound where sound water management has been opposed for reasons of equity, or disproportionate costs for (categories of) water users: affordability issues are often referred to, to block water reforms; farmers and industries claim they cannot cover the costs attached to water management, or that these costs would impair their competitiveness. These considerations are important, but they are often overstated.

Lessons have been learned on the social consequences of water tariff policies for domestic uses. Low water prices hurt the poor most, as they deprive utilities from revenues to expand coverage, forcing the poor to procure poor quality water from private vendors. Water tariffs can be structured to account for the basic needs of all segments of the population. However, social policy objectives are better attained through socially targeted measures such as income support. Targeting and keeping the transaction costs low are essential criteria in designing such measures.

Similarly, where countries have raised water charges for farmers, the available evidence indicates no reduction in agricultural output (OECD, 2009). Where high levels of taxes have been applied to chemical inputs to comply with the Polluter Pays principle, often coupled with a mix of other policy measures, they have usually led to reductions in input use without loss of farm production or income (OECD, 2012b).

Policy debates are opportunities to review the potential impacts of improved water management on specific water users (poor households, farmers, selected industries), to compare with the actual costs of poor water management or poor water services, and with the willingness to pay. Such reviews need to be made at several scales, to balance private costs and benefits and gains for the wider community. This is not a case for public subsidies, but rather due consideration of the equity principle for water management financing.

Based on such debates, the Equity principle can justify that selected beneficiaries do not cover the cost of the service they get; this is acknowledged in Article 9 of the Water Framework Directive, “where this does not compromise the purposes and the achievement of the objectives of this Directive” (see the consolidated version of the WFD). The Equity principle should not be tied to the Polluter Pays principle, as this can result in second and third best solutions to pollution challenges.

Policy coherence and alignment of incentives

Water management is affected by initiatives taken by other policy communities. Policies in agriculture, energy, urban development or trade are often responsible for ever growing pressures on water resources. Changes in those policies, including their financing components, can in many cases facilitate reductions of water management costs.

For instance, policies that raise producer prices or subsidise input use encourage farmers to increase production and use more inputs than would be the case in the absence of this support. Assessing these perverse support mechanisms, with a view to phasing them out, can contribute to lowering the cost of water resources management. Efforts in this direction are ongoing in OECD countries, but more could be done: some 50% (2008-10) of total OECD agricultural producer support provides incentives to produce and/or use variable inputs, compared to 85% in 1986-88 (OECD, 2012b).

A policy framework for water financing needs to look beyond the water sector, and to ensure coherence with non-water sectors. The EU Water Framework Directive has stressed the importance of analysing the financing linked to sector policies (*e.g.* agriculture, energy or climate change) that directly support projects and actions that impact on the water system. For example, in Spain 25% of agricultural subsidies (in the context of the Common Agricultural Policy) remain coupled to production, encouraging inefficient use of water (Aldaya *et al.* 2010).

Because of the intersectoral nature of water management, its financing will rely on financial sources from both the water sector and other economic sectors (in particular for promoting good practices in these sectors and limit their pressures on aquatic ecosystems). The mechanisms and processes developed for ensuring coherence between water and sector policies, and thus financing water resources management, deserve further investigation and analysis.

Notes

1. It is worth noting that when capital costs are based on historic (and not replacement) costs, they tend to largely underestimate the financing requirements.

2. The 1999 amendment of the Water Law introduced a factor of 0.5 to 2, to be applied to tariffs reflecting financial costs, depending on whether consumption exceeds or is below reference levels. But these reference levels are likely to be determined with respect to individual concessions and do not reflect scarcity of the resource.

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Chapter 3

The value added of economic instruments

A range of mechanisms can be used to transfer some of the costs of water resources management activities from the public purse to the beneficiaries of water management, including (see Rees, Winpenny and Hall, 2008, for more information):

- Regulatory levies. These are increasingly being used to recover regulatory costs from the regulated parties. The classical example is water licensing fees – when the fee is set to pay only for the administrative cost of issuing a license to abstract water. Other examples include the pollution control tax in Spain (to pay for enforcement by river basin agencies) or the research charge in South Africa.
- Pollution and abstraction charges or taxes. They are based on the user-pays and polluter-pays principles. They include charges associated with non-tradable abstraction, consumption or pollution permits, and effluent or pollution charges. They aim to recover costs and to internalise negative externalities associated with water abstractions or polluting activities. As a proxy, most charges are set to cover the costs of investment programmes aimed at environmental improvements.
- Payments for ecosystem services. In some cases, downstream beneficiaries pay to regulate or preserve or restore upstream environments (*e.g.* flood management), as they benefit from activities made by others to reduce water consumption or pollution. Upstream land and water users/polluters receive compensation to provide environmental services and avoid damaging practices.
- Permit markets: Markets for abstraction and pollution permits are created to: *i)* facilitate market-regulated water permit reallocation

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

under scarcity conditions; and *ii)* provide incentives for pollution abatement and technological improvements, by allowing polluters who can outperform environmental standards to sell excess pollution rights.

Theoretical and empirical economic analyses suggest that price-based approaches to water conservation are more cost-effective than non-price approaches. In the case of domestic water uses, Olmstead and Stavins (2007) note that the "gains from using prices as an incentive for conservation come from allowing households to respond to increased water prices in the manner of their choice, rather than by installing a particular technology or reducing particular uses, as prescribed by non-price approaches". Therefore, appropriate water pricing can lower financing requirements for water resources management.

OECD countries are gaining experience with abstraction, pollution/effluent charges and other economic instruments – such as tradable water rights or payment for watershed services – to achieve more economically efficient, socially equitable and environmentally sustainable abstraction and allocation among competing uses. This section compiles some of the lessons learned from this experience as regards water management financing.[1] It concludes with a note of caution: economic instruments operate better under specific conditions, which have to be identified and met.

Economic instruments for water management

A wide array of economic instruments is available to manage water. Table 3.1 provides an inventory.

Table 3.1. **Possible economic instruments for water management**

Possible economic instruments	Advantages of use
Marginal social cost pricing, incorporating the scarcity value of water (a combination of user tariffs and abstraction charges)	Signals the optimal time to invest in water infrastructure so that supply is augmented efficiently Reduces demand for water during periods of scarcity
International and regional water markets	Allows trade of water from areas of surplus to increase the water supply in areas of scarcity Allows trade of water from low to high value uses creating incentives to use water efficiently and reduce demand
Buy-backs of water use rights	Secures water for environmental flows and offsets economic losses
Emission permit trading for point and nonpoint pollution	Allows pollution to be reduced from the lowest cost sources
Emission taxes and pollution charges	Creates ongoing incentive for all sources to reduce pollution
Insurance schemes[2]	When premium reflect risks level, insurance schemes can reduce the exposure of economic assets to (flood) risks and provide incentives to locate in low-risk areas.

Source: adapted from Grafton, Q. (2011), *Economic Instruments for Water Management*, paper submitted to the OECD Environment Directorate [ENV/EPOC/WPBWE(2011)13].

Economic theory (Thomas Tietenberg, in particular) suggests that economic instruments work best when they are designed to address one particular objective. It follows that water policies should rely on a combination of economic instruments. The French approach combines seven taxes (see Box 3.1).

Box 3.1. **Eight taxes to manage water in France**

Since January 1st, 2008, French water agencies charge seven types of taxes, defined as follows:

- Tax on water pollution. For households, the tax is based on the annual volume of water billed. For cattle breeders, the tax is based on the size of the cattle. For industries, the tax is based on annual pollution discharged to the environment.
- Tax for modernisation of the waste water drainage system. It is paid by all users connected to a sewerage system and based on volumes of drinking water supplied.
- Tax on diffuse agricultural pollution. It is paid by retailers of pesticides.
- Tax on the abstraction of water resources. Paid by any water user, it is based on annual volume of withdrawals. Rates depend on water uses and water bodies.
- Tax for storage in low water periods (paid by owners of water reservoirs).
- Tax on obstacles on rivers.
- Tax for the protection of aquatic environments; it is a tax on fishing paid by fishermen through unions.

Recently, local authorities have been granted the right to levy a tax to finance urban storm water management.

Source: Bommelaer, O., J. Devaux (2012), "Financing Water Resources Management in France", *Études & Documents* No. 62, January 2012, MEDDTL, Paris; additional information is appended. Centre d'Études sur les Réseaux, les Transports, l'Urbanisme et les Constructions Publiques (French Centre for Studies on Networks, Transport, Town Planning and Public Building, CERTU) (2012), *Taxe pour la gestion des eaux pluviales urbaines* (Tax on urban rainwater management), *Fiche No. 3*, March 2012.

The following sections explore how such instruments are used to finance water resources management.

Abstraction charges in OECD countries

Abstraction charges in OECD countries are often designed to provide funding for water resources management or for watershed protection activities. However, they seldom reflect water scarcity and tend to be relatively low.[3] Abstraction taxes imposed on groundwater tend to be higher than on surface water. In most cases, charges are collected and retained locally.

The form taken by taxes and fees/charges and the basis for their calculation vary considerably by country and sector. Charges can take the form of a nominal license fee linked to an abstraction permit regime, a volumetric charge varying with abstraction or consumption volumes, or a flat or variable charge linked with other criteria (*e.g.* area of industrial estates).

Table 3.2 builds on the most recent information in the OECD/EEA database on economic instruments for environmental policies. They may therefore not be comprehensive.

In Canada, most provinces levy licence fees to major water users for access to the resource. The provincial licence fees for water are related to the cost of administering the licensing programme. These are regulatory levies and not abstraction charges.

In Germany, abstraction charges have been introduced with the dual objective of decreasing abstractions and raising revenues for use in environmental protection measures. Revenues have been used for nature conservation, protection of ground and surface water, reforestation, soil protection and decontamination. In seven Länder (in Berlin, for example), part of the revenue is earmarked for groundwater protection.

In Portugal, since 2008, water supply and sanitation service providers include abstraction charges in the retail tariffs, dependent on the actual use and the type of user. The proceedings are earmarked to a water protection fund (50%), or finance Basin Water Authorities (ABH; 40%), and the National Water Authority in charge of water resources management (INAG; 10%).

Pollution charges in OECD countries

More countries report the use of pollution charges than abstraction charges. Pollution charges can be linked to different characteristics of the polluter (*e.g.* its sector, processes), the effluents (volume or pollutant concentration), or the recipient water body.

Table 3.3 summarises the characteristics of pollution charges in selected countries for which information is available in the OECD/EEA database (unless otherwise specified). These charges can represent a significant share of the water bill (about one-third of water supply and sanitation bills for households, in the case of France, as an illustration).

Table 3.2. **Abstraction charges in selected OECD countries, 2011**

Country	Levied by	Tax name	Specific tax base	Tax rate
Belgium/ Flanders	Regional administrations	Groundwater tax	Quantity of used groundwater; varies per user type	0.0603 EUR per m^3 groundwater (minimum rate for 2011)
Belgium/ Wallonia	Regional administrations	Groundwater tax	Quantity of used groundwater	
Canada	Province	Water Abstraction Permit Fees	Varies per user type and per type of use	
Czech Republic		Charge for withdrawal of groundwater	Underground water abstraction for drinking water supply	0.0813 EUR per m^3.
Czech Republic		Charge for withdrawal of groundwater	Underground water abstractions for other purposes	0.122 EUR per m^3.
Denmark		Water charges	Water consumption	0.9734 EUR per m^3 on average (2003)
Estonia		Water abstraction charge	groundwater (distinction by aquifer) and surface water	
France	Basin	Charge on water abstraction	Water abstraction	
France	City	Charge on water consumption	Consumption of public potable water	
Germany	Land	Water abstraction charge	for groundwater, surface water; per type of use	
Greece		Charge on irrigation water	Irrigation water	
Hungary		Charge on water abstraction	Water abstractions; varies by water source and region	Effective rate up to EUR 0.04 per m^3

Table 3.2. **Abstraction charges in selected OECD countries, 2011** *(continued)*

Country	Levied by	Tax name	Specific tax base	Tax rate
Israel		Water extraction levy	for different uses; per season	
Italy	Regions	Charge on water services	Water services – domestic use	
Japan	Local govt	Charge on abstraction of water from rivers	Quantity of river water abstracted	
Korea	Municipalities	Water use charge	per river	0.1037-0.1102 EUR per m^3
Mexico	Treasury	Charge on water use	Per user type, source and location	
Netherlands		Tax on groundwater extraction	Extracted groundwater	0.1826 EUR per m^3
Netherlands		Tax on tap water	Tap water delivered to a consumer	0.147 EUR per m^3
Poland		Charge on groundwater abstraction	per type of use	0.015-0.0255 EUR per m^3
Poland		Charge on surface water abstraction	per type of use	0.009-0.0128 EUR per m^3
Slovenia		Payment for water rights	per type of use	
Slovenia		Water abstraction charge	per type of use	
Spain	Province	Charge on water	per type of use	
UK		Abstraction Charges	Water resources	0.005 EUR per m^3 on average

Source: OECD/EEA database on instruments used for environmental policy and natural resources management.

Table 3.3. **Pollution charges in selected OECD countries**

Country	Levied by	Tax name	Specific tax base	Tax rate	
Australia	State	Water effluent charge	volume, pollution content (17 types of pollutants)	0.0015	EUR per kg assessable load.
Belgium/ Flanders		Waste water charge	Volume and pollution content	0.8968	EUR per m³ drinking water.
Belgium/ Wallonia		Waste water charge	per type of use and reuse (for manure spreading)		
Canada	Province	Charge on discharge	Volume and pollution content	70.7074	EUR per tonne.
Czech Republic		Fee for discharge of wastewater into groundwater	Pollution content	14.2285	EUR per year. (1 equivalent citizen due to the capacity of the sewerage plant)
Czech Republic		Fee for discharge of wastewater into surface water	Emissions of organic substances	0.6504	EUR per kg.
Denmark		Charge on sewage discharge	Water consumption	2.1989	EUR per m³ on average
Denmark		Duty on wastewater	Nitrate, phosphate or organic content in wastewater	2.6816	EUR per kg.
Estonia		Sewage charge	industry, households	0.9- 4.33	EUR per m³.
Estonia		Water pollution charge	per substance	11731	EUR per tonne.
Finland		Wastewater user charges	Water consumption or waste water volume/quality (larger sources) + fixed components	2.28	EUR per cubic metre (in total) on average in Feb 2011
France	Basin	Wastewater user charges	Water consumption		Varies by municipality
France	Basin	Water effluent charges	Volume of pollutants discharged by industries		Varies by water agency.
Germany	Land	Wastewater charge	Pollution load (noxiousness)	35	EUR per unit of noxiousness.

Table 3.3. **Pollution charges in selected OECD countries** *(continued)*

Country	Levied by	Tax name	Specific tax base	Tax rate	
Greece		Wastewater charges	Municipal and industrial wastewater		NULL
Hungary		Wastewater charges	industry, households	0.11 – 3.43	EUR per m^3.
Hungary		Water load charge	per substance	156.7417	EUR per kg.
Italy		Charge on water services	Water services – sewer		a monthly fixed amount defined by municipalities
Japan		Wastewater user charges	Municipal multipurpose septic tanks		Varies by municipality.
Korea		Sewage treatment fee	Municipal wastewater		National average was EUR 0.18 per tonne in 2010.
Korea		Water effluent charges	per substance (18 types of pollutants)	64.8223	EUR per kg.
Mexico		Water effluent charges	Quantity of wastewater in excess of permissible contents of COD and TSS		Varies with the carrying capacity of the recipient body.
Netherlands		Municipal sewerage charge	Discharge of household wastewater		Rates are locally determined per household, differentiated according to the number of members.
Netherlands		Tax on the pollution of surface waters	BOD, COD and heavy metals, for large polluters	31.76	EUR per pollution unit
Norway		User charges on wastewater treatment	The fee reflects the actual cost of wastewater treatment, and must be calculated on the basis of the principle of full cost recovery.		Varies between municipalities
Poland	Region	Water effluent charges	based on temperature, pollution load	0.15	EUR per 1000 m^3.
Slovak Republic		Charge for discharging of wastewater	pollution content	4.3206	EUR per kmol.

Table 3.3. **Pollution charges in selected OECD countries** *(continued)*

Country	Levied by	Tax name	Specific tax base	Tax rate
Slovenia		Wastewater collection and treatment charge	Consumption of water	Varies between municipalities
Slovenia		Wastewater pollution tax	Unit of pollution	26.4125 EUR per unit of pollution
Spain	Basin	Tax on wastewater treatment	Pollution content and location	EUR 0.0167*(diameter² + 225N) per household per 2 months; N number of dwellings or commercial activities
Sweden	Municipality	Wastewater user charges	Wastewater and drinking water	Varies by municipality; full cost charging.
Sweden		Water pollution fee	Oil spill	18-51 basic amounts + 0.04-0.12 basic amounts per 1 000 litres above 101 000 litres, depending on the size of the ship.
Turkey		Charge on water pollution	Registration of water pollution control charge	
Turkey		Wastewater user charges	Municipal and industrial wastewater volumes	Varies by municipality
United States	State	Wastewater user charges	Water consumption, or discharge toxicity (larger sources)	11.4556 EUR per month for households on average (1994)
United States	State	Annual waste discharge license fees		11.7 EUR per million litres.

Source: OECD/EEA database on instruments used for environmental policy and natural resources management.

Putting a price on water

Putting the right price on water and water-related services encourages people to waste less, pollute less, invest more in water infrastructure and value watershed services. Pricing water can serve four objectives:

- Along with tax incentives and transfers, tariffs on water-related services generate finance to cover investment and operation and maintenance costs.
- It helps to allocate water among competing uses.
- It can manage demand[4] and discourage depletion of water resources.
- Appropriate tariffs ensure adequate and equitable access to affordable water and water-related services.

Efforts are being made in OECD countries to better account for the costs and externalities of water use by households and industrial users (OECD, 2010a). This is reflected in the level of prices (which have increased, at times substantially, over the last decade) and in the structure of tariffs (which better reflect consumption and treatment costs). Water tariffs in Denmark reflect the choice to recover all supply and sanitation costs from users (see Box 3.2).

Box 3.2. **Full-cost water pricing in Denmark**

Since 1992, urban water prices in Denmark have been based on full-cost recovery so that prices cover both economic (through user charges) and environmental costs (through taxes). All urban water users are metered and water prices are charged according to the volume consumed. Since the policy's introduction, water prices have risen substantially; during the period 1993-2004, the real price of water (including environmental taxes) increased by 54% and prices are now among the highest in the OECD. The rise in prices has led to a substantial decrease in urban water demand from 155 to 125 litres per person per day, one of the lowest levels in the OECD. Since water pricing is purely volumetric, there are no social tariffs and the affordability of water services is ensured through separate social policy.

Source: OECD (2008a), *OECD Environmental Performance Reviews: Denmark 2007,* OECD Publishing, Paris. DOI : *http://dx.doi.org/10.1787/9789264039582-en*.

The level of prices for water supplied to farms has risen in OECD countries. Frequently, however, farmers are only paying the operation and maintenance costs for water supplied, with little or no recovery of capital costs of irrigation infrastructure. Water scarcity and environmental costs are rarely reflected in irrigation water prices. This often results from claims that higher water prices will undercut farmers' competitiveness on global markets. Spain illustrates a move towards a better account of the capital and resource costs in irrigation water (see Box 3.3). Pricing policies for farmers are often combined with other (regulatory) instruments, such as abstraction thresholds and permits.

Box 3.3. **Accounting for capital and resource costs for irrigation water in Spain**

In Spain, water pricing based on surface irrigated is still widespread in gravitation-based irrigation. However, in May 2009, a ministerial order introduced the obligation (to be implemented gradually), to meter all water consumption, regardless of the type of consumptive use, although the obligation may not apply to individual final consumers. The government aims to introduce two-part tariffs, with a surface component to reflect fixed infrastructure costs and a per-unit volume component in irrigation on the basis of this newly introduced obligation. The government also removed the subsidised tariffs for electricity in irrigation, leading to an increase of costs by 60%, which resulted in some irrigation being abandoned. This measure is appropriate as subsidies for energy, by reducing pumping costs, contribute to excessive extraction of water, especially in the case of groundwater, which has proven difficult for the authorities to control. There has been pressure to reduce the impact of the deregulation on farmers' irrigation costs, although the share of irrigation costs to total costs in farming is often modest, especially where water productivity is relatively high.

Source: Fuentes A. (2011), "Policies Towards a Sustainable Use of Water in Spain", *OECD Economics Department Working Papers*, No. 840, OECD Publishing, Paris. DOI: *http://dx.doi.org/10.1787/5kgj3l0ggczt-en*.

Increasingly, wastewater charges are being introduced to cover wastewater management costs. Most countries levy separate charges for sewerage and for wastewater treatment, although in most cases the basis for charging remains water consumption. Only the size of the volumetric rate differs.

The pricing of water supply and sanitation services to industry is a little different to household tariff structures. For example, more countries and regions use decreasing block water tariffs for industry, particularly for large users. The desire to keep large customers that provide substantial local and stable revenues seems to inhibit the use of tariff structures that would encourage less water use. With regard to wastewater management, there is a growing use of separate charges for wastewater collection and for wastewater treatment, with the latter increasingly based on the pollution load of industrial effluents, thus better reflecting actual treatment costs.

Innovative instruments to finance water resources management

There is increasing use of innovative policy tools to finance water management. A variety of water funds aim to secure funding for water infrastructure.

In the US, Clean Water and Drinking Water State Revolving Funds have been instrumental in leveraging federal budgets. For the financial year 2010, the U.S. Environmental Protection Agency (EPA) requested USD 3.9 billion for Clean Water and Drinking Water State Revolving Funds (SRFs) for funding water infrastructure projects. This represents about 40% of the total budget request of USD 10.5 billion, a 157% increase as compared to the previous year. The Clean Water and Drinking Water SRFs provide grants to states to capitalise their own revolving funds. The SRFs generate funding for loans even without Federal capitalisation, as repayments and interest are recycled back into the program. EPA estimates that for every Federal dollar invested, approximately two dollars in financing is provided to the municipalities (USEPA, 2009).

Box 3.4. **Water funds to finance conservation and water supply in Latin America**

Water users pay into the funds in exchange for the product they receive – fresh, clean water. The funds, in turn, pay for forest conservation along rivers, streams and lakes, to ensure that safe drinking water flows out of users' faucets every time they turn on the tap.

Some water funds pay for community-wide reforestation projects in villages upstream from major urban centres, like Quito, Ecuador, and Bogotá, Colombia. In other cases, like in Brazil's Atlantic Forest, municipalities collect fees from water users and make direct payments to farmers and ranchers who protect and restore riverside forests on their land through water producer initiatives.

These "water producers" are being compensated for a service they provide to people downstream in Rio de Janeiro and São Paulo. They receive USD 32 per acre, per year, for keeping their riverside forests standing.

The Water Producer concept was first developed by Brazil's National Water Agency (ANA), which has been partnering with the Nature Conservancy in the implementation of the projects across Brazil.

Source: The Nature Conservancy; see *www.nature.org/ourinitiatives/regions/latinamerica/water-funds-of-south-america.xml*.

China accumulates experience with water funds. Since 1997, all Chinese governments (from national to city levels) are required by law to set up Water Funds fed with at least 3% of each government revenues and 15% of the urban maintenance and construction tax (for cities with major flood control tasks). Some local governments (such as Guandong and Guanxi) allocate also a share of income from land sales and auctioning of development rights (DRC, 2010).

The Nature Conservancy is launching water funds across Latin America, which pay for watershed protection and reforestation, thereby helping to provide fresh water today and into the future (the box explains the operation of the water funds). The Conservancy's growing portfolio of water funds provide a steady source of funding for the conservation of more than 7 million acres of watersheds and secure drinking water for nearly 40 million people.

There are limited but increasing examples of innovative instruments that raise revenues for difficult to fund functions, such as environmental restoration. For instance, in the United States regulation obliges hydropower producers to invest in salmon restoration and they can do so by buying in-stream water rights (using a specialised intermediary such as the Oregon Water Trust).

A similar instrument is implemented in Germany on a voluntary basis: energy consumers ultimately pay for the cost of modernising the stock of hydropower plants as to contribute to achieving water policy objectives (specifically, achieving good ecological status as demanded by the EU WFD). The mechanism used is the structure of feed-in tariffs specified in the German Renewable Energy Law: when hydropower facilities comply with certain criteria (such as ensuring biological continuity of the river, or being built in a location where there are barrages or weirs), they are paid a higher-feed in tariff from electricity distributors, which is reflected in the energy bill paid by the end users. The additional remuneration is paid to hydropower producers for 20 years and varies according to facility size and output – smaller plants are paid higher remunerations per kWh than bigger plants to ensure their profitability; plants producing more than 5 MW are only paid for the increased part of production after modernisation.

An increasing variety of agreements tend to harness beneficiaries to finance water quality measures in agriculture. These are illustrated by voluntary agreements between water supply utilities and farmers to reduce pollution and water treatment costs (see OECD, 2012b). In the EU and the United States, farmers are paid for a variety of environmental stewardship measures, including reducing nitrate contamination. While these have been primarily funded through public budget allocation - implicitly recognising society as a whole as a beneficiary – it is possible to design alternative funding mechanisms with specific fees or levies on water bills, fees for recreational uses or fisheries and levies on flood plain dwellers, so as to allocate costs more directly to direct beneficiaries.

Box 3.5. **Achieving cost savings through voluntary cooperative agreements**

An approach to reduce costs in the water resources management sector – in particular concerning water quality issues – is the shift from point of use measures to point of source measures. Changing agricultural practices to reduce pollution with fertilizers and pesticides instead of treating water before use is a primary example. One way to induce changes in agricultural practices is the establishment of voluntary agreements between farmers and water companies, whereby the latter are providing advice and financially support farmers for agreed production methods that reduce pressures on water resources. In the context of voluntary cooperative agreements (CAs), both parties are interested in minimising the costs and environmental pressures. Whereas farmers benefit from the modernization of farming methods, the interest of the water companies to support the agricultural sector in the conversion to more sustainable farming practices (*e.g.* intercropping, reduction of fertilisers and pesticides, conversion to permanent grassland, etc.) lies in the prevention of costly remedial measures (such as water treatment, closing wells and conveyance or remote water resources). It can be assumed, that CAs implement the most cost-effective changes in farming practice, as they are tailored to the site-specific conditions and environmental problems in the catchment. As all relevant farmers located in the catchment area are involved, the contracts can contribute to integrated water resources management. In some EU Member States, such agreements are already in place for more than 20 years.

Table 3.4. **Two examples of cooperative agreements in Germany**

Name of the cooperative agreement	10^6 m³/year	Euro/year	Euro/m³
CA "Viersen"			
Groundwater abstraction	5.5		
CA expenditure of the water company		395 000	0.07
Saved costs in water treatment		648 000 to 972 000	0.12-0.18
Economic net benefit		More than 253 000	
CA "Stevertalsperre"			
Water abstraction	100		
CA expenditure of the water company		480 000	0.005
Saved costs in water treatment		1 000 000 to 1 500 000	0.10 to 0.15
Economic net benefit		More than 520 000	

Box 3.5. **Achieving cost savings through voluntary cooperative agreements** *(continued)*

However, the establishment of voluntary agreements requires institutional, but also cultural preconditions. In the UK, for example, CAs are not widespread as water companies do not have the right to pass on costs, such as compensation payments, to consumers through water charges (although their water charges would decrease, once the changes in practice showing effect). Furthermore, UK regulators rely more on mandatory rules to meet the polluter pays principle and have strong reservations against paying polluters not to pollute. In addition, relying on changing agricultural practices instead of treatment processes has different uncertainty. Treating water has the advantage that the compliance with standards (*e.g.* pesticide concentration in drinking water) can be achieved with a high degree of certainty. The preventative approach by employing CAs might be less certain due to unexpected events in the water catchment area. Furthermore, lag times might exist between the time the measures are taken and the time improvements in the aquatic environment are recorded, a problem for areas where immediate action is required to meet statutory drinking water quality or where the limited availability of water resources does not allow for temporary measures (such as closing wells or water blending).

Source: Heinz, I. (2008), "Co-operative Agreements and the EU Water Framework Directive in Conjunction with the Common Agricultural Policy", *Hydrology and Earth System Sciences*, Vol. 12, pp. 715-726.

Aylward (2009) reports on two innovative, voluntary mechanisms of a different kind:

- The Bonneville Environmental Foundation (BEF) launched in 2009 a system of water restoration credits (WRCs). Water users who want to reduce their water footprint can buy water restoration credits. The money raised through the WRCs is used to fund flow restoration projects. One WRC equals 1 000 gallons of water restored to rivers and streams that are certified by the National Fish and Wildlife Foundation as being critically dewatered. Similar to carbon offset payments, WRCs allow purchasing water and environmental benefits independent of the location (so-called offsite mitigation) – as respective mitigation options might not be in place where the damage takes place.
- The "Blue Water Programme", launched in Oregon's Deschutes Basin by the Deschutes River Conservancy and a regulated municipal water supply company, allows customers of the water supply company to add a monthly amount to their water bill to support instream leasing of water rights. While only 2% of the customers decided to support the system, the generated income provides almost 6% of the Deschutes River Conservancy's budget for leasing water rights.

Such a variety of innovations calls for a thorough documentation of the actual benefit and effectiveness, the cost-effectiveness of the measures, and their sustainability. In particular, opportunities for replication and scale up need to be assessed, taking account of institutional and other requisites which drive the capacity of each tool to deliver.

A note of caution: Requisites for economic instruments to deliver

A preliminary assessment by EPI-Water[5] suggests that the track record of economic instruments for water management is ambivalent. Economic instruments are often effective at raising revenues or stimulating economic development (hydropower generation, irrigated agriculture). However, the link with environmental policy can be thin, or ill-defined. When there are trade-offs between financial sustainability and other environment policy objectives, economic instruments are often designed to contribute to the former (EPI-Water, 2012).

The assessment also highlights the linkages between economic policy instruments and the institutions needed to make then work. In particular, water rights need to be properly defined (not only for market mechanisms).

Cost recovery instruments can be complex to administer and their effective management may overwhelm the capacities of countries. Countries should assess whether their governance systems are prepared to manage the proposed system before introducing reforms. It may be necessary to strengthen governance systems, to focus on a limited number of cost recovery instruments, or both.

Similarly, transaction costs can be high, and they should be taken into consideration when considering the design and implementation of alternative instruments to finance water resources management.

Putting a price on water can also hinder revenues of service providers. This is particularly the case when the revenue of utilities (be they public or private) is based on volumes of water sold, or of wastewater treated. However, the impact is not straightforward, as it depends on the elasticity of water demand to price (see a discussion in Box 3.6). Moreover, accompanying measures can be implemented to mitigate the adverse effects on, for instance, the capacity of the service provider to operate and maintenance water systems (which are characterised by high fixed costs). Innovative business models decouple revenues from volumes. Energy suppliers have paved the way, when part of their revenues is generated from high-value services, such as control over total energy costs. Water utilities (for domestic or irrigation uses) would gain from exploring such innovative approaches.

Box 3.6. **Price elasticity of water demand**

Studies abound on the effect of price variations on water demand. As noted by Olmstead and Stavins (2007), there is a critical distinction between the technical term "inelastic demand" and the phrase "unresponsive to price." Inelastic demand will decrease by less than one percent for every one percent increase in price. In contrast, if demand is truly unresponsive to price, the same quantity of water will be demanded at any price.

Meta-analyses indicate that water demand is responsive but inelastic. The noted reference study by Dalhuisen *et al.* (2003) concludes that, globally, price elasticity is -0.41, but varies in many contexts. In a US context, Olmstead and Stavins (2007) assessed that, on average, a ten percent increase in the marginal price of water can be expected to diminish demand in the urban residential sector by about 3 to 4 percent.

Consumers' responses to price variations depend on a series of factors. Price structures and water bills affect elastiticity (combining water supply and sanitation bills allows to display a higher price). It follows that, under price-based approaches, low-income households contribute a greater share of a city's resulting aggregate water consumption reduction than they do under certain types of non-price demand management policies (Olsmtead, Stavins, 2007).

The case of irrigation water deserves particular attention. Israel offers an example where substantial increases in water prices (by 65% between 1998 and 2008; OECD, 2010b) have allowed water consumption to fall, while the quantity of crops produced remained steady. In Spain, there was significant discrepancies in elasticities of irrigation water, based on water scarcity and crop patterns. Elasticity was higher where water is abundant and lower where water is scarce (because water uses are already efficient). Elasticity is low for high value crops. In developing countries, where irrigation water can be very cheap, even significant price increases (in %) may fail to trigger changes in farming practices.

Pricing alone is usually not enough to reach water policy objectives: in France, it was assessed that a marginal price increase by 50% would reduce water demand in a given territory by 10% by 2020, which may not be sufficient.

Source: adapted from Dalhuisen, J.M. *et al.* (2003), "Price and Income Elasticities of Residential Water Demand: A Meta-Analysis", *Land Economics*, May 2003, Vol. 79, No. 2, pp. 292-308; and Olmstead, S.M. and R.N. Stavins (2007), "Managing Water Demand. Price vs. Non-Price Conservation Programs", *A Pioneer Institute White Paper*, No. 39, July 2007.

Notes

1. Complementary analyses on economic instruments for water policies at large can be found in Grafton (2011).

2. For instance, in France, a fund dedicated to flood protection is financed by an additional premium on the package policy for dwellings and on insurance contracts for vehicles. In 2010, this amounted to EUR 154 million, of which 140 were earmarked for flood prevention. Compare with EUR 1 300 million, secured to cover the costs of natural disasters.

3. For abstraction charges, and other economic instruments to reflect resource scarcity, analysis needs to be based on reliable hydrological and economic information, a knowledge base which is often lacking.

4. Empirical evidence however indicates that price elasticity of water consumption is low in the short term. As a consequence, prices can only drive water demand if they increase significantly, which may trigger affordability issues

5. EPI Water is a research project financed by the European Commission under the FP 7 programme. It reviews empirical evidence on the actual performance of economic policy instruments for the management of water resources. The interim report builds on over 30 case studies, in Europe and in selected non European countries.

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Chapter 4

Issues related to the implementation of the four principles

Several issues need to be addressed, when considering alternative paths to finance water resources management. This section explores some of them. They all have an empirical dimension: there is no generic, definitive answer, and they all deserve thorough policy considerations on a case by case basis.

The following issues are discussed here:

- Should revenues from water-related taxes be earmarked for water expenditure?
- How can costs of water management be reduced, including through operational efficiency?
- What is the role of the private sector?
- How to value water services, as a precondition to assess benefits and harness beneficiaries?
- Governance arrangements that match financing strategies.

Earmarking revenues from water-related taxes: Balancing efficiency and financial security

Revenues from water-related services or taxes can feed into central budgets and be spent for general purposes. This ensures allocation efficiency of public funds. They can alternatively be earmarked and allocated to water management. This can be detrimental from a welfare perspective, but can be instrumental to secure funding for water management. The Recommendation

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The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

of the OECD Council on Water Management Policies and Instruments indeed prescribed earmarking, back in 1978: as regards charges on water abstraction and waste water discharge, the Council recommended that "their proceeds should be allocated to water resources development and pollution control" (OECD, 1978). This was justified by the observation that charges "generate an essential income which may provide water management authorities with useful financial capability to support, for the benefit of the community, pollution control and water resource development projects which are considered most appropriate and urgent" (ibid.).

In practice, whether revenues from water charges serve general purposes or are earmarked for water resources management will depend on contextual features. In most OECD countries, abstraction charges are collected and retained locally. Only in a few cases does the revenue merge into general taxation. This is the case in Denmark and Mexico, while in Germany some abstraction charges go into the budgets of some of the *Länder*.

Pollution charges are usually collected at the local level – rarely at the river basin level – and earmarked to finance environmental activities. In the Czech and the Slovak Republics, revenues are collected nationally but allocated to specific national environmental funds. In the Netherlands, charges apply to industrial and municipal discharges to state waters; they vary according to provinces to reflect pollution abatement costs; revenues go to the central government but are earmarked to finance water and wastewater management activities. In Australia, the States/Territories of New South Wales, Victoria and South Australia are operating pollution charge systems. These systems were initially set up to recover the administrative costs of licensing, monitoring and enforcement, but in recent years, *incentives for license holders to continuously reduce their discharges to water* have become prominent (OECD, 2008b).

In some instances, countries adopted alternative cost allocation mechanisms that recognise the existence of a broader set of beneficiaries. Under the principle of compensation recognised under Korean law, revenues collected from downstream beneficiaries are used to compensate upstream residents for losses due to land use regulation, an important step towards truly integrated water and land management at the river basin level.

How can costs of water management be reduced: Efficiency and cost-effectiveness as drivers for financial performance

A series of initiatives can lower the cost of water management. Cost effective water management can also generate additional sources of funding: it can enhance the creditworthiness of water-related investment, and facilitate private sector investment.

Cost-effectiveness

In many instances, policy mixes to manage water are not cost effective. For instance, state subsidies to mitigate euthropication in Sweden have been issued regardless of local conditions – with low cost-effectiveness. The government is funding research to improve the cost-effectiveness of this policy; it explores alternative mechanisms, such as a permit system for nutrients that could save about SEK 60 million in the Southern Baltic river basin alone.

Cost-effectiveness analysis (CEA) is seldom applied in the water sector. In Europe, even though it is encouraged by the EU WFD, CEA has rarely been applied at the stage of programme design. Most EU member states are rather falling back on expert judgement or (local and/or national) working groups. Malta is an exception (see Box 4.1).

Box 4.1. **Applying cost-effectiveness analysis in Malta**

With French support, Malta has developed a cost-effective draft programme of measures for restoring groundwater resources. After an analysis of pressures on groundwater resources, a list of potential measures (including technical, regulatory, research and awareness raising approaches) was developed. This list was refined taking into account existing or planned actions as well as preliminary measures proposed or implemented in other EU member states. A database was compiled adding information on their effectiveness and costs – types of costs included *i)* investment costs, *ii)* operation and maintenance costs, *iii)* administrative costs, *iv)* other relevant and indirect costs. A discount rate was applied for estimating annualised costs for each individual measure. Cost-effectiveness ratios were calculated and measures ranked according to their ratio.

This approach was, however, limited to measures aimed at restoring the quantitative status of groundwater in Malta and excluded measures already compulsory by law as well as measures which are seen as a pre-condition to effective water management (*e.g.* an effective regulatory framework or an enhanced knowledge base). The analysis looked at all measures linked to the quantitative status of groundwater, independent from the sectors they apply to. A cost-effective combination of measures was then compared to alternative scenarios giving more prominence to desalination. In addition to costs, these scenarios were compared in terms of distributional effects and additional environmental impacts (in particular linked to energy consumption and green house gas emissions).

Source: MRA (Malta Resources Authority) & MEDAD (French Ministry of Ecology and Sustainable Development) (2007) "Towards a draft programme of measures for restoring groundwater resources in Malta", Final report, Twinning light project: MT2004/IN/EN/07TL, unpublished.

Managing demand for water is often among the most cost-effective options for water management. Economic instruments (water pricing, water trading) as well as other instruments can achieve significant cost savings by reducing the demand for water and its associated costs. Examples include the use of a water extraction levy in Israel, water reallocation in the US, or even the relocation of water-intensive economic activities (in South Africa). In Australia demand management makes use of regulations, incentives (providing subsidies for water efficient appliances); farmers are trained to use best irrigation management practices and technologies.

In a similar vein, there are high costs of replacing and expanding existing systems under a traditional capital intensive engineering approach. More efficient, lower cost alternatives are worth exploring, such as constructed wetlands for wastewater treatment, managed realignment of rivers for flood risk management, and aquifer recharge for water storage (see Box 4.3). However, such alternative, green infrastructures are not a panacea and may, at times, be just as expensive as treatment plants.

Box 4.2. **Cost savings through water demand management in Spain**

Spain uses its natural water resources intensively, mostly in agriculture, thanks to a highly developed dam infrastructure. The limits for extraction of natural resources have largely been reached and climate change is expected to continue lowering natural water endowments markedly in future especially in dry areas of the country.

The costs of exploiting alternative supply sources on a large scale, notably desalination and recycling, remain well above water prices paid by consumers at present. Overall, the expansion of both conventional and unconventional water supply is subject to limitations, at least at current prices. Hence, effective demand management is crucial in order to make sure that water abstractions are kept within environmentally sustainable limits and made available to priority uses.

The government has recognised that water policies therefore need to switch to demand management, so as to ensure that available resources are put to most efficient and priority use.

Scope for water savings is substantial, especially in agriculture, where much irrigation water generates little value-added. The government has subsidised the use of more efficient irrigation technology at considerable budgetary cost, which has contributed to a modest reduction of water use in irrigation in recent years.

Source: Fuentes A. (2011), "Policies Towards a Sustainable Use of Water in Spain", *OECD Economics Department Working Papers*, No. 840, OECD Publishing, Paris. DOI: *http://dx.doi.org/10.1787/5kgj3l0ggczt-en*.

Box 4.3. **Relying on ecosystem services to provide cost-effective wastewater treatment functions**

Making use of processes occurring in natural ecosystems can represent one alternative to reduce water management costs, by substituting for advanced technical installations (such as sophisticated wastewater treatment plants). Sewage treatment functions – in particular tertiary treatment processes – can be found in different natural and semi-natural systems, including land treatment, floating aquatic plants and constructed wetlands. Natural treatment systems represent the most cost-effective option in terms of both construction and operation, provided certain conditions are met. In particular the availability of sufficient land is important, making *e.g.* constructed wetlands frequently well suited for small communities and rural areas. Operating costs, such as energy, are minimal compared to other treatment methods. However, those systems require frequent inspections and constant maintenance to ensure smooth operation. Furthermore, natural biological systems can produce effluents of variable quality depending on the time of year and type of plants, although they can handle fluctuating water levels. Mechanically-based technologies, on the other hand, are easier to construct and to operate, as they are offering a more controlled environment which produces a more consistent quality of effluent, being one reason why communities still tend to this solution, although it is generally linked to high costs and require more skilled personnel for its operation. According to the Centre for Alternative Wastewater Treatment, the capital costs of ecologically based wastewater treatment systems is USD 126-303 per m^3 treated per day, while for traditional systems it is USD 593-741. Aquatic and terrestrial ecosystems are used for sewage treatment in a number of locations throughout the world, providing both low cost sanitation and environmental protection, including the following examples from the United States.

In 1972, a new federal legislation in California required from the small city Arcata (California) to comply with the water quality standards for their wastewater discharges into the Humboldt Bay. Instead of investing into a regional sewage processing plant, the city decided to use the wastewater to create and nourish a wetland – situated on a former landfill – which at the same time provides wildlife habitat and recreation possibilities for the community. Whereas Arcata's share of the construction of a regional sewage plant was estimated to be about USD 10 million, developing the wetland treatment functions cost only USD 5 million. Also the annual maintenance of the latter is lower, being about USD 500 000 instead of USD 1.5 million. The marsh treats today the sewage from about 19 000 persons.

In 1990, in Phoenix (Arizona) city managers were confronted with the need to improve the performance of a wastewater treatment plant to meet new state water quality standards. As the costs of upgrading the plant were estimated at USD 635 million, managers started to look for a more cost-effective way to provide the required treatment services to the plant's wastewater discharges. According to the results of a preliminary study, a constructed wetland system would sufficiently clean the discharged water. At the same time, it would provide high-quality habitat for birds, including endangered species, and protect downstream residents from flooding, while requiring lower costs than updating the existing treatment plant. Consequently, the 12-acre "Tres Rios Demonstration Project" has been started in 1993 and receives now about 7.6 million litre of wastewater per day.

Source: Mattheiss, V., P. Strosser, J.M. Carrasco Rodriguez (2010), *Notes on Financing Water Resources Management*, Background report for the OECD project on Financing Water Resources Management.

Operational efficiency

Operational efficiency of water services (be they water supply, sanitation, irrigation, or flood management services) can generate additional sources of finance, as users are usually more willing to pay for improved services. It can cut costs, as it decreases wastage and mitigates the risk of investing in oversized infrastructures. It can make projects more bankable as well, as it increases the creditworthiness of project owners.

Water infrastructure is not always well utilised and managed. This is particularly true of wastewater infrastructure, but it is also applicable to dam operations and other infrastructures. Brazil has introduced innovative incentive-based approaches to achieve cost reductions that rely on paying for proven results, rather than for physical works. The River Basin Clean-Up Programme (PRODES) has provided incentives for increasing the operational efficiency of wastewater treatment infrastructure, while the Water Producer Programme pays for ecosystem services based on an assessment of performance on erosion reduction and forested areas – not on works undertaken.

Roles for the private sector: Harnessing private sources of finance

The private sector can play an important part in channelling resources to finance water infrastructure. This includes the water industry, the financial sector (which may realise water-related investment opportunities) and water users in the fields of real estate and property development, energy production, industry and farming. Insurance schemes and companies (be they public or private) deserve a particular attention: they collect information on water-related disasters; they can have a genuine interest in financing prevention measures (which lower the costs of reparation); they provide a mechanism to raise funds and channel them to purposes that can be aligned with policy objectives (see Table 3.1, and Grafton, 2011, for further elaboration on this).

Private finance can be harnessed either through private companies, or through capital markets.

Private finance has to be repaid, based on ultimate sources of finance, namely revenues from user tariffs, taxes from public authorities, or transfers from the international community.

Given the “lumpy” nature of investments in water resources management infrastructure and the long-term nature of the benefits that it provides, commercial finance may usefully provide “bridging” finance. For instance, Chinese cities such as Guandong and Guanxi take on bank loans for flood control projects and repay them using proceedings from land sales or flood control security fees. In the Czech Republic, the government has taken loans from the European Investment Bank to finance investments in flood management, and water administrators take loans to finance investments in profit-making infrastructure (such as hydropower). The drinking water sector makes frequent use of loans.

As mentioned above, sound water management can enhance the credit-worthiness of water projects and attract private finance. As an illustration, stable revenues from user charges are considered a secure source of funding on which to recoup investments costs.

Moreover, economic instruments can send the right signals to (public and) private investors. When water prices reflect the scarcity of the resource, they send signal to investors on the right time to invest in resource augmentation: a fall in water availability pushes up water prices and makes infrastructure investments profitable; thereby increasing water supply and balancing the supply and demand for water (Grafton, 2011).

Box 4.4. **Signalling the right time to invest: water supply in Sydney**

In 2007, a contract for a desalination plant was signed in Sydney due to concerns over water shortages. However, the construction of the plant took several years, during which the ending of the drought alleviated some of the water security concerns. Following the construction of the plant, water prices increased by 50% from 2007 to 2010 to cover the costs of investment. By contrast, if scarcity prices had been introduced in Sydney prior to building the desalination plant, the market would have sent signals about the optimal time to invest in desalination. By estimating the optimal time to invest in desalination based on efficient volumetric prices, Grafton and Ward (2010) found that the investment in desalination in Sydney was made prematurely, and led to welfare losses valued at hundreds of millions of dollars per year. These losses arose from the costs associated with using mandatory water restrictions rather than dynamically efficient pricing and, ultimately high volumetric water prices needed to cover the high capital costs associated with the premature construction of the desalination plant.

Source: Grafton, Q. and M.B. Ward (2010), *Dynamically Efficient Urban Water Policy*, CWEEP Research Paper 10-13, Australia National University.

How to value water services: A precondition for sound financing

The Polluter Pays and Beneficiary Pays principles assume that the value of water-related services is known. This is usually not the case. In a recent note on Financing Water resources management in France, Bommelaer and Devaux (2012) list a catalogue of potential benefits:

- Benefits for public health and biodiversity;

- Direct socio-economic impacts on hydropower; fishing, aquaculture and fish farming; tourism; development of waterways transport; natural mineral waters; spas and hydrotherapy; recreational activities related to water (*e.g.* improved bathing quality);
- Improved risk control;
- Enhanced commitment of stakeholders.

However, several of these benefits, such as the benefits related to environmental flows of water, are typically not valued by markets.

As stated by Grafton (2011), the first-best economic solution would be to estimate the full marginal value of environmental flows in each watercourse and reach the optimal level of water abstraction, where the marginal net benefit of extracting additional water is equal to the marginal benefit of leaving it in the environment, via taxes or permits. However, because environmental benefits are typically not represented in water markets, the economic value of such benefits has to be estimated using non-market valuation techniques, such as contingent valuation, the travel cost method, and hedonic estimation (see Box 4.5).

Box 4.5. **Non-market valuation of environmental flows in rivers Murray and Coorong, Australia**

The River Murray and the Coorong and its mouth are a unique ecosystem which provide habitat for breeding birds, fish, and vegetation. However, decreasing environmental flows due to over-extraction and declining inflows mean that the area is in decline. One method of estimating the value of environmental flows is to design a survey which asks people their willingness to pay for improvements in environmental quality, using this as a measure of the value people put on the environmental services provided.

In order to estimate the value of these environmental flows in the Murray River and the Coorong, MacDonald *et al.* (2011) designed a survey and sent it out to over 3 000 Australian residents. The survey described the impact of low environmental flows on waterbird breeding habitat, native fish populations, and healthy vegetation in the area, and set out ways of improving environmental quality by purchasing water use rights from willing sellers, investments in irrigation efficiency, and habitat rehabilitation, together with the costs of these policies. The survey then asked respondents to choose between various policy options which had different environmental impacts and different costs.

Box 4.5. **Non-market valuation of environmental flows in rivers Murray and Coorong, Australia** *(continued)*

Through a statistical analysis of the results from the survey, MacDonald *et al.* (2011) found that Australian residents were willing to pay substantial amounts to improve the quality of the Murray River and Coorong indicating that the value of environmental flows in the area are significant. Specifically, total willingness to pay (in present value terms) to increase the frequency of waterbird breeding from every 10 years to 4 years, to increase native fish populations from 30 to 50% of original levels, to increase the area of healthy native vegetation from 50% to 70%, and to improve waterbird breeding habitat quality in the Coorong was AUD 13 billion. The authors stress that, due to the uniqueness of the Coorong, this value cannot be used to estimate the value of other watercourses in Australia, and further surveys are required.

Source : MacDonald, D.H. *et al.* (2011), "Valuing a Multistate River: The Case of the River Murray", *The Australian Journal of Agricultural and Resource Economics,* Vol. 55, pp. 374-392; quoted from Grafton, Q. (2011), *Economic Instruments for Water Management*, paper submitted to the OECD Environment Directorate [*ENV/EPOC/WPBWE(2011)13*].

The French Department of the Commissioner General for Sustainable Development has combined several methods to value wetlands services in one pilot basin (see Devaux, Marical, 2011). This innovative approach factors in a large number of services, such as climate regulation, inputs to agriculture and shellfish farming, educational and scientific benefits. This results in a higher value generated by wetlands than assessed in previous reviews, and opens new perspectives on policies to secure these services. From a methodological perspective, it combines:

- Methods which infer the value of wetland from the costs that would be incurred if it were to disappear;
- Revealed preferences that infer the value of services from actual decisions made by individuals and observed on a market;
- The benefit transfer methods, building on a literature review;
- The stated preference methods, through surveys focused on willingness to pay for the preservation of selected environmental goods or services.

One lesson that derives from this work is that, the larger the budget allocated to economic valuation, the higher the aggregated value of the services. This bias notwithstanding, more thorough assessment of the value of water-related services can only benefit policy makers and improve the relevance of instrument choices for water management.

Governance arrangements that match financing strategies

Governance arrangements underpin the financial sustainability of the water sector.

First, water resources management can be organised in more or less cost effective ways. Given the trend towards increasing water governance costs, it is worth looking into opportunities for savings in this domain. In Brazil, the National Water Agency (ANA) has launched an Integration Pact framework involving ANA, the States and the river basin committees. The aim is to reduce the administration and compliance costs derived from the federal nature of water management in Brazil. The framework enables joint implementation of water management instruments through the establishment of goals, activities and deadlines for each party. The Czech Republic has identified that some (limited) cost reductions could be achieved by integrating the management of all watercourses in the river boards. In France, public authorities have traditionally encouraged inter-municipal co-operation in order to reduce the cost of providing water-related services. Several countries in Eastern Europe, the Caucasus and Central Asia are considering setting up regional water utilities to address the consequences of over-fragmented water systems.

Second, sound governance can increase the effectiveness of water policies. In the Netherlands, the Interest-Pay-Say principle ensures that all relevant stakeholders participate in decision making regarding water management. As mentioned above, EPI-Water shows how the effectiveness and efficiency of economic instruments depend on the institutional arrangements in place: a mismatch between institutions and policy instruments can typically generate high transaction costs, or hamper the design or implementation of the instrument. It is therefore important to make sure that governance structures and policy instruments match.

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Annex A

Cost-recovery strategies in selected OECD countries and BRICS

This appendix synthesises information collected on financing water resources management in selected OECD countries, Brazil and India. Each fiche gives an overview and complements illustrations used in the body of the report. These are not necessarily best practices.

Cost-recovery strategies in Australia

In order to achieve cost recovery, the National Water Initiative requires metropolitan water providers to move towards upper bound pricing for water services (full cost recovery, including externalities) and it commits states and territories to achieve lower bound pricing (fully recovering operating costs) for rural areas. Due to the high cost of provision, in small communities water services are financed via direct government transfers from consolidated revenue.

State and territory governments have been responsible for financing water resources planning and management though tax revenue and planning and management charges. The instruments used and the levels of cost recovery vary greatly across jurisdictions. Federal departments and agencies (including the Murray-Darling Basin Authority) do not impose charges to recover the costs of water planning and management activities. Most of the states, with the exception of Western Australia, recover at least some of the costs of water governance, from less than 5% in Queensland to nearly 70% in New South Wales. States use either charges (licence charges, abstraction charges) or levies. The National Water Initiative commits states and territories to bring into effect consistent approaches to pricing and attributing the costs of water planning and management. In the Murray-Darling Basin, the Australian Competition and Consumer Commission considers that information on costs and charges for water planning and management activities is not sufficient or is not always provided in a way that promotes transparency. The federal government is considering an approach focused on improving the transparency of water planning and management activities, costs and charges, including the development of a voluntary reporting framework to be adopted by Australian governments.

In New South Wales (NSW), government expenditures for water planning and management activities are funded through annual charges on licence holders (water license charges). The Independent Pricing and Regulatory Tribunal (IPART) uses a price determination framework to set maximum charges for bulk water services and resource management activities by NSW Office of Water. The charges include a fixed component (determined by entitlement volume) and a variable component (usage charge), and they vary by types of systems, valleys and the reliability class of the entitlement. In 2006, IPART projected total water planning and management costs for 2006/7 to be AUD 46.9 million, with AUD 30.5 million allocated to users.

In Queensland, activities are funded primarily through consolidated revenue (public budgets), with a small proportion of costs being recovered through charges. They include a license fee of AUD 58.75/ML and a water harvesting charge of AUD 3.52/ML. The total amount collected is AUD 2.4 million per year, which represents less than 5% of water planning and management costs.

The Australian Capital Territory applies a water abstraction charge to both the urban and rural sectors to cover the costs incurred by the government in supplying water, including the cost of catchment maintenance, the environmental impact of water use and a scarcity pricing component. The charge is currently levied at AUD 0.51/KL for urban users and AUD 0.25/KL for rural users. The total revenue derived in 2007/8 was AUD 29.5 million.

Victoria has set a levy on water supply authorities to fund programmes that promote the sustainable management of water or address adverse water-related environmental impacts. The rate is 5% of the revenue for urban water supply authorities and 2% of the revenue for rural ones. The authorities pass this cost onto customers through water charges. The revenue from the levy, which totalled AUD 61 million in 2008, is paid into the general public budget.

In South Australia, cost recovery of water planning and management activities predominantly occurs through a state-based levy and regional levies. For example, the Save the Murray levy is paid by SA Water customers, collected by the government and paid into the Save the Murray Fund. The levy rates are AUD 35.20 per year for residential customers and AUD 158 per year for farming and commercial properties greater than 10 hectares (with some exemptions), and the amount raised totalled AUD 21.1 million in 2006/7.

In sum, the Australian experience highlights the need for substantial public financial resources to support the rapid uptake of strong legislative and institutional reforms. Australia is progressively implementing consumption-based pricing and full cost recovery service pricing (including recovery of capital costs for water storage and delivery infrastructure in metropolitan areas). The arrangements for funding water planning and management vary greatly across jurisdictions. The balance of tariffs, taxes and transfers will shift overtime as the water financing framework matures.

Cost-recovery strategies in Brazil

In Brazil, general tax revenue currently pays for 96.5% of the investments in water resources management (WRM) at federal level. The government programmes are co-ordinated by the different ministries and the investments selected according to each government's priorities, which do not necessarily match the priorities defined by the river basin committees in their respective water resources plans. The priorities and amounts invested vary between governments as well as between years within the same government.

In 1997 the Brazilian Water Law introduced the possibility of water use charges and specified the financing of WRM as one of the three objectives of water pricing. Water charges are paid by bulk water users based on their rights. The mechanisms and values (rates) are defined by the Water Resources Councils (at National or State level) based on the proposals from the river basin committees, which are built on a broad discussion process involving civil society, water users and the public sector. So far, the implementation of water pricing has been progressive – out of 160 river basin committees created, 14 river basins (representing 17% of the country's population) have implemented water pricing. The charged amount results from multiplying unit rates by the calculation base (for quantitative uses it is usually the volume granted in the water rights, and for qualitative uses it is the organic load disposal measured in terms of biological organic demand) and applying reduction coefficients (to account for water quality, water use efficiency and ability to pay). The unit prices (rates) are low – typical values are EUR 0.0039/m^3 for abstraction, EUR 0.0079/m^3 for consumption and EUR 0.03/Kg biochemical oxygen demand (BOD). The unit prices are not automatically adjusted for inflation – which amounted to 40% in 2003-2009. All river basin committees have established reduction coefficients for the agricultural sector than run from 0.5 to 0.025. Bill collection rates are high: 99% in the PCJ river basin and 95% in the Paraíba do Sul river basin (together representing 85% of collected charges). The total amount collected by water pricing in Brazil was EUR 20.5 million. Overall, the amounts collected support only a minor part of the total WRM costs in the respective river basins (4-11%). The incentive effect to encourage the rational use of water is also limited.

There is a levy on hydroelectricity paid as financial compensation for the use of water resources. The mechanisms and values (rates) were established by the Federal Constitution in 1988 and a Federal Laws of 1990 and 2001. The revenues generated by the 6.75% levy on hydroelectricity generation and distribution are substantial – EUR 527 million was paid by 150 hydroelectricity plans in 2009. The amount corresponding to a 0.75% charge is allocated to the National Water Agency (ANA) and the amount corresponding to a 6% charge is distributed among the Union (10%), the States (45%) and Municipalities (45%) affected by the hydroelectricity plants. The amounts to be transferred to ANA in 2009 were EUR 59 million (representing 68% of ANA's budget), but only EUR 33 million were effectively transferred due to a change in government priorities. Of the EUR 47 million to be transferred to federal ministries, only EUR 34 million were effectively applied to the water resources management system. States and municipalities received EUR 422 million, but the application of those financial resources (representing over 85% of the total financial compensation) is not committed to the water sector. Overall, only a small part of the revenues is invested in the implementation of the WRM system, as most of the revenues are invested according to the respective governments' general priorities.

Except for the revenues raised by water pricing, the water legislation does not define specific rules for public spending in water resources management. The revenue generated by the water use charges must be invested in the river basin where it was collected, according to the respective water resources plan. The investments are selected by the river basin committee, based on the water resources plan. Administration costs (salaries, rent, general services such as accounting) are limited by law to 7.5% of the total revenue. There is no national fund for water resources in Brazil. Almost all States have created state water funds, but only a few States (such as Sao Paulo, Rio de Janeiro and Minas Gerais) transfer financial resources regularly to their water funds.

Cost-recovery strategies in the Czech Republic

The Czech model of combining state budgets and water levies has been in place for over 20 years. Options to finance the projected increase in WRM expenditure include the increases in abstraction and effluent charges and the introduction of new levies on hydropower and navigation.

The Czech Republic levies a fee for the abstraction of both surface and groundwater. Surface water levies represent the main basis for funding the management of water resources. The payments reflect the expenses of the administration of watercourses and watersheds and their related infrastructure. Reductions in abstractions have been compensated by increases in levy rates. Levy rates for surface water vary between water administrators – they are

CZK 2.68-4.65/m³ for abstraction from major watercourses and CZK 1.34-1.60/m³ from minor watercourses. Three river boards have implemented abstractions for through flow cooling, charged at CZK 0.53-1.03/m³. Groundwater users pay CZK 2/m³ for drinking water supply and CZK 3/m³ for other uses. Groundwater charges generated CZK 380 million for the regional authority (earmarked for water infrastructure) and an equivalent amount for the State Environmental Fund.

Effluent charges are based on the level of concentration within the emission limits, taking into account the overall level of pollutants. Effluent charges for surface water generate CZK 300 million per year for the State Environmental Fund, while effluent charges for groundwater generate CZK 2 million for the municipalities.

Operating costs for drinking water supply and sanitation infrastructure are covered by the water bills paid by service users. The rate of cost recovery is 100% when only operating costs are included, but drops to 10-20% when renewal and new investment costs are included. This is partly driven by the failure to account for the full depreciation of the infrastructure assets. Costs for WRM amount to 3-7% of the water bill.

Cost-recovery strategies in France

In France, water users and beneficiaries contribute financially to water management through a variety of mechanisms. The water bill paid by urban water users amounted to EUR 11.8 billion (EUR 7 billion for drinking water supply and EUR 4.8 billion for sanitation), of which EUR 1.4 billion was paid to the water agencies. The water agencies raised a total of EUR 1.9 billion in 2008 via water levies. This amount is expected to increase to EUR 2.1 billion in 2012. In addition, beneficiaries of water management also pay around EUR 160 million for waterways management and contribute over EUR 140 million to flood management via an insurance premium.

Since 2008, the water levy system of the water agencies includes the following levies:

- The tax on water pollution (including both domestic and non-domestic water pollution) applies to all water users connected or connectable to the sewerage system. For domestic water pollution the tax base is water consumption and the maximum tax rate is EUR 0.5 /m³. For water pollution from industry, the tax base is the actual pollution discharged, with different tax rates and exemption thresholds applying to different pollutants. Cattle breeders pay a tax based on the size of the cattle. The amounts raised in 2009 were EUR 1 124 million for domestic and EUR 116 million for non-domestic users.

- The tax for modernisation of wastewater drainage systems applies to all users connected to sewer systems. The tax base is drinking water consumption, with maximum rates of EUR 0.3/m³ for domestic users and EUR 0.15 for non-domestic users. The amount raised in 2009 was EUR 201 million.
- The tax on diffuse agricultural pollution applies to pesticide use and is paid by pesticide distributors. Water agencies can modulate the tax rate between EUR 0.5-3/kg. The amount raised in 2009 was EUR 24 million.
- The tax on the abstraction of water resources applies to any water user. The tax base is the annual volume withdrawn. The tax rates are modulated according to water users and water bodies. The amount raised in 2009 was EUR 354 million.
- The tax for storage in low water periods is paid by the owners of water reservoirs. The amount raised in 2009 was EUR 1 million.
- The tax on obstacles on rivers is paid by any person having an installation which is a continuous obstacle between the two banks of a river. The amount raised in 2009 was EUR 0.3 million.
- The tax for the protection of aquatic environments is paid by fishermen. The amount raised in 2009 was EUR 4.7 million.

Other instruments for raising revenues for water management are:

- The tax for the drainage, conveyance, storage and treatment of storm waters, which can be levied by municipalities. The tax base is the surface area of the buildings connected to a public storm water drainage network. The maximum tax rate is EUR 0.2/m2 and year. Tax reductions are applied to the buildings that include systems to limit the discharge of rainwater into the network.
- The three levies raised by the French Inland Waterways: tolls on freight and yachting (EUR 12.4 million in 2008), hydraulic tax (paid by the owners of hydraulic works according to the area occupied as well as EUR 0.00325/m³ withdrawn or discharged – a total of EUR 124 million in 2008) and tax on state land (paid by telecom operators and other activities occupying lands on the waterway bank – a total of EUR 25.8 million in 2008).
- The premium for prevention and compensation of natural disasters paid by the holders of insurance policy (12% premium for dwellings and 6% for vehicles – amounting to EUR 1.3 billion and of which at least EUR 140 million will be dedicated to flood prevention in 2010).

Allocation of financial resources by the water agencies and local authorities is guided by a number of rules. Water agencies can subsidise between 30-45% of investments made by municipalities, industry or farmers to preserve water resources. Water agencies and local authorities can allocate up to 1% of their budgets for water-related development co-operation projects – as a result EUR 17 million were transferred to several hundred small projects in Asia, Africa and Latin America in 2008.

As regards use of commercial finance, the water agencies can borrow in the market to finance the programme of measures. This has been particularly the case of the Loire-Brittany and Rhine-Meuse water agencies. Since 2009 the water agencies have benefited from access to soft loans from the *Caisse de Depots et Consignations*.

Cost-recovery strategies in India

In India, a portion of revenue of the water supply agencies comes from the provision of services such as irrigation and drinking water. In the case of surface irrigation, the governments and agencies levy water user charges that are fixed on a per hectare basis and vary according to the nature of crop cultivated. They are designed to cover operation and maintenance costs, but seldom serve for the intended purpose – cost recovery rates of operation and maintenance (O&M) for large and medium projects is about 9% and for small projects about 3%. This is partly due to rates not being revised annually (sometimes for decades) to take account for inflation, as well as to low collection rates (themselves the result of low willingness to pay due to low quality of service, and low willingness to charge). These ratios have decreased overtime – in the 1970s they were over 90% for large projects and over 10% for small ones. In the case of groundwater, no water extraction charges are levied, while farmers are supplied electricity for free or at heavily subsidised rates.

Rates of recovery of O&M costs in the urban water sector are higher than in the irrigation sector – consistently around 17% since the mid-1980s. Municipalities make use of water and wastewater levies, though the nature of the levies (taxes or charges) and the collection methods vary. Cost recovery of O&M costs in the rural water supply sector are very low and comparable to those of small irrigation projects.

Rates of recovery for O&M cost vary significantly among States, but there is no uniform pattern of good and bad performers. Large irrigation projects reach 30% in Karnataka and Orissa and less than 3% in Rajasthan. Minor irrigation projects reach 16% in Rajasthan and less than 1% in Punjab. Rural water supply schemes reach over 15% in Punjab and less than 1% in Karnataka and Orissa. Urban water supply schemes reach over 27% in Orissa and 0% in Punjab and Karnataka.

Accordingly, as a rough estimate public financial resources could account for around 70% of water sector revenue (divided between 65% allocation to water agencies for surface water projects and 5% for watershed management and environmental protection). Private financial resources could account for 30% of revenues, with 25% through direct expenses in groundwater extraction and 5% via water user charges for surface irrigation. The revenue from public budgets can vary significantly from year to year and from planned to actual. Around 95% of the planned budget and 90% of the executed budget of the Ministry of Water Resources comes from the Five Year Plan.

India's water sector has traditionally received significant support from development co-operation. Aid flows do not always show up in the public budgets, as they are often channelled directly to water sector organisations. With annual lending exceeding on average USD 300 million since 1993, the World Bank represents over 70% of external aid to the sector and between 5-10% of water sector expenditures. As loans need to be repaid, only the grant component should be seen as revenues for the sector. The pattern of donor assistance suggests little co-ordination.

In order to mobilise commercial finance, some States have created irrigation development corporations. The corporations tap capital markets by issuing government-guaranteed high return water bonds, which sometimes are tax-free. To service the borrowed funds, the corporations have been granted administrative and financial autonomy. The corporations have been able to raise significant capital, but they have largely failed to make use of the financial autonomy to enforce disciple in water pricing and cost recovery, raising concerns about their financial sustainability.

Cost-recovery strategies in Sweden

In Sweden, water charges are based on water meters for drinking water consumption and a connection charge for sewage treatment based on statistical coefficients for sewage discharge per person – the average cost was EUR 390 for a detached house (EUR 3/m^3) and EUR 290 for an apartment (EUR 2.1/m^3). Industrial treatment facilities must be funded by each company. Traditionally requirements for improved wastewater treatment at unconnected rural households have not been enforced by the municipalities, but increases in enforcement resources are changing the situation.

Permits for water activities are issued by environmental courts, after the application has been reviewed by the county boards. The environmental court levies a licensing charge between EUR 150-40 000 to cover the associated costs, and the county boards also levy a charge. Minor water activities do not require a license, but they have to register with the country board, which charges EUR 120 for the corresponding review. In total the rate of recovery of water management costs by these charges has been estimated at 24%. The country boards also charge for issuing permits for wastewater facilities serving more than 2 000 people – the average fee is EUR 5 400. Management costs for environmentally hazardous activities are recovered at 65%.

Explicit rules for public spending on WRM do not exist. A more integrated approach to spending public resources is needed, to overcome current misalignment between priorities and funding. The DWAs are supposed to elaborate the programmes of measures, but have no say over the allocation of public funding. The Swedish Environmental Protection Agency (SEPA) distributes funds to the country boards, which decide on the remedial actions to be subsidised with them. The ministry of agriculture decides on the budget for environmental subsidies within the EU agricultural support (these are growing and will exceed those going to SEPA and the water authorities) – distributing funds on the basis of large geographic scales that do not correspond with individual river basins. The Swedish Meteorological and Hydrological Institute allocates funds for modelling without taking account SEPA's priorities. Another problem is that the SEPA-managed LOVA programme provides 50% subsidies to measures aimed to decreasing nutrient loads, but it does not specify load reductions.

Annex B

An OECD survey on investment needs for water supply and sanitation

The OECD Secretariat recently surveyed the estimated capital cost needed to attain two levels of universal water, sanitation and sewerage coverage worldwide by 2050. It concentrated on municipal (domestic and commercial water provision) and domestic rural coverage. The survey did not cover operations, maintenance or financing. It did not cover other types of water infrastructure (for irrigation, storage, or else). The survey covers capital spending between 2008 and 2050.

A "full" coverage scenario was developed where all people living in urban areas have access to piped water and household sewerage. In the "basic" scenario, half of those living in slum areas get local access to a continual supply of potable water and fully managed sanitation blocks, while the other half have full household coverage. For the rural population, "basic" access means appropriate sanitation facilities and local access to potable water while under "full" coverage, piped water is available on a household basis.

Cost elements needed for universal coverage were developed for bulk water distribution and treatment, household water delivery, household sewerage and sanitation, mains sewerage and sewage treatment and recovery, along with water metering, systems monitoring and where appropriate desalination and advanced water and sewage treatment.

A series of datasets were developed for 156 countries worldwide, where reasonable access to data was available and the population exceeded 0.5 million. The outputs were grouped by region and into World Bank categories by income, as well as OECD members (all but Iceland and Luxembourg being surveyed) and the BRIC (Brazil, Russia, India, China) countries.

The database was designed to allow it to be modified as new and improved data becomes available and to develop a series of new scenarios as and when these are needed. Suggestions for further research are also made.

The global capital spending forecast is for USD 7.52 trillion under the "basic" scenario and USD 9.23 trillion under the "full" scenario. These figures cover the 43-year period between 2008 and 2050. They do not cover operation and maintenance costs, but include the complete rehabilitation of existing networks. It was noted that the range of forecasts for various coverage targets in the past have varied markedly. Compared to some of the more recent ones, the forecasts may appear conservative. Using a different methodology, OECD (2006-07) estimated water infrastructure needs at USD 772 billion per annum by 2015 and USD 1 038 billion per annum by 2025; these figures cover not just the provision of new infrastructure but also maintenance needs (estimated at 3% of the replacement cost of capital stock for water and sanitation).

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OECD PUBLISHING, 2, rue André-Pascal, 75775 PARIS CEDEX 16
(97 2012 09 1 P) ISBN 978-92-64-17981-3 – No. 60225 2012

OECD Studies on Water

A Framework for Financing Water Resources Management

Water is essential for economic growth, human health, and the environment. Yet governments around the world face significant challenges in managing their water resources effectively. The problems are multiple and complex: billions of people are still without access to safe water and adequate sanitation; competition for water is increasing among the different uses and users; and major investment is required to maintain and improve water infrastructure in OECD and non-OECD countries. This OECD series on water provides policy analysis and guidance on the economic, financial and governance aspects of water resources management. These aspects generally lie at the heart of the water problem and hold the key to unlocking the policy puzzle.

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Please cite this publication as:

OECD (2012), *A Framework for Financing Water Resources Management*, OECD Studies on Water, OECD Publishing.
http://dx.doi.org/10.1787/9789264179820-en

This work is published on the *OECD iLibrary*, which gathers all OECD books, periodicals and statistical databases. Visit ***www.oecd-ilibrary.org***, and do not hesitate to contact us for more information.

Co-distributed by
IWA Publishing
Alliance House, 12 Caxton Street,
London SW1H OQS, UK
Telephone: +44 (0) 20 7654 5500
Fax: +44 (0) 20 7654 5555
E-mail: publications@iwap.co.uk
www.iwapublishing.com

OECDpublishing
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ISBN 978-92-64-17981-3
97 2012 09 1 P