Chapter 4

Policy coherence toward water security

Water security should be pursued taking account of complex links with economic and sectoral policies. Setting acceptable levels of water risks among stakeholders should be the result of well-informed trade-offs between water security and other policy objectives. Meeting the coherence challenge also requires a coherent approach between water and other (sectoral, environmental) policies.

In view of the gloomy outlook regarding water stress and water pollution, and the growing uncertainties regarding floods and droughts, governments need to speed up efforts to enhancing overall efficiency and effectiveness in water management to alleviate growing water security concerns. As explained in previous Chapters, this entails better risk management and better water policies. But water security should also be pursued taking account of complex links with economic and sectoral policies.

Allocating water risks between residential, agricultural, industrial and environmental uses raises a significant political economy question. As explained in Chapters 1 and 2, setting acceptable levels of water risks among stakeholders is one of the most challenging and controversial tasks in the risk management process. It should be the result of well-informed trade-offs between water security and other (sectoral, environmental) policy *objectives*.

Meeting the coherence challenge also requires a coherent approach between water policies and other (sectoral, environmental) policies (in part, following OECD, 2012a).

In particular, the nexus between water, energy, food and the environment presents significant challenges for water security, and has been attracting increasing policy attention in recent years. Increasing the coherence of policies (policy objectives and policy instruments) across these areas is essential if governments wish to meet the range of policy goals while not undermining water security objectives.

The linkages between water and energy are important and pervasive. The importance of water in energy production and use is matched by the importance of energy in water. As countries confront water resource constraints, their arsenal of policy options has typically included energy-intensive solutions such as long haul transfer and desalination. The corollary is also true: many countries address energy constraints with water-intensive options such as steam-cycle power plants or biofuels. However, this approach, whereby water planners assume they have all the energy they need and energy planners assume they have all the water they need, is not likely to work effectively in the future. Countries that deploy incoherent water and energy policies might find themselves with severe scarcity of one resource or the other, or both.

Similarly, water and agriculture are inextricably linked, not least because agriculture accounts for around 70% of water withdrawals globally. Support provided to lower the costs of water supplied to agriculture, for example, by not reflecting the scarcity value of water, can undermine efforts to achieve water security objectives. Agricultural support policies linked to production can also jeopardise water security through providing incentives to intensify and extend production more than would be the case in the absence of this form of support. But isolating and quantifying the overall economic efficiency and environmental effectiveness of agricultural support on water is difficult and further analysis on causation is needed.

Policies across water, energy, agriculture and environment are often formulated without sufficient consideration of their inter-relationship or their unintended consequences.The silo nature of many governments' approaches to policy development in the different areas is the key contributor to this incoherence. This translates into differences in temporal scales between energy, agricultural and water policy objectives (e.g. forward-looking water plans are often on the 50-60 year horizon, whereas energy plans are up to 20-30 years ahead, and agricultural planning is generally within a much shorter time horizon).

Success in achieving greater coherence between energy, agriculture and water policies will ultimately depend on removing policy inconsistencies, especially where energy and agricultural support policies conflict with water security goals. More coherent policy approaches are slowly beginning to take shape in a growing number of OECD countries. For example, lowering overall agricultural support and shifting from direct production and input agricultural support to decoupled payments over the past 20 years in many OECD countries has, in part, led to improvements in water resource use efficiency and helped to lower water pollution pressure from agricultural activities. But much more needs to be done in both OECD and non-OECD countries.

Options to enhance policy coherence include exploiting win-wins (such as taking steps to increase both water and energy efficiency) and assessing and managing trade-offs between (sometimes conflicting) policy objectives.

Spillover effects of sectoral and environmental policies on water security

By creating incentives towards meeting their own objectives, sectoral (e.g. agricultural, energy) and environmental (e.g. climate, biodiversity) policies may have significant spillover to water security. The links between water and other related security objectives – food, energy, climate, biodiversity – are not routinely addressed or fully understood. Yet uncoordinated policy aimed at security in one area may result in less security in another: less water security as the cost of greater energy security through biofuel production, for example (Zeitoun, 2011).

Complexity arises from the need to consider the direct and indirect impacts of sectoral policies on water security. The same sectors (e.g. agriculture, energy) that impact on water also impact on other components of the environment (e.g. climate, nature). Moreover, within a sector, the objectives of environmental protection and improving water management sometimes conflict with each other (e.g. subsidies to fast-growing forest plantations aimed at carbon sequestration are sometimes at the detriment of old growth natural forests that better regulate water flows).

When they last met at the OECD in 2010, Ministers of Agriculture from OECD member countries and key emerging economies recognised that an integrated approach to **food security** is needed involving a mix of domestic production, international trade, stocks, safety nets for the poor, and other measures reflecting levels of development and resource endowment, while poverty alleviation and economic development are essential to achieve a sustainable solution to global food insecurity and hunger in the longer term. If people are hungry today, it is because they cannot afford to buy food, not because there is not enough available.

The Millennium Development Goals of halving the share of the global population suffering from hunger in 2015 compared with 1990 will not be met. Increasing productivity, establishing (and enforcing) well-defined land property rights and ensuring that well-functioning agricultural markets provide the right signals are the three priority areas where coherent action is required if the additional one billion tonnes of cereals and 200 million tonnes of meat that would need to be produced annually between now and 2050 to feed everyone is to be produced without over-exploiting scarce natural resources or further damaging the environment (including water) (OECD, 2011a).

Food security impacts on water security through agricultural policy distorting production and trade of agricultural commodities, thereby distorting the domestic and global demand for water.

In the agricultural sector, irrigation has to some extent helped with climatic risk management, thus reducing pressures on governments to compensate for flood damage downstream or for crop losses as a result of periodic droughts. However, below-cost pricing is prevalent for publicly-funded irrigation systems. It is, in the main, national treasuries that have financed dams, reservoirs and delivery networks, as well as a large part of the cost of installing local and farm infrastructure. Governments generally attempt to recover some of these costs through user charges, but revenues are rarely enough to cover even operation and maintenance costs.

The economic distortions caused by the often enormous under-pricing of water used in agriculture have been compounded in many instances by agricultural policies, particularly those linked to the production of particular commodities. Such linked support draws resources, including water, into the activity being supported, thereby driving up both the price of water to other users and the volume of agricultural subsidies. As a rule, farmers have free access to (or are charged only a nominal fee for) water that they pump themselves. And several countries continue to offer preferential tariffs for electricity used to pump water for irrigation.

There are conflicting views about whether trade in virtual water can lead to overall savings in global water resources (Lenzen et al., 2012). Countries are experiencing vastly different degrees of water scarcity. There is indirect virtual water use throughout the supply chains underlying all traded goods. When adjusting water volumes for water scarcity and when indirect virtual water is appraised the Heckscher-Ohlin Theorem can be validated.[1] In other words, trade liberalisation tends to reduce water use in water scarce regions and increase water use in water abundant regions.

However, the global impact of agricultural trade liberalisation and policy reform on water systems is likely to be limited. Research suggests that the impact of hypothetical Doha-like liberalisation of agricultural trade on water use would be a change in regional water use of less than 10%, even if agricultural tariffs are reduced by 75% (Berrittella et al., 2007). Patterns are non-linear: water use may go up for partial liberalisation, and down for more complete liberalisation. This is because different crops respond differently to tariff reductions, but also because trade and competition matter too.

Moreover, there has already been a major reduction in overall agricultural support in OECD countries over the past 20 years, including production and input related support, limiting impacts of further liberalisation. Other drivers are having a much greater impact on global water systems that agricultural support, notably increasing agricultural production and rising trend of world commodity prices. For example, there is a strong correlation between increases in world dairy prices, rising cow numbers and increasing nutrient water pollution in New Zealand.

Energy policy makers are facing the daunting challenge of achieving energy security, environmental protection and economic efficiency (the three Es). The need to increase **energy security** was the main objective underpinning the establishment of the International Energy Agency (IEA). According to the IEA, energy security can be described as “the uninterrupted physical availability at a price which is affordable, while respecting environment concerns". IEA member countries co-operate to increase their collective energy security through diversification of their energy sources and improved energy efficiency.

Energy security impacts on water security through increasing the water needs and water pollution linked to increased energy supply or further reliance on renewable energies, such as hydropower and biofuels.

Oil security remains a cornerstone of the IEA.[2] At the same time, the IEA is progressively taking a more comprehensive approach to the security of supplies, including natural gas supplies and power generation.

A universal phase-out of all fossil fuel consumption subsidies by 2020 – ambitious though it may be as an objective – would cut global primary energy demand by 5%, compared with a baseline in which subsidies remain unchanged (IEA, 2010). Reducing reliance on fossil fuels would also impact on the competition between food and biofuels for water (water for energy), which is directly related to the demand (and cost) of fossil fuels.

Support to agricultural feedstocks to produce biofuels and bioenergy has been increasing in recent years. Such support can have significant impacts on water quality and availability. The water quality impacts may be caused by the use of agrochemicals in intensive bioenergy feedstock production systems (OECD, 2012b). The impact on water balances remains unclear. It is largely an empirical question and needs to be assessed in a way that compares the effects of alternative uses of resources (OECD, 2010a). Research suggests that the quantity of water needed to produce each unit of energy from second generation biofuel feedstocks (e.g. lignocellulosic harvest residues and forestry) is much lower than the water required to produce ethanol from first generation feedstocks (such as from cereals, oilseeds and sugar crops), although this can vary according to the location and practices adopted to produce these different feedstocks.

Renewable energy sources will have to play a central role in moving the world onto a more secure, reliable and sustainable energy path. The potential is unquestionably large, but how quickly their contribution to meeting the world's energy needs grows hinges critically on the strength of government support to stimulate technological advances and make renewables cost competitive with other energy sources. Government support for renewables can, in principle, be justified by the long-term economic, energy security and environmental benefits they can bring, though it is essential that support mechanisms are cost-effective (IEA, 2010). Nearly all OECD countries have introduced renewable energy targets with a view to curb greenhouse gas emissions. However, such targets have proved to be a very expensive method of reducing greenhouse gas emissions compared with other abatement options, costing several times as much as the carbon taxes that have been introduced and well above the price in carbon cap-and-trade schemes. Apart from lowering carbon emissions, the expansion of renewable energy has been pursued for other reasons, such as reducing air pollution, strengthening energy security, raising employment levels, and increasing innovations. There is little or no evidence that such non-greenhouse gas related benefits justify the "excess" abatement costs or that special high support to renewables is the most efficient way to achieve such objectives.

The greatest scope for increasing the use of renewables in absolute terms lies in the power sector. The share of renewables in global electricity generation is expected to increase from 19% in 2008 to almost one-third (catching up with coal) by 2035 (IEA, 2010).

The increase is expected to come primarily from wind and hydropower, with hydropower remaining the most common form of renewable energy.

Since 1990, global hydropower generation has increased by 50%, with the highest absolute growth in China (OECD/IEA, 2010). Hydropower contributes to energy security and climate protection, being a renewable energy technology. When produced in storage schemes (e.g. storing water through dams),[3] it also brings water security benefits, through the supply of drinking water or water for irrigation and flood/drought risk management. In some cases, however, these benefits come at important social costs (i.e. displacement of people) and environmental costs (i.e. changes in flow and continuity of rivers). Brokered by the World Bank and the World Conservation Union (IUCN), a temporary World Commission on Dams (WCD) was established between 1998 and 2000 in response to the escalating local and international controversies over large dams. Its final report recommends that decisions on major infrastructure developments take place within a framework that recognises the rights of all stakeholders, and the risks that each stakeholder group is asked, or obliged to sustain (WCD, 2000). There is a need for cost benefit analysis prior to any project of building a new dam or retrofitting old ones.

As a natural resource, water is obviously influenced by climatic factors. What comes immediately to mind when addressing the interface between **climate policy** and water resources are water quantity issues (floods and droughts). But there are also water quality implications. For example, reducing the use of nitrogen fertilisers to curb greenhouse gas (nitrous oxide) emissions also reduces nitrate pollution. Water quantity and water quality are both part of the equation.

The benefits of climate change mitigation are long-term. Even if strong action was taken today, there would be no discernible effect (identifiable benefit) on rates of warming (and rainfall distribution) for considerable periods of time. Thus assessing the spillover effects of mitigation policy on water security entails looking at the ancillary benefits of mitigation. For instance, using hydropower to reduce carbon dioxide emissions can contribute to flood control through construction of dams and water reservoirs. It also entails looking at the ancillary costs. For example, hydropower dams may impose fish population relocation or could cause significant methane emissions (e.g. when vegetation covered by the dam decomposes).

There is concern that adaptation to climate change may greatly increase the costs of providing water infrastructure (Hughes et al., 2010). The water infrastructure design shall evolve, for example, to avoid disruption of biological sewage treatment (which does not operate well under high temperatures) or to reduce siltation in dams (due to increased soil erosion). Existing capital stock may have to be replaced quicker than expected, such as water supply reservoirs and flood control dykes, or displaced in the case of low-lying and coastal areas threatened by flooding and rising sea level. In regions becoming dryer with climate change, the scope for increasing usage of natural water supplies is reduced, and alternative supplies (desalination, water re-use) are costly.

As is the case for mitigation, information on the ancillary costs and benefits of adaptation policy would certainly contribute to better integrate adaptation concerns into water security planning. For example, the ancillary benefits of adaptation on flood risk management include restoration of natural habitats (in floodplains).

Understanding the effects of mitigation and adaptation policies on water security, and the interactions between them, is essential. For example, it may prove more cost-effective to support the creation of wetlands (in which bacteria convert nitrate to nitrogen released to the atmosphere) than to encourage organic farming or afforestation of farmland (to reduce the level of fertilisation).

Climate policy appears to have significant spillover to other policy areas that affect water security. This includes, *inter alia,* sectors as diverse as energy, transport, agriculture, forestry, fisheries and tourism. Information on such indirect water impacts of climate policy would certainly contribute to better integration of water security concerns by such sectors.

For example, in New Zealand, the carbon emission trading scheme (ETS) led to convert pastoral land to forestry, which also contributes to reduce nitrogen leaching into water. Innovative agreements have been made between farmers and major greenhouse gas (GHG) emitters (through a Trust) where the latter receive ETS credits in exchange of the former converting pastoral land to forestry, which also contributes to reduce nitrogen leaching into water (OECD, 2011b). This is occurring in Lake Taupo, the largest lake in the country, in danger of degradation due to agricultural effluent. A nitrogen cap-and-trade system was put in place for farmers around the lake. Instead of trading their nitrogen pollution rights, farmers can opt for permanent reductions in nitrogen, for which they are financially compensated through the Trust. In turn the Trust is financed by major GHG emitters, through purchases of ETS credits. Farmers are paid for the reduction in nitrogen emissions, at the same time as they receive income from forestry credits.

Healthy ecosystems underpin water security. Most notably, nature plays a very important role in regulating water flows. Healthy ecosystems reduce runoff (and therefore flood levels of the streams flowing from preserved areas) and improve water infiltration into the soil (helping to replenish the ground water). Nature also plays a role of purification of water resources, thus contributing to better water quality. For example, almost 1 million urban dwellers rely on natural wetlands for wastewater retention and purification services (WWAP, 2009). Healthy ecosystems can also enhance food security and climate security with spillover effects on water security. For example, healthy ecosystems help produce more food from each unit of agricultural land and improve resilience to climate change (Boelee, 2011).

A key step in addressing water risks is to understand ecosystems better and to seek to optimise the range of goods and services these ecosystems can provide to enhance water security. Greater coherence could be sought between water security and ecosystem protection objectives. For example, the World Wildlife Fund for Nature (WWF) is working toward the protection and management of 250 million hectares of representative wetlands worldwide.

To the extent that pressures on ecosystems increase water risks, **nature protection policy** can enhance water security. For example, to address flood risks technical engineering approaches of making/reinforcing dykes in lowland/downstream areas or lower river deltas are often seen as the most cost-effective option to protect densely populated and economically important areas. However, investments in land-use changes and floodplain restoration can be justified economically in the long run if, besides the expected value of the damage avoided, the additional non-priced socioeconomic benefits associated with these measures are taken into account (Brouwer and Van Ek, 2004). The net welfare gain would then also include improving river accessibility for recreational reasons and conserving high levels of biodiversity.

An interesting development of nature protection policy is the rapid increase in payments for ecosystem services (PES) over the past decade. As a voluntary, flexible, incentive-based and site-specific instrument, PES can provide potentially large gains in cost effectiveness compared to indirect payments or other regulatory approaches used for water security objectives (OECD, 2010b). PES is a mechanism under which the user or beneficiary of an ecosystem service makes a direct payment to an individual or community whose land use decisions have an impact on the ecosystem service provision (e.g. reducing water risks). The payments compensate individuals, such as farmers or foresters, for the additional costs of biodiversity and ecosystem service conservation and sustainable use, over and above that which is required by any existing regulations.

A criticism, however, is that PES fail to realise their potential cost-effectiveness gains. This is because PES programmes often make fixed uniform payments on a per hectare basis while biodiversity and ecosystem benefits tend to vary from one location to another. Moreover, individual holders of land-use rights are likely to have different opportunity costs of ecosystem service provision. PES programmes should be designed to take these differences into account.

For a PES programme to produce clear and effective incentives any conflicting market distortions, such as environmentally-harmful subsidies, should be removed. For example, policy intervention to further enhance the water security services unique to forests should not imply giving more subsidies to forest owners (to improve forest management) or to farmers (to convert farmland to forest). That would run the risk of repeating in the forestry sector the mistakes that policy reforms are now seeking to address in the agricultural sector. The reform of agricultural policy underway in OECD countries has in itself important implications for farmland conversion into forests: where price support to commodities is reduced, there is less incentive to expand agricultural production on marginal land. Instead of seeking compensation for any foregone revenues (from timber sales or from farming), any forestry payments should reward the provision of well-targeted and otherwise unremunerated water security services.

Currently, there are few examples where government has coordinated negotiations between potential beneficiaries and providers of ecosystem services but not directly funded the services. As with negative externalities, positive externalities are of public interest only where transaction costs are too high for those with direct benefits to coordinate with providers. Payments for ecosystem services between private actors that do not require government coordination are just normal market activity.

Effects of non-water environmental markets on water security: Some empirical evidence

Ecosystem service values are often addressed (and even modelled) as though they were independent. In reality the marginal value of an ecosystem service changes when complementary or conflicting ecosystem services are regulated. An existing regulation can either reduce or increase the value and cost of regulating a second ecosystem service. One example of this is the interaction between land-related climate change mitigation and water quality. Others would be links between water quality and quantity, climate change and water quantity, and any of these and biodiversity values. These interactions occur for all forms of regulation but are particularly visible with market-based instruments and especially environmental markets where allowance prices are visible and the cost of regulation and its distribution depends not only on abatement costs but also on the value and initial distribution of allowances.

This section considers interactions among environmental markets, with an empirical focus on two markets, for water quality and greenhouse gas emissions from land use. This helps identify how the interaction of externalities and markets can lead to unexpected water risks, but also opportunities to reduce water risk and ease the path for regulation.

In New Zealand, the Lake Taupo water quality market has vividly illustrated the potential for positive interaction between land-related climate change regulation and water quality regulation. Nearly all trades to date have involved some land conversion into forestry (Duhon et al., 2012). These farmers have not only sold nitrogen allowances, but have also sold carbon credits through New Zealand's emissions trading system (Mighty River Power, 2010).

In the Lake Rotorua catchment, Yeo et al.(2012) have modelled the interactions between these markets for the planned Lake Rotorua catchment nutrient trading system, the existing forestry component of the New Zealand Emission Trading System (ETS) (Karpas and Kerr, 2011) and the potential regulation of agricultural greenhouse gas emissions in New Zealand (Kerr and Sweet, 2008).

They find that greenhouse gas emissions trading alone can lead to large gains in water quality, while water quality trading has even larger impacts on greenhouse gas emissions (in this case where the nitrogen cap is very stringent) (Table 4.1). For sheep/beef farmers, the loss of farm profits as farmers de-intensify and in some cases convert to forestry is larger under the combination of both regulations because their profitability in sheep/beef production becomes so low relative to alternative uses. In contrast, for dairy farmers, the combination of two regulations makes it easier to stay in dairy farming than under water quality regulation alone. This is because the strong mitigation response by sheep/beef farmers to the combined regulation reduces their demand for nitrogen allowances, lowers the price of nitrogen allowances in the catchment, and makes it more profitable for dairy farmers to pay for nitrogen and continue to farm.

Table 4.1. **Effects and costs of combined greenhouse gas and nitrogen policies, Lake Rotorua**

			Sheep/beef farms		Dairy farms	
	N leaching	Net GHG emissions	Abatement cost (loss of profit from farming)	Economic profit (including permit cost and revenue)	Abatement cost (loss of profit from farming)	Economic profit (including permit cost and revenue)
	(tonnes/year)		(USD/ha/year)			
No regulation	506	137 133	–	480	–	1 369
GHG only	392	70 239	43	423	42	1 041
N only	134	-34 415	126	152	937	92
Both N and GHG	134	-75 663	409	246	448	245

Note: Scenario with no free allocation of nitrogen allowances. N: nitrogen; GHG: greenhouse gas.
Source: Derived from Yeo et al.(2012).

Another interesting impact of the combined regulations is that both sheep/beef and dairy farmers are better off with the GHG (emissions trading) regulation as well as the nitrogen cap if they are required to purchase all their allowances (and able to sell carbon credits) (Table 4.1). For sheep/beef, the benefit comes from carbon credit revenue; for dairy, it is because of the fall in the cost of the nitrogen allowances they purchase.

A contrasting case, where the two environmental markets could come into conflict arises in the Manawatu catchment (Manawatu-Wanganui region, New Zealand) where the emissions trading policy can induce land conversion into maize which is associated with high nitrogen losses (Daigneault et al., 2012). They also find that if an emissions trading system is already operating, the addition of a nutrient trading system could lead to real environmental gains at relatively low cost. In contrast, if the water quality regulation already exists (with a low level of stringency) adding the GHG regulation provides little gain at high cost. Clearly the interactions are sensitive to local conditions.

Thus the marginal environmental value from additional regulation is sensitive to the existing regulation for other related services. This is true of environmental markets but also of other market-based instruments. When several ecosystem service markets or payment/tax systems interact it is critical to take account of the interactions between them. Many efforts to value ecosystem services in order to provide payments ignore this. A payment for one ecosystem service (e.g. greenhouse gas mitigation) reduces the marginal value of complementary ecosystem services (e.g. water quality).

A framework for managing trade-offs between policies

As we have seen, pursuing sectoral and environmental policy objectives may have significant spillover to water security. Water policies have an important role to play in the overall mix of policies to achieve water security objectives, but sectoral and economic policies often play the most important role. Appropriate co-ordination and coherence therefore needs to be embodied within this policy mix – both domestically and internationally.[4]

This co-ordination is most likely to be effective when due account is taken of water security objectives in the initial establishment of objectives in non-water policy areas. This implies that sectoral decision makers should systematically undertake both *ex ante* and *ex post* assessments of the water impacts of their activities. This can usually best be achieved through the use of evaluation tools, especially environmental impact assessments, regulatory impact assessments and cost-benefit analysis.

Subsidies for various economic purposes are pervasive, both in OECD countries and worldwide. Many subsidies distort prices and resource allocation decisions, altering the pattern of production and consumption within the domestic economy and across countries. As a result, subsidies can have unforeseen negative effects on water. For example, agricultural subsidies can lead to overuse of pesticides and fertilisers; coal subsidies can substitute natural gas for more water intensive energy source such as coal; fuel tax rebates and subsidies for road transport increase eutrophying depositions of nitrogen oxides (NO_X).[5]

Regular efforts should therefore be made to identify those subsidies whose removal (or reform) would benefit water security. A quick scan of these subsidies would likely be sufficient to understand the main effects that subsidy reform would have on the decisions of consumers and producers, as well as the key linkages between those decisions and water. This would also provide an initial ranking of subsidies in terms of their harmfulness to water security.

Using one subsidy to offset the negative environmental effects of another is likely to be both ineffective and inefficient. In most case, reforming both of these subsidies will be a better solution. For example, high levels of production-linked price support have traditionally been provided to the agriculture sector. This has encouraged overuse of chemical inputs, as well as expansion of farming onto land that is of relatively low value economically – but often of high value to protect water systems. In turn, this has led to efforts to address these negative environmental impacts via subsidies that are conditional on meeting certain environmental standards (cross-compliance). It will generally prove to be more efficient and effective to reform the original subsidy than to retain (and try to correct) the environmental problems it creates through cross-compliance requirements.

A major factor that can promote the reform of environmentally harmful subsidies is increased transparency. It should therefore be made clear to the public-at-large who is benefiting from existing subsidy programmes, and the conditions under which these subsidies are being provided.

Conclusions

Food security impacts on water security through agricultural policy distorting production and trade of agricultural commodities, thereby distorting the domestic and global demand for water. The economic distortions caused by the often enormous under-pricing of water (or the electricity to pump water) used in agriculture are compounded by agricultural policies, particularly those linked to the production of particular commodities. Such linked support draws water into the activity being supported, thereby driving up both the price of water to other users and the volume of agricultural subsidies. There is need to pursue efforts toward agricultural policy reform.

However, the impact of agricultural trade liberalisation and policy reform on regional water use (e.g. water-abundant countries exporting more water-intensive goods) is likely to be limited. This is because of two main reasons. First, there has already been a major reduction in overall agricultural support in OECD countries over the past 20 years, including production and input related support, limiting impacts of further liberalisation. And, most importantly, other drivers are having a much greater global impact on water risks that agricultural support, notably increasing agricultural production and rising trend of world commodity prices.

Energy security affects water security through increasing the water needs and impairing the water quality linked to increased energy supply and changes in the energy mix. For example, coal subsidies encourage energy consumption, which may increase water risks; coal subsidies can also substitute natural gas for coal, a more water intensive energy source.

Energy security also affects water security insofar as it promotes further reliance on renewable energies, such as hydropower and biofuels. When produced in storage schemes, the expansion of hydropower can bring water security benefits through increasing freshwater supply and improving flood/drought risk management. There is little or no evidence, however, that government support to hydropower is the most efficient way to achieve such objectives. Moreover, the benefits of hydropower may come at important social (e.g. displacement of people) and environmental (e.g. changes in flow and continuity of rivers) costs. There is a need for cost benefit analysis prior to any project of building a new hydropower dam or retrofitting old ones.

Support to agricultural feedstocks to produce biofuels and bioenergy has been increasing in recent years. Such support can have significant impacts on water quality and availability. The water quality impacts may be caused by the use of agrochemicals in intensive bioenergy feedstock production systems. The impact on water balances remains unclear, though. It will depend on the extent to which advanced biofuels – whose feedstock crops tend to be less water-intensive – penetrate markets but foremost on the location and practices adopted to produce these different feedstocks.

Understanding the effects of **climate mitigation and adaptation policies** on water security, and the interactions between them, is essential. For example, where the objective is to manage the risk of nitrate pollution of water, an adaptation policy to expand natural floodplains through supporting the creation of wetlands (in which bacteria convert nitrate to nitrogen released to the atmosphere) may prove more cost-effective than a mitigation policy to reduce nitrous oxide (N_2O) by encouraging organic farming (to reduce the level of fertilisation).

Moreover, climate policy appears to have significant spillover to other policy areas that affect water security. This includes *inter alia* sectors as diverse as energy, transport, agriculture, forestry, fisheries and tourism. Information on such indirect water security impacts of climate policy would certainly improve economic efficiency (e.g. avoiding farmers to be paid for the reduction in nitrogen emissions at the same time as they receive income to convert farmland to forest land, which also contributes to reduce nitrogen leaching into water) and social welfare (e.g. air quality co-benefits of mitigating carbon emissions improve human health and reduce eutrophying depositions on surface water).

To the extent that pressures on ecosystems increase water risks, **nature protection policy** can enhance water security. As a flexible, incentive-based and site-specific instrument, payments for ecosystem services (PES) can provide potentially large gains in cost effectiveness compared to indirect payments or other regulatory approaches to manage water risks. For this, the payments should only compensate holders of land-use rights (e.g. farmers or foresters) for the additional costs of ecosystem service provision, over and above legal requirements. They should not take the form of uniform payments on a per hectare basis, as is often the case, but take account of differences in ecosystem benefits and opportunity costs for holders of land-use rights.

Any conflicting market distortions should be removed. For example, policies to enhance the water security services unique to forests should not imply giving more subsidies to foresters to improve forest management. That would run the risk of repeating in the forestry sector the mistakes that policy reforms are now seeking to address in the agricultural sector. Instead of seeking compensation for any foregone revenues from timber sales, any forestry payments should reward the provision of well-targeted and otherwise unremunerated water security services.

Ecosystem service values are often addressed as though they were independent. In reality there are **interaction between ecosystem services.** When several policy instruments to promote ecosystem service interact it is critical to take account of the interactions between them. Many efforts to value ecosystem services in order to provide payments ignore this. A payment for one ecosystem service (e.g. greenhouse gas mitigation) reduces the marginal value of complementary ecosystem services (e.g. water quality).

Decoupling **subsidies** from the use of water resources, as well as from production and consumption activities that harm the water environment, can yield important benefits to water security. This approach is fundamentally more coherent than one which promotes economic goals in isolation of water security considerations.

Notes

1. The Heckscher-Ohlin (H-O) Theorem states that the water-abundant country A exports the water-intensive good, while the capital-abundant country B exports the capital-intensive good.
2. For example, each IEA member is required to hold oil stocks equivalent to at least 90 days of net imports.
3. As opposed to run-of-river schemes, which use the natural flow of a river.
4. In part, following OECD, 2008.
5. Eutrophication results from discharges of nitrogen and phosphorus to inland and coastal waters.

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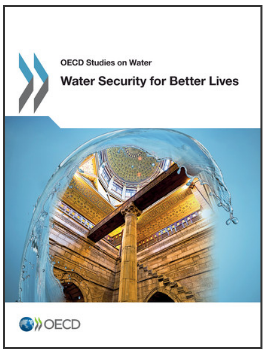

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