Chapter 1

What are the benefits of investing in WSS?

This chapter identifies the types of investments that are required to deliver WSS and presents available evidence on the magnitude of the benefits that are generated from such services. Such benefits usually outstrip the costs of service provision and provide a strong basis for investing in the sector.

Water and sanitation services (WSS) generate substantial benefits for human health, the economy as a whole and the environment. Access to clean drinking water and sanitation reduces health risks and frees up time for education and other productive activities, as well as increases the productivity of the labour force. Safe wastewater disposal helps to improve the quality of surface waters with benefits for the environment (*e.g.* functioning of ecosystems; biodiversity), as well as for economic sectors that depend on water as a resource (*e.g.* fishing, agriculture, tourism).

For such benefits to be generated sustainably, investments in a whole range of services alongside the WSS value chain need to be carried out, ranging from protecting the raw material (freshwater resources) to building storage capacity or water transport networks, all the way to investments into collection, safe disposal, treatment or reuse of wastewater. Once built, the infrastructure needs to be adequately maintained and operated so as to provide sustainable, affordable and reliable access to water and sanitation services. New and recurrent investments in water and sanitation services are therefore critical in order to expand access to the services and maintain their ability to deliver benefits over time.

1.1. Identifying necessary investments in WSS

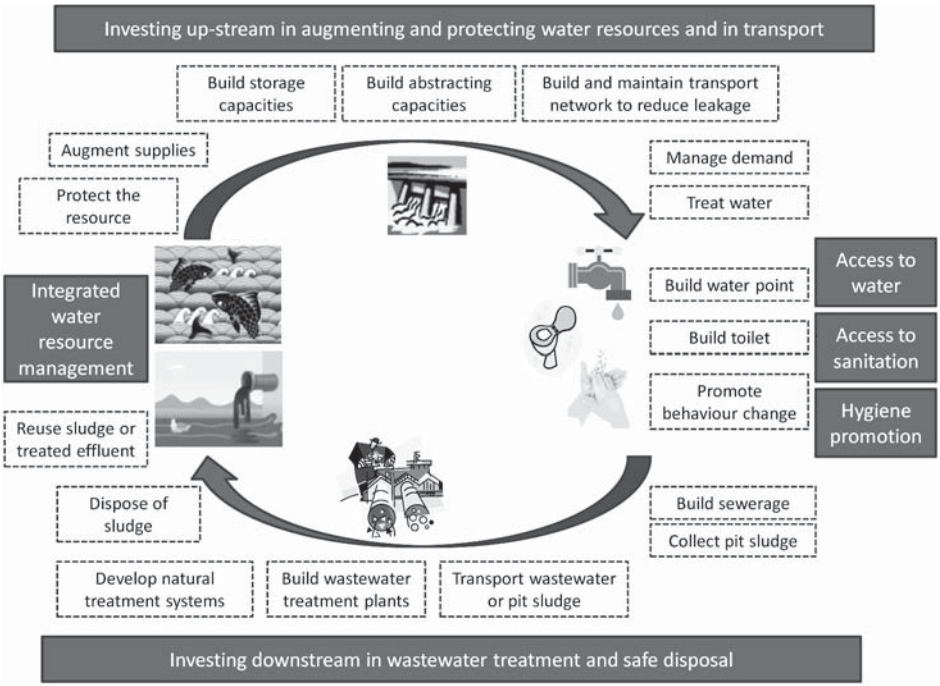
What investments are needed?

The report considers the investments needed to ensure sustainable provision of WSS services alongside the entire WSS "value chain", as shown in Figure 1.1.

Providing access is usually considered as the main entry point for the delivery of WSS. Access to water services can be provided via a well or a handpump or via a reticulated network system. When water is provided via a network, this can be done via a household connection (within the house or in the yard) or a public connection, referred to as standpipes or tap stands. Investments required can range from digging a well and maintaining it in good working order to building water transport and distribution networks with associated water treatment facilities.

To ensure that water is provided to the right standard (defined based on WHO guidelines on drinking water quality), water treatment is necessary to remove suspended solids, bacteria, algae, viruses, fungi, minerals and man-made chemical pollutants including fertilisers. Treatment is usually carried out off-site at the point of source, although it may also be required at point-of-use (*i.e.* at household level), as water may be contaminated during transport or storage. Examples of water treatment technologies include filtration, chlorination, flocculation, solar disinfection, boiling and pasteurising.

Figure 1.1. **The value chain of sustainable water and sanitation services**



Source: OECD (2011), *Benefits of Investing in Water and Sanitation: an OECD Perspective*, OECD, Paris.

According to the WHO-UNICEF Joint Monitoring Program, "Sanitation is generally referred to as the provision of facilities and services for the safe disposal of human excreta. Sanitation also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal". Providing access to sanitation usually means investing in the first segment of the sanitation value chain, *i.e.* ensuring that humans are adequately separated from their excreta. There are two main types of facilities for collecting human excreta: on-site sanitation systems (such as dry-pit latrines or ventilated improved pit latrines) and network-based sanitation solutions, with or without treatment of the sewage collected.

Hygiene promotion is a key intervention to ensure that access to water and sanitation services can deliver benefits. They include provision of hand washing points, hygiene and health education and the encouragement of specific behaviours such as hand washing at critical times, keeping animals out of the kitchen, proper management of child excreta and proper storage of household drinking water.

Adequate investments are needed both downstream and upstream from providing access in order to ensure sustainable services. Investing in water resource management upstream is critical, so that sufficient water resources of adequate quality are available over time with limited negative impact on other alternative uses of water. Downstream from providing access, adequate investment in wastewater collection, safe storage or treatment and disposal is necessary so as to ensure that the impact of wastewater being released in the environment is adequately controlled and good quality of the water resources is maintained. Recycling and reuse of treated wastewater can also reduce the amounts of water consumed and generate by-products that can be used for agriculture or energy production.

WSS typically require significant capital investments up-front in long-lived assets, which can generate benefits over several decades if adequately maintained. The bulk of investments are underground (particularly piped networks), which means that monitoring asset condition is not an easy task. Relatively simple equipment, such as hand pumps, can also fall into disrepair if sustainable systems for ensuring ongoing repairs and maintenance are not in place. To maintain incentives for efficient service delivery, it is therefore critical to invest in adequate "sector software", alongside the hardware. At sector level, this could include improving overall sector governance, conducting tariff reforms or introducing incentives for performance improvements (see section 3.1 about the need to improve efficiency and reduce costs in order to shrink the sector's financing gap).

Who is responsible for investing?

Investors in water and sanitation services differ according to the type of services provided. For the most basic levels of service, such as a well, borehole or an on-site sanitation facility, households would be the prime investors. For anything beyond that, services are usually provided by a distinct "service provider". The organisation of water and sanitation service provision varies widely from one country to another and water service providers have different financing requirements and risk profiles. In about 90% of cases, formal water services are delivered by public entities, which may include state-owned enterprises, local governments, municipal companies, asset-holding agencies, etc. Ministries and government agencies are also primary investors in "sector software" and accompanying measures.

Water services are usually locally provided, given that water and sewage are bulky and costly to transport over long distances, with a limited case for integrated transportation networks as they exist for electricity or gas. As a result, most water service providers were initially set up at the municipal level. Over the years, however, market structure reforms in the water sector have oscillated between decentralisation reforms, which may be driven by broader

country-wide decentralisation processes and some degree of aggregation (in order to reach a more efficient scale of operations). In some countries, particularly in the OECD, the pressure for achieving economies of scale for service provision has led to some degree of aggregation, either through the formation of groupings of municipalities (as in France, Italy or Spain) or the creation of regional or even national providers (such as watershed-based water companies in England and Wales, regional companies in Portugal and Italy, State-level companies in Brazil or national ones in West Africa). In developing countries, since the early 1990s, WSS have progressively been decentralised, which means that currently, the majority of water and sanitation service providers in those countries tend to operate at the local level. Such decentralised authorities have often been struggling to establish their financial standing in order to access financing on their own credit.[1]

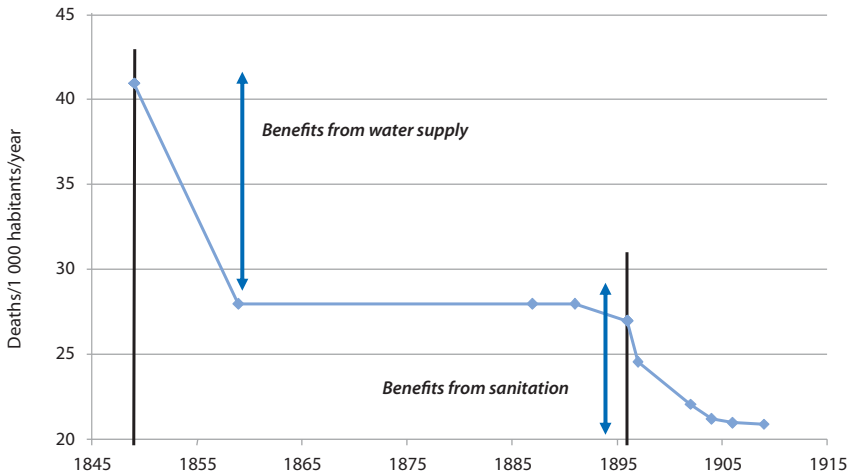
As discussed in the rest of the report, all these entities can source financing from a variety of sources (including tariffs, transfers, ODA or repayable financing). However, differences in ownership or scale of operations can have a substantial impact on the type of financing that can be mobilised and at which cost.

1.2. Estimating the benefits of investing in WSS

Benefits from the provision of basic water supply and sanitation services are massive and far outstrip costs. In most OECD countries, these benefits have been reaped since the late 19th all the way through the late 20th century when basic water and sanitation infrastructure was extended to reach large parts of the population. For example, in In Marseille (France), water supply was a significant constraint on the city's growth during the early 19th century. A catastrophic drought in 1834 meant that water availability dropped from 75 litres per capita per day to 1 litre per capita per day and triggered a cholera epidemic. This in turn led to the construction of a canal to bring water, which allowed augmenting water supply to 370 litres a day after its completion in 1848. Increased water availability helped bring down mortality significantly, although it remained at much higher levels than in other French cities at the time (28 deaths/1 000 inhabitants as opposed to 9/1 000 in Paris at the same time). Higher water supply also meant more dirty water lying about: it is not until ambitious sewerage works were completed and households got connected to the sewers that mortality rates dropped significantly. Although attributing causality is always a perilous exercise, Figure 1.2 shows a clear correlation between a reduction in mortality and the timing of water and sanitation investments.

In France, overall, the total length of water supply networks grew from about 25 000 km in 1940 to over 800 000 km in 2004 (Smets, 2008). Only

Figure 1.2. **Impacts of water and sanitation investments on mortality in Marseille (France)**



Source: AESN (2007), "Bénéfices de l'assainissement", Rapport d'étude AESN, February 2007, Seine Normandie, France.

27% of the French population had toilets inside their home in 1954 against 98% today and three quarters of the treatment plants in operation by 2009 was built after the 1990s (although the older ones tended to be larger plants). In the United States, the introduction of water chlorination and filtration in 13 major US cities during the early 20th century led to significant reductions in mortality with a calculated social rate of return of 23 to 1 and a cost per person-year saved by clean water of about USD 500 in 2003 US dollars.[2]

In developing countries, WHO has estimated that almost 10% of the global burden of disease could be prevented through water, sanitation and hygiene interventions. Children are most affected, with 20% of disability adjusted life-years (DALYs)[3] in children under 14 attributable to inadequate water, sanitation and hygiene and 30% of deaths of children under 5.

Health benefits from improved access to sanitation and hygiene appear to be most significant, followed by improved access to clean water. With respect to water, there is reasonable evidence to support the finding that the quantity of water provided is paramount (particularly in order to adopt basic hygienic practices) if health benefits are to be achieved and may be more critical than the quality of such water, which is also important.

In developing countries, WHO estimated that achieving the MDGs for water and sanitation could generate an estimated USD 84 billion per year in

Table 1.1. **Overall benefits of meeting the MDGs in water and sanitation**

Type of benefits	Breakdown	Monetised benefits (in USD)
Time savings from improved water and sanitation services	• 20 billion working days a year	USD 63 billion a year
Productivity savings	• 320 million productive days gained in the 15-59 age group • 272 million school attendance days a year • 1.5 billion healthy days for children under 5	USD 9.9 billion a year
Health-care savings		USD 7 billion a year for health agencies USD 340 million for individuals
Value of deaths averted, based on discounted future earnings		USD 3.6 billion a year
Total benefits		**USD 84 billion a year**

Source: Prüss-Ürstün *et al*., 2008, *Safer water, better health: costs, benefits and sustainability of interventions to protect and promote health*, World Health Organization, Geneva, 2008, based on an evaluation by Hutton and Haller (2004).

benefits, with a benefit to cost ratio of 7 to 1.[4] As shown in Table 1.1, three quarters of the benefits would stem from time gains, *i.e.* time that is gained by not having to walk long distances to fetch water or to queue at the source.[5] Most other benefits are linked to a reduction of water-borne diseases such as reduced incidence of diarrhoea, malaria or dengue fever, which are estimated either in terms of reduced health care costs or productivity savings.

In addition, WSS generate a number of non-economic benefits that are difficult to quantify but that are of high value to the concerned individuals in terms of dignity, social status, cleanliness and overall well-being. More broadly, adequate water and sanitation services appear to be a key driver for economic growth (including investments by firms that are reliant on sustainable water and sanitation services for their production processes and their workers).

Wastewater collection and treatment can generate health and environmental benefits, with ripple effects on other economic sectors, such as agriculture, fisheries, tourism or industry. The benefits of wastewater collection and the resulting protection from contamination are obvious to most individuals. By contrast, the benefits of wastewater treatment are less obvious to individuals (as is often the case with public goods) and more difficult to assess in monetary terms. The consensus on the need for increased urban wastewater treatment as well as safe disposal of its residues has therefore developed more slowly, probably also due to the relatively high costs of such interventions. In

the United States, the 1972 Clean Water Act built an important legal basis for expanding wastewater treatment facilities. In Europe, the European Union Urban Waste Water Treatment Directive adopted in 1991 represented the policy response to the growing problem of untreated sewage disposed into the aquatic environment.

All benefits from wastewater treatment are linked to an improvement in water quality through the removal of different polluting substances, generating withdrawal benefits (*e.g.* for municipal water supply as well as irrigated agriculture, livestock watering and industrial processes) and in-stream benefits (benefits that arise from the water left "in the stream" such as swimming, boating, fishing).

Wastewater treatment can have a beneficial impact on the environment and economic activities that are dependent on it. For example, in the Black Sea, the degradation of water quality due to enrichment in nutrients led to an important increase in algal mass affecting aquatic life. The mass of dead fish was estimated at around 5 million tons between 1973 and 1990, corresponding to a loss of approximately USD 2 billion. Water quality is also an essential factor for certain tourism activities and sewage treatment leads to enhanced tourism attraction. In most countries, non-compliance with certain norms for bathing water leads to the closure of beaches and lakes for recreational purposes and therefore influences strongly the local tourism economy. In Normandy (France), for example, it has been estimated that closing 40% of the coastal beaches would lead to a sudden drop of 14% of all visits, corresponding to a loss of 350 million Euros per year and the potential loss of 2 000 local jobs.

Benefits for property have also been shown to be significant. People living in the surroundings of water bodies benefit from increased stream-side property values when wastewater treatment measures ensure a certain quality of water bodies. Several studies show that in proximity of areas that benefited from improved water quality, property values were found to be 11% to 18% higher than properties next to water bodies with low quality.

Finally, wastewater treated to adequate levels can be reused. Both faeces and urine can be used as potent fertilisers for agriculture, as well as for producing biogas for energy production. For example, biogas plants can be built to use animal and human waste to produce a colourless clean gas similar to liquefied petroleum gas (LPG), which can be used for cooking and lighting with virtually smoke-free combustion. A study by Winrock International evaluated an integrated household-level biogas, latrine and hygiene education programme in Sub-Saharan Africa and found that the programme's economic rate of return was 178%, with a 7.5% financial rate of return.[6] Sludge from wastewater treatment plants can also be mixed with biodegradable municipal waste. However, making such projects economically viable would require operating at a large scale, with waste collected from several hundred thousand people.

Aggregated economy-wide assessments of benefits of water quality improvements are very few and far between, however. The US Environmental Protection Agency estimated the net benefits of water pollution legislation in the last 30 years in the United States at about USD 11 billion annually, or about USD 109 per household. In South East Asia, the Water and Sanitation Program estimated that, due to poor sanitation, Cambodia, Indonesia, the Philippines and Vietnam lose an aggregated USD 2 billion a year in direct financial costs (equivalent to 0.44% of their GDP) and USD 9 billion a year in economic losses (equivalent to 2% of their combined GDP). The financial losses include change in household and government spending as well as impacts likely to result in real income losses for households (*e.g.* health-related time loss with impact on household income) or enterprises (*e.g.* fisheries). The economic costs include the financial costs as well as longer-term financial impacts (*e.g.* less and fewer educated children, loss of working people due to premature death, loss of usable land, tourism losses) (Hutton *et.al.*, 2008).

Protecting the quality of the resource and balancing supply and demand so as to ensure water security and reliability are critical to ensure that benefits from WSS are generated sustainably over time.[7] For water services to be provided sustainably over time, it is critical to ensure that the raw material, clean water, is adequately protected and managed. This will become increasingly relevant with increasing pressures on the resource exerted by economic and demographic growth as well as the potential impacts of climate change on the water cycle.

Protecting water catchments and reducing pollution to water resources result in similar benefits to end-customers as those described from providing access to safe water. In addition, protecting water resources directly at the source by limiting pollution from catchments generates indirect benefits, such as avoided (investment and treatment) costs and can be overall more cost-effective, as discussed in Box 1.1. Increasingly, countries are recognising the benefits of managing water resources using a river basin approach, given that reducing pollution at the source tends to be a cheaper option than treating water before supplying it to consumers.

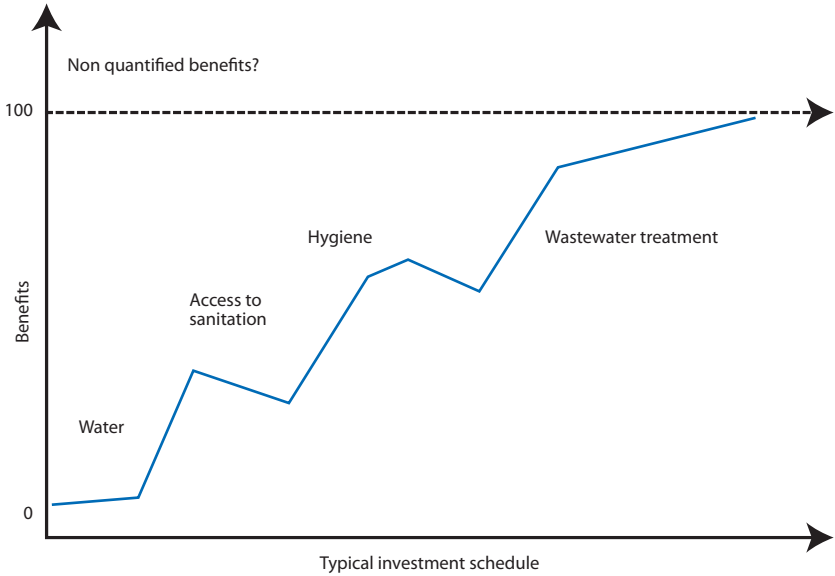
In order to ensure a reliable water supply, there is a need to balance water supply and demand. The degree of certainty with which water is supplied is an important factor in determining the benefit that water users derive from the service and strongly influences their willingness to pay. Increased reliability of water supplies avoids the need for households to store water for shortage situations and therefore induces cost savings. Water supply reliability is also an important parameter for economic activities (industries, but also agriculture and services) which use water in their processes or as a non-substitutable input.

Box 1.1. **Water catchment protection in New York (United States)**

The most famous case of benefits linked to water catchment protection is reported in New York. A new drinking water regulation required water suppliers to filter their surface water supplies, unless they could demonstrate that they had taken other steps – including watershed protection measures – to avoid harmful water pollution. Confronted with the choice between the provision of clean water through a newly built filtration plant or managing water sheds, New York City concluded that the latter was more cost-effective. Whereas the costs of the filtration plant have been estimated at between USD 6 billion to USD 8 billion, watershed protection efforts, including the acquisition of critical watershed lands and a variety of other actions designed to reduce contamination sources in the watershed, were estimated to cost only around USD 1.5 billion – thus four to five times less. As a consequence, New York City chose the second solution that favored investing in natural rather than built capital.

Source : Salzman (2005), as presented in OECD (2010b).

Figure 1.3. **The water and sanitation benefits curve**



Source: OECD (2011), *Benefits of Investing in Water and Sanitation: an OECD Perspective*, OECD, Paris.

The combined magnitude of the benefits of WSS can vary substantially depending on the level of sector development. Figure 1.3 represents the streams of benefits coming from a typical investment schedule.

In most countries where the "access gap" is still large, providing access to water services is seen as a priority as it can indeed deliver substantial benefits, particularly if combined with hygiene education. If access to water is provided without corresponding investments in sanitation, however, this can generate temporary disbenefits, as abundant water supply can create pools of stagnant waters mixing with excreta and other types of waste (such as grey waters).

Connecting people to sewers without wastewater treatment can sometimes generate disbenefits in the cases in which it transforms diffuse pollution into point-source pollution (a sea outfall for example). Wastewater treatment would eliminate all residual risks. However, benefits would start tailing off once a high degree of wastewater treatment is reached (although this would clearly depend on maintaining existing installations, so that they can continue to deliver benefits). Going further, there may be some additional benefits (such as from an improved living environment or benefits for future generations) which may be harder to quantify but that could nevertheless justify investments in WSS beyond the level at which quantifiable benefits overtake costs.

There are few aggregated estimates of benefits and few rules of thumb that could be applied universally, however, given that benefits from water and sanitation investments tend to vary substantially according to local factors, such as the level of development of the infrastructure, the prevalence of water-related diseases, environmental status, etc. The benefits and costs of each particular investment or set of measures would therefore need to be estimated in each location specifically, in order to select the investments with the highest benefit-cost ratio and allocate scarce resources to the most cost-effective investments. Given that carrying out a full evaluation of benefits is potentially expensive and time consuming, one alternative from a methodological point of view is to compare interventions based on cost-effectiveness criteria, *i.e.* to evaluate how much different interventions cost in order to achieve similar objectives (and therefore generate the same amount of benefits).

In developing countries, for example, it was found that investing in WASH (water, sanitation and hygiene) is very cost-effective. The Disease Control Priority project (an ongoing effort to assess disease control priorities and produce evidence-based analysis and resource materials to inform health policymaking in developing countries) found that hygiene and sanitation promotion activities cost respectively USD 3 and USD 11 per DALY averted. By comparison, the cost-effectiveness of promoting oral rehydration therapy, the main other measure to prevent diarrhoea mortality, was estimated at USD 23 per DALY, which means that hygiene and sanitation promotion compares favourably

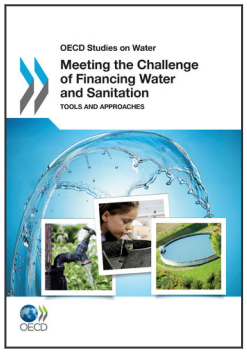
to such measure. Infrastructure investments had a much higher cost when compared to effectiveness. For example, the cost-effectiveness of constructing sanitation facilities (including promotion) was USD 270 per DALY. As for water supply, providing a community connection was estimated to cost USD 94 per DALY, while it was more than twice as much for household connections (USD 223 per DALY). These measures are still cost-effective when compared to other health measures: for example, the provision of antiretroviral therapy against AIDS was estimated to cost USD 922 per DALY.[8]

Haller *et al.* (2007) conducted a cost-effectiveness analysis which indicated that the provision of in-house piped water supply and sewer connection is the intervention that maximises health gains but is also the most expensive intervention: they estimated that piped water supply and sewer connection would achieve a maximum health gains (71 million DALYs averted) but that investment and recurrent costs would also be quite important (ranging from USD 48 billion to 60 billion). From this analysis, they concluded that for many developing countries, in-house piped water supply may not be affordable in the short to medium-term and governments and households may need to settle in the short-term for second-best solutions, although health and non-health benefits would not be as large. They suggested that disinfection at point of use, which has a better cost-benefit ratio (USD 338 to USD 461 million for 17-19 million DALYs averted) could be used as an efficient short-term policy strategy to further reduce diarrhoea incidence, while time elapses during the extension of coverage and upgrading of piped water and sewage services. This investment strategy for water improvements is also recommended by Edwards (2008), in a guide to understanding costs and benefits of water interventions published by WHO.

In OECD countries, maintaining existing infrastructure so that it can continue to deliver an ongoing benefit stream should be a priority, together with the need to adapt to a changing climate, therefore generating substantial investment needs going forward. By contrast, the case for investing in additional improvements is sometimes less clear-cut, as the marginal value of incremental improvements is likely to go down, at least when measurable benefits are accounted for.

Notes

1. See OECD (2010a) for more detail on the issues faced by decentralised entities to access financing.
2. See OECD (2011) for more detailed facts and figures.
3. The sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability.
4. MDG 7c calls for reducing by half the proportion of people without sustainable access to safe drinking water and basic sanitation (see *www.undp.org/mdg/goal7.shtml*).
5. The value of those time gains is estimated on the assumption that any time "gained" in such a way could be productively used on income-generating activities. This may not be possible in some developing economies, but such time would nevertheless be gained for other activities generating more intangible benefits, such as furthering education for children and adults alike.
6. Renwick, M. *et al*. (2007).
7. The benefits (and associated financing) of investing in integrated water resource management are discussed in more detail in a companion report (OECD [2012 forthcoming], *Financing Water Resources Management*, Paris).
8. Cairncross and Valdmanis (2006): *www.dcp2.org/main/Home.html*.



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