World Health Organization

WHO/HSE/WSH/12.01

Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage

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Printed by the WHO Document Production Services, Geneva, Switzerland

Executive Summary

Globally, large numbers of people remain without access to basic levels of drinking-water supply and sanitation (WSS). According to data compiled by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP), in 2010 783 million people continued to use unimproved sources to meet their drinking-water needs and 2.5 billion people continued to use an unimproved sanitation facility or defecate in the open. One of the UN Millennium Development Goal (MDG) targets is to halve, by 2015, the proportion of people without sustainable access to safe drinking-water and basic sanitation, with 1990 as the baseline year.

According to the JMP, the rate of progress towards achieving this target is such that the target will not be reached in its entirety by 2015. While the drinking-water target was met in 2010, sanitation is still considerably off-track. Based on the most recent estimates sanitation coverage must increase globally from 63% to 75% between 2010 and 2015. At the current rate of progress, sanitation coverage is predicted to be 67% in 2015, 580 million people short of the MDG target.

In 2010, the United Nations General Assembly and the UN Human Rights Council recognized access to safe drinking-water and sanitation as a human right. The concept of progressive realization inherent to the rights-based approach will result in intensified monitoring to be able to hold governments accountable for meeting their human rights obligations. Those still lacking access tend to be poor and marginalized groups. The JMP progress report showed that, in 2010, the poorest households, as measured by wealth quintiles, have significantly lower access than households in the two highest wealth quintiles.

In order to address these remaining challenges, further evidence is collected, compiled and analysed to support a greater allocation of resources to water supply and sanitation by decision makers and to select the most efficient interventions. The Sanitation and Water for All (SWA) partnership – launched in 2009 – is a global initiative to support countries in the scale-up of WSS services, especially those countries with low coverage or those most off-track to meet targets. To keep attention focused on meeting the MDG target, the "Sustainable sanitation: Five year drive to 2015" has been launched by the United Nations. Economic evidence is recognized as key for the achievement of the WSS goals – it helps justify increasing investment and expenditure, and it supports decisions to select efficient WSS options by explicitly comparing costs and benefits of a range of alternative WSS technologies and service delivery approaches.

The present study aimed to estimate global, regional and country-level costs and benefits of drinking-water supply and sanitation interventions to meet the MDG target in 2015, and to attain universal coverage. These economic data will provide further evidence to support investment in water supply and sanitation systems and services, with a focus on services that are both socially efficient and financially sustainable. The results will help donors and governments of low- and middle-income countries to justify allocation of adequate budgets for such systems and services.

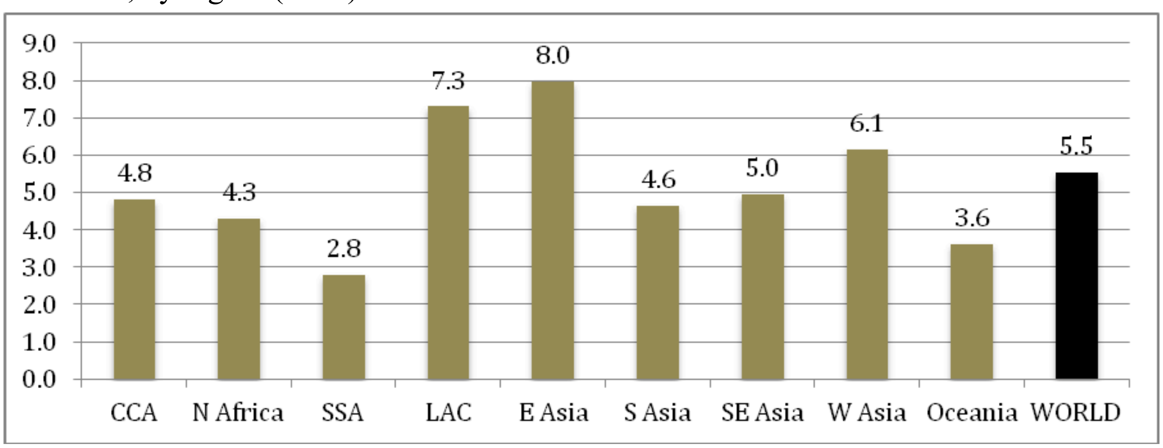
This report updates previous economic analyses conducted by the World Health Organization, using new WSS coverage rates, costs of services, income levels and health indicators. Benefit-cost ratios (BCR) and costs are estimated to meet the MDG drinking-

water and sanitation target and to attain universal access of basic services. Rural and urban areas are analysed as separate targets[1]. The analysis utilises WSS coverage definitions of the JMP. More low- and middle-income countries have been included, from under 100 countries in the previous analyses to a total of 136 countries in the current analysis. The quantitative model is run at country level, and the results aggregated to give the regional (nine MDG developing regions) and global averages, weighted by country population size. However, despite the improved data sources available, reliable data inputs on key variables are still lacking for many countries. To fill these gaps, cost and benefit data are extrapolated to neighbouring countries.

A large range of economic and social benefits can result from improved WSS services. Reductions in cases and deaths associated with diarrhoeal disease and in indirect adverse health impacts (e.g. through malnutrition), as well as time benefits resulting from the proximity of improved WSS services are expected to account for a large share of total benefits. Economic benefits related to savings from the health improvements of upgraded WSS services relate to seeking less health care, to reduced losses of productive time due to disease and to a reduction in premature mortality.

Summary results for attaining universal access to sanitation are shown in Figure A. The benefit-cost ratio (BCR) for the necessary interventions varies from 2.8 in the SSA region to 8.0 in E Asia. The global economic return on sanitation spending is US$ 5.5 per US dollar invested.

Figure A. Benefit-cost ratios of interventions to attain universal access of improved sanitation, by region (2010)



Summary results for attaining universal access to drinking-water are shown in Figure B. The benefit-cost ratio (BCR) for the necessary interventions varies from 0.6 in Oceania to 3.7 in S Asia. The global economic return on water spending is US$ 2.0 per US dollar invested. Combined water supply and sanitation interventions have a benefit-cost ratio of 4.3 at the global level, ranging from 2.0 in Oceania to above 5.0 in the LAC and E Asia regions.

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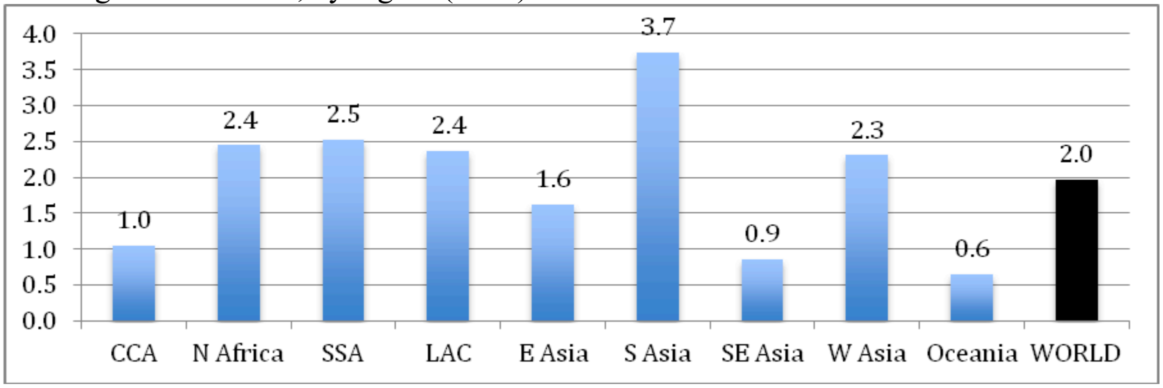
[1] For example, if a country has surpassed its MDG target for urban sanitation but is off-track to meet the target applied to rural areas, the excess urban coverage does not balance out the rural deficit.

Figure B. Benefit-cost ratios of interventions to attain universal access of improved drinking-water sources, by region (2010)



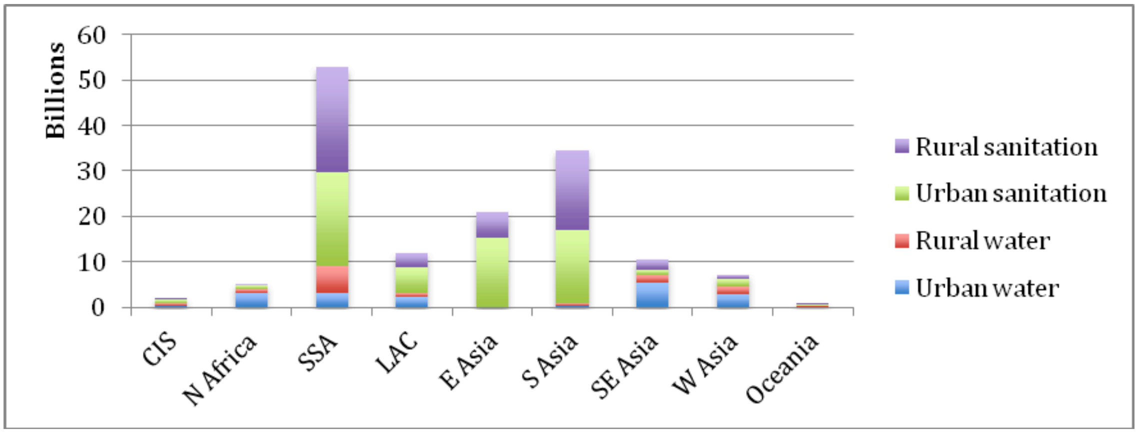
The total global economic losses associated with inadequate water supply and sanitation were estimated at US$ 260 billion annually, or 1.5% of Gross Domestic Product of the countries included in this study. The total economic benefits of meeting the MDG target amount to US$ 60 billion annually. The benefits are dominated by sanitation, accounting for US$ 54 billion. The three regions where benefits are greatest are S Asia, E Asia and SSA. Attaining universal sanitation will more than triple the benefits compared with current coverage, to US$ 220 billion annually. Other regions contributing importantly to global benefits for universal access are LAC, SE Asia and W Asia.

The main contributor to overall benefits of sanitation is the value of time savings which accounts for more than 70% of total benefits in all regions, and is as high as 80% to 90% of total benefits in most regions. In SSA and S Asia an important contribution comes from health benefits, especially the value of saved lives. Health care savings – which tend to be financial in nature – vary across regions between 5% and 13% of total benefits. In terms of overall value, the global picture on sanitation benefits is dominated by E Asia and S Asia, with over US$ 30 billion combined benefits. SSA contributes an important saving with US$ 10 billion annually.

The main contributor to overall benefits of drinking-water systems and services is the value of time savings which accounts for almost 70% of total benefits in all regions, and is as high as 80% in the CCA, LAC and N Africa regions. In SSA, S Asia and E Asia the health improvements contribute to at least 35% of overall benefits. Health care savings account for more than 10% of total benefits in all regions, rising to as high as 25% in E Asia. In terms of overall value, the global picture of drinking-water benefits is dominated by the SSA region, with over US$ 3.2 billion, followed by N Africa with US$ 1 billion, W Asia with US$ 0.6 billion and LAC with US$ 0.5 billion. The economic benefits of extending services to the unserved in E Asia are negligible because two of the three East Asian countries (China and Republic of Korea) have already met the MDG target for water.

Figure C shows the total financial capital costs of achieving the drinking-water and sanitation MDG target. The sanitation costs are estimated at US$ 115 billion, or US$ 23 billion per year from 2010 to 2015, and 54% of these costs are for urban areas. The majority of global costs are incurred in three regions: SSA, S Asia and E Asia. The drinking-water costs are estimated at US$ 30 billion, or US$ 6 billion per year from 2010 to 2015[2]. 59% of these costs are for urban areas. The regions with the greatest drinking-water spending needs are SSA, SE Asia, W Asia, and LAC. In SSA the greatest investment needs are in rural areas, while in other regions urban areas dominate these investment needs. Looking at drinking-water and sanitation investment needs together, global costs of US$ 145 billion over the period 2010-2015 are dominated by SSA with US$ 53 billion – which represents over one-third of the global investment needs.

Figure C. Total financial capital costs to expand coverage to achieve the WSS MDG target, from 2011-2015 (in billions of US$)



The overall expenditure needs presented are dominated by capital costs. The global recurrent costs, including those incurred by operation and maintenance, are estimated at US$ 13 billion for sanitation and US$ 3 billion for water, over the period 2010-2015. Therefore, US$ 16 billion out of the total WSS costs of US$ 161 billion to meet the MDG target – that is, 10% – are estimated to be for operation and maintenance costs.

Achieving the MDG target is a stepping-stone in the process to attaining universal coverage. However, attaining the goal of universal coverage will have different time horizons in different countries. The cost estimation of attaining universal coverage in this report ignores the timescale and simply estimates the costs of reaching the unserved by using current unit costs of water and sanitation services. Recurrent costs are excluded. The incremental (i.e. additional after the achievement of the MDG target) capital costs of attaining universal coverage are presented in Figure D. Globally, they amount to US$ 217 billion for sanitation and US$ 174 billion for drinking-water, over the five-year period 2010-2015. E Asia accounts for almost US$ 120 billion of the global combined water supply and sanitation spending requirements of almost US$ 400 billion. While globally sanitation capital requirements exceed those of drinking-water, in some regions water capital requirements dominate. Regions with capital investment needs exceeding US$ 40 billion are SSA, S Asia and LAC. SE Asia and W Asia represent important costs at over

[2] Note that for the estimation of benefit-cost ratios, a direct comparison of annual economic benefits should **not** be made with annual financial costs, given that the investment lasts longer than the 5 year MDG period 2010-2015. Instead, the benefits are compared with annualized financial cost, using a depreciation method taking into account the duration of life of the infrastructure, and adding recurrent costs.

US$ 25 billion each. Urban investment needs dominate rural ones across all regions in both water and sanitation.

Figure D. Total financial capital costs to expand coverage to attain universal access of improved drinking-water sources and sanitation (incremental costs after achieving MDG targets), from 2011-2015 (in billions of US$)

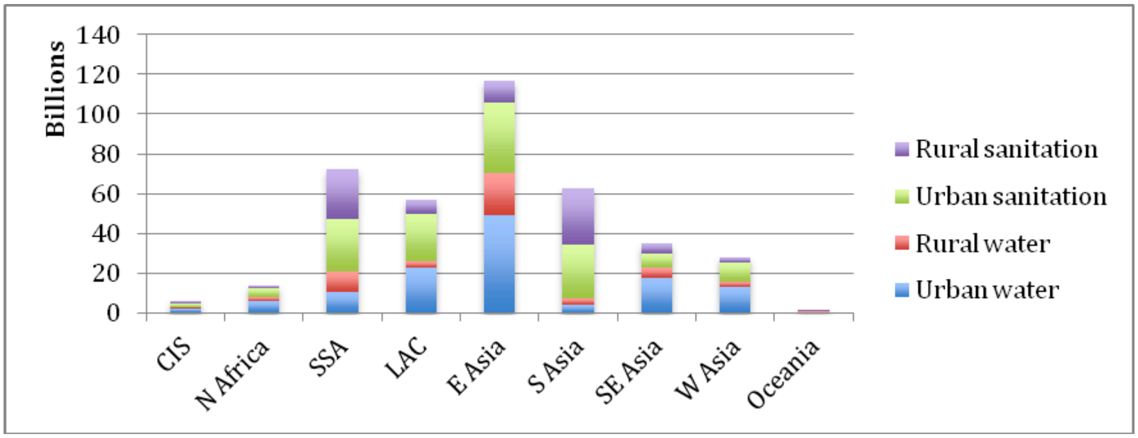


Table A presents the total costs of attaining universal coverage over the 2010-2015 period. In total, investment requirements are in excess of US$ 535 billion, consisting of US$ 332 billion for sanitation and US$ 203 billion for water. Urban costs dominate rural with US$ 339 billion for urban and US$ 197 billion for rural, for water and sanitation combined.

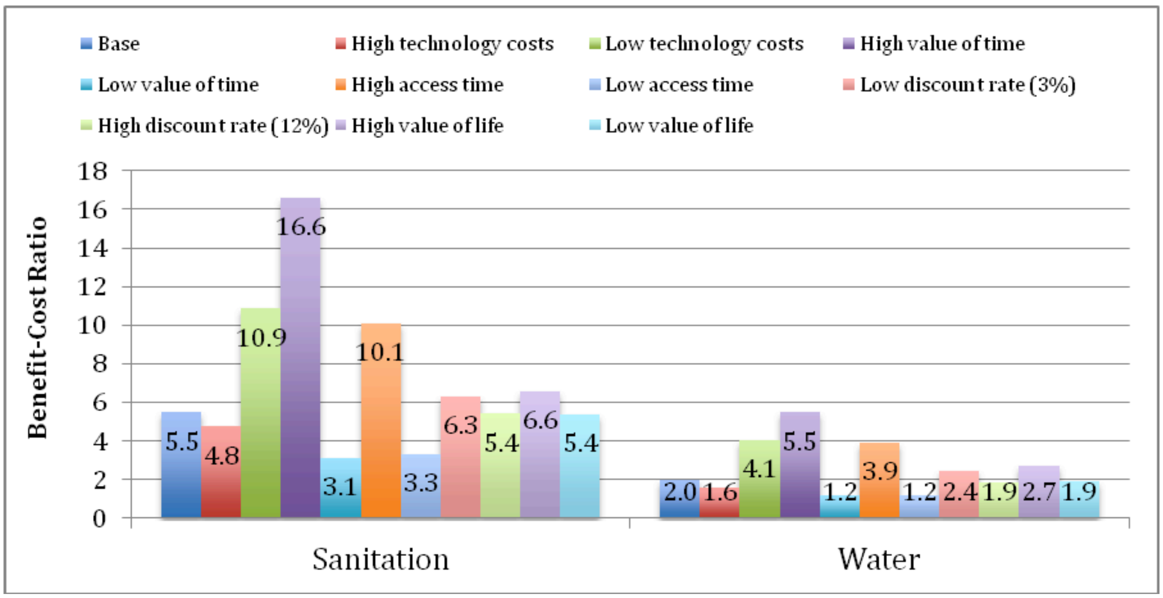
Table A. Total financial capital costs to expand coverage to achieve MDG targets and attain universal access of improved drinking-water sources and sanitation[1], from 2011-2015 (in millions of US$, 2010)

Region	**Water supply**			**Sanitation**		
	Urban	**Rural**	**Total**	**Urban**	**Rural**	**Total**
CCA	2,009	1,836	3,845	2,729	833	3,562
N Africa	8,842	3,057	11,898	5,036	1,333	6,369
SSA	13,620	16,010	29,629	47,026	48,198	95,224
LAC	24,745	4,364	29,109	29,144	10,188	39,332
E Asia	48,902	21,346	70,248	50,812	16,607	67,419
S Asia	4,187	3,644	7,831	43,736	45,460	89,197
SE Asia	22,835	6,712	29,547	8,250	7,602	15,852
W Asia	15,746	4,624	20,370	11,010	3,765	14,775
Oceania	163	700	864	182	480	662
All	**141,049**	**62,293**	**203,341**	**197,925**	**134,466**	**332,392**

[1] Table A is the sum of the data presented in Figure C and Figure D. Totals may not equal exactly sum of components due to rounding.

A global economic analysis of this nature has a number of uncertainties and weaknesses. One-way sensitivity analysis illustrates the sensitivity of the base-case results to key areas of uncertainty, shown in Figure E. The analysis shows that the results are most sensitive for the approach chosen to value time. When time is valued at 100% of the GDP per capita instead of 30%, the global benefit-cost ratio increases to 16.6 for sanitation and 5.5 for water supply. This variable is important because a large proportion (>80%) of the quantified economic benefits are the opportunity costs of time spent to access WSS services. The BCR results are also sensitive to the unit costs of WSS services, varying between 4.8 and 10.9 for high and low sanitation costs and 1.6 and 4.1 for high and low drinking-water supply costs. Varying the value of life between half the baseline assumption (human capital approach) to a high value using value-of-statistical life, a smaller impact on the benefit-cost ratios is observed, from 5.4 to 6.6 for sanitation and from 1.9 to 2.7 for drinking-water supply. Variations in the discount rate for future costs and benefits from 3% to 12% have an even smaller impact. In no cases does the uncertainty in a single parameter lead to a BCR of below 1. However, given that several potential benefits have been omitted from the calculations (e.g. nutrient reuse, educational impacts, cleaner environment, tourism and intangibles such as privacy, dignity and security), it is unlikely – even under pessimistic values for several parameters simultaneously – that the interventions would become economically unviable.

Figure E. Global benefit-cost ratios under high and low parameter values



In this study the economic returns of water supply and sanitation services are found to be more conservative than those found in previous studies. Compared to a previous global economic study, in this new study the benefit-cost ratios for water and sanitation investments declined from 4.4 to 2.0, and from 9.1 to 5.5, respectively. This reduction results mainly from the higher investment cost estimates used in this study, and a more complete inclusion of operation and maintenance costs; in addition, the assumption for the economic value of time – at 30% of the GDP per capita – is more conservative than that used in previous analyses. Therefore, these new values – 2.0 for water supply and 5.5 for sanitation – are based on more conservative estimates of some model parameters, and are hence more likely to be bare minimum estimates of economic rates of return.

With the returns demonstrated by this study, economic arguments remain highly relevant to support a further expansion of WSS coverage in the majority of low- and middle-income countries. Many countries have not yet met the MDG target – neither the drinking-water nor the sanitation component. Hence, advocacy messages can confidently put the economic returns at least at two times the investment for water supply and at least at five times the investment for sanitation. These messages continue to be relevant for those countries that are on-track to meet the MDG target, as there is still a long way to go before universal coverage of basic WSS services will be attained. Therefore, in all countries economic arguments can continue to be used in support of greater resource allocations and strengthened WASH policies. This study has further underlined and confirmed that drinking-water supply and sanitation continue to be economically viable.

An equally crucial component of the cost-benefit analysis is the estimation of global and regional costs of meeting the MDG target and attaining universal access. While the water component of the global MDG target was achieved in 2010, a country-by-country analysis of the target indicates significant investments are still needed in expanding access to drinking-water to meet the MDG target in a large number of countries. Moreover, the sanitation component of the target remains significantly off-track. This study shows that the lack of sufficient progress towards the MDG target has led to an increase in annual financing requirements for water and sanitation. In annual terms, the investment requirements on new facilities to meet the MDG have increased to US$ 32 billion per year (over the five-year period 2011-2015), compared with the previous estimate of US$ 18 billion per year (over the ten-year period 2006-2015). This increase is partly due to the slow progress, especially in sanitation; it is also due to the higher unit costs used in the present study.

While it should be a priority of governments and service providers to extend coverage to unserved populations, there is a very real risk that funds are diverted away from the operation, maintenance and replacement of existing infrastructure. To understand the financing needs for this component, the present study estimates the costs of keeping populations already served covered – i.e. to prevent them from slipping back to unimproved categories of facilities or service. The study shows that the costs to keep these populations served, including renovation and replacement of facilities, will exceed the costs of new coverage to meet the MDG target by 50 times for drinking-water supply and by six times for sanitation. Clearly, meeting these requirements needs to be guaranteed to prevent slippage. Assuming that aid money will not increase significantly in the next five years, clearly governments and households will have to meet a large proportion of the funding gap. The exploitation of alternative financing sources to fill this gap, such as private equity markets, impact investing funds (e.g. social impact bonds) and pension funds, can be supported by the evidence on economic returns.

With these massive financing needs just to meet the MDG target, it is perhaps premature to start talking about universal coverage as a global policy target. Clearly there has to be a longer time horizon to attain universal access. An additional US$ 390 billion are required to meet the capital costs of the unserved getting access to drinking-water and sanitation. On the short term, arriving at this funding volume is not feasible, nor would recipient countries be able to absorb this level of capital influx. However, over 20 or 30 years, universal access may be feasible with progressive increases supported by economic growth, a growing tax base for the poorest countries and successful advocacy. Over 20 years for example, it requires US$ 20 billion annually to extend coverage. However, this does not take into consideration further population growth, price increases above the average rate of inflation, and the expectations of populations for 'higher' levels of service than those assumed in the baseline assessment of this present cost study.

A global study with disaggregation at country level will be imprecise, unless considerably more resources are put into collecting more detailed input data for each and every country. However, a global study such as this one can be used to motivate countries to generate their own estimates on economic return and financial cost of increasing investments in water supply and sanitation. National studies should be conducted within the context of national policy processes, demanded by – even contracted by – the users of the information, to ensure that the studies generate policy-relevant information. These studies include WSS costing and financing studies over a medium- to long-term time horizon; the economic value of health gains; improving performance of WSS programmes; exploration of other economic benefits not previously assessed, including reuse and energy benefits obtainable from sanitation; intangible benefits such as private and social benefits; and environmental benefits of averted pollution due to improved sanitation and wastewater management.

Abbreviations

BCR	Benefit-cost ratio
CBA	Cost-benefit analysis
DHS	Demographic and Health Survey
ESI	Economics of Sanitation Initiative
GDP	Gross domestic product
HCA	Human capital approach
IRC	International Water and Sanitation Centre (Netherlands)
JMP	WHO/UNICEF Joint Monitoring Programme on Water Supply and Sanitation
MDG	Millennium Development Goal
NGO	Non-governmental organization
OECD	Organization of Economic Cooperation and Development
UNICEF	United Nations Children's Fund
US$	United States Dollar
VOSL	Value of a statistical life
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSP	Water and Sanitation Program (World Bank)
WSS	Water Supply and Sanitation

MDG REGIONS

N Africa	Northern Africa
SSA	Sub-Saharan Africa
LAC	Latin America and the Caribbean
CCA[3]	Caucasus and Central Asia
E Asia	Eastern Asia
S Asia	Southern Asia
SE Asia	Southeast Asia
W Asia	Western Asia
Oceania	Oceania

[3] Formerly CIS – Commonwealth of Independent States; the Russian Federation, Belarus and Ukraine have joined the group of developed countries.

Acknowledgements

The author, Guy Hutton (Independent Consultant), would like to thank the water, sanitation and health team at the World Health Organization, under the leadership of Robert Bos, for their valuable support in the realization of this study. The following WSH staff played a key role in this study: Rifat Hossain (WHO) contributed to study management and data sourcing; Selma Telalgic (PhD Candidate, Cambridge University, UK) compiled coverage and cost data during an internship at the WHO. Catarina Fonseca (IRC International Water and Sanitation Centre, the Netherlands) provided valuable comments on the study methodology at the design phase. Catarina Fonseca, Peter Burr and the entire WASHCost team at IRC - International Water and Sanitation Centre in the Netherlands, CoWater in Mozambique, Kwame Nkrumah University of Science and Technology in Ghana and Center for Economic and Social Studies in Andhra Pradesh, India are thanked for providing cost data tabulations from the WASHCost project. The United Nations Children's Fund is thanked for co-financing this study.

The technical support of all those mentioned above is gratefully acknowledged. Declaration of Interest forms have been completed by all contributors and no conflict of interests were identified.

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1. Introduction

Globally, large numbers of people remain without access to basic levels of drinking-water supply and sanitation (WSS). According to data compiled by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP), in 2010 783 million people continued to use unimproved sources to meet their drinking-water needs and 2.5 billion people continued to use an unimproved sanitation facility or defecate in the open [1][4].

One of the UN Millennium Development Goal (MDG) targets[5] is to halve, by 2015, the proportion of people without sustainable access to safe drinking-water and basic sanitation, with 1990 as the baseline year. According to the JMP, the rate of progress towards achieving this target is such that the target will not be reached in its entirety by 2015. While the drinking-water target was met in 2010, sanitation is still considerably off-track. Based on the most recent estimates sanitation coverage must increase globally from 63% to 75% between 2010 and 2015. At the current rate of progress, sanitation coverage is predicted to be 67% in 2015, 580 million people short of the MDG target.

Many governments have set national drinking-water and sanitation targets for 2015 and beyond, and they may have different ways of monitoring them (e.g. differences in definitions of access, data sources, methodology). Indeed, many governments have set more ambitious targets than the global MDG target – hence requiring an even greater drive to meet them.

In 2010, the United Nations General Assembly and the UN Human Rights Council recognized access to safe drinking water and sanitation as a human right[6]. The concept of progressive realization inherent to the rights-based approach will result in intensified monitoring to be able to hold governments accountable for meeting their human rights obligations. Those still lacking access tend to be poor and marginalized groups. The JMP progress report showed that, in 2010, poorer households, as measured by wealth quintiles, have significantly lower access than households in the two highest wealth quintiles [2].

A comparison of progress in rural and urban areas since 1990 shows that greater progress has been made in expanding water and sanitation services to urban areas. Of the 783 million people still using unimproved drinking-water sources, 83% (653 million) live in rural areas. Of the 2.5 billion people still not served with improved sanitation facilities, 72% (1.8 billion) live in rural areas.

Even if the world would meet the MDG target for both water supply and sanitation, 25% of the world's population – 1.8 billion – would remain without access to improved sanitation in 2015. If current trends in sanitation continue, this figure will be closer to 2.4 billion. At current rates of progress in access to drinking-water, 8% (605 million) of the world's population will still be using unimproved sources of drinking-water in 2015. The remaining unserved populations are generally the poorer and marginalized members of

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[4] http://www.wssinfo.org
[5] Goal 7, Target C.
[6] The resolutions and decisions adopted by the Human Rights Council are contained in the report of the Council on its fifteenth session (A/HRC/15/60), chap. I. Also, refer to the resolution A/HRC/RES/18/1.

society, and thus are harder to reach with services. Equity in achieving the MDG targets is important, not only because the poorest households are least able to invest in their own facilities, but also because they have the most to gain due to their heightened vulnerability to adverse health outcomes. Hence, there is increasing pressure for universal access to safe drinking-water and basic sanitation to be adopted as a global development goal, leveraging additional efforts and resources that are targeted to ensure the poorest and most vulnerable are reached.

In order to address these remaining challenges, further evidence is collected, compiled and analysed to support a greater allocation of resources to water supply and sanitation by decision makers and to select the most efficient interventions. The Sanitation and Water for All (SWA) partnership – launched in 2009 – is a global initiative to support countries in the scale-up of WSS services, especially those countries with low coverage or those most off-track to meet targets. To keep attention focused on meeting the MDG target, the "Sustainable sanitation: Five year drive to 2015" has been launched by the United Nations[7].

Economic evidence is recognized as key for the achievement of the WSS goals – it helps justify increasing investment and expenditure, and it supports decisions to select efficient WSS options by explicitly comparing costs and benefits of a range of alternative WSS technologies and service delivery approaches. In the early 2000s, several economic studies were published. A previous global economic study by WHO has been used widely to justify increased spending on WSS [3]. In 2006, WHO and UNDP collaborated to update this global cost-benefit study, focusing on off-track countries only [4]. A later costing study using the same underlying dataset presented updated global and regional costs of meeting the MDG target for the year 2004 [5]. Other studies, reviewed by the World Water Council, have also estimated global and regional costs of achieving the Millennium Development Goal target for drinking-water and sanitation [6]. The review concluded that all the studies have similar problems of weak underlying unit cost data, and furthermore, given their broad geographical scope, they lack sensitivity to local issues such as varying population densities and selection of appropriate technologies. Some of the reviewed costing studies partially dealt with these issues by presenting total costs under different scenarios (high/low unit costs, high/low technology). The resulting cost estimates provide ranges of likely cost but are too imprecise for decision making at country level.

This report updates previous economic analyses conducted by the World Health Organization, using new WSS coverage rates, costs of services, income levels and health indicators. Ranges on benefit-cost ratios are presented taking into account uncertainty in the underlying cost data and the choices of actual WSS technologies made at country level. The main report presents regional results, with country results provided in annexes B and C.

[7] http://www.sanitationdrive2015.org/

2. Study methods

2.1 Study aims

The present study aimed to estimate global, regional and country-level costs and benefits of drinking-water supply and sanitation interventions to meet the MDG target in 2015, as well as to attain universal coverage. These economic data will provide further evidence to support investment in water supply and sanitation systems and services, with a focus on services that are both socially efficient and financially sustainable. The results will help donors and governments of low- and middle-income countries to justify allocation of adequate budgets for such systems and services.

Compared to earlier analyses [3, 5, 7, 8], the following have been updated or revised to increase accuracy of cost estimates for current global and country-level decision makers:

- Updated figures. Where available, input data reflect the year 2010. Variables for which 2010 data are not yet available are extrapolated from the most recent year using trend lines.
- More low- and middle-income countries have been included, from under 100 countries in the previous analyses to a total of 136 countries in 2010 (Annex A).
- Health impacts from inadequate WSS and health risk reductions from WSS interventions are based on more recent studies. 'Indirect' adverse health impacts and deaths are also included, e.g. the impact of diarrhoeal diseases on malnutrition.
- Improved unit cost estimates of WSS services, using data from a greater number of country unit cost studies of better quality.
- Countries are aggregated to nine developing country MDG regions instead of eleven developing country WHO regions used previously (section 2.2).

Despite the improved data sources available, reliable data inputs on key variables are still lacking for many countries. To fill these gaps, cost and benefit data are extrapolated between countries. Annex B presents the unit costs per country and technology.

2.2 Countries and regions included

The quantitative model is run at country level, and the results aggregated to give the regional and global averages, weighted by country population size. In the original cost-benefit study [3, 8], countries with no available 1990 coverage baseline estimate were excluded from the costing. More recently, backward projection of 1990 baselines for these countries has been made by the WHO/UNICEF JMP and these estimates were used in this costing study. Hence almost all low- and middle-income countries have been included in this study, thus better reflecting the global picture. Countries omitted were mainly small island states, as well as DPR Korea, Puerto Rico, and Hong Kong SAR, for which there is no reporting of WSS coverage data by the JMP.

Results are presented for the following nine MDG regions:

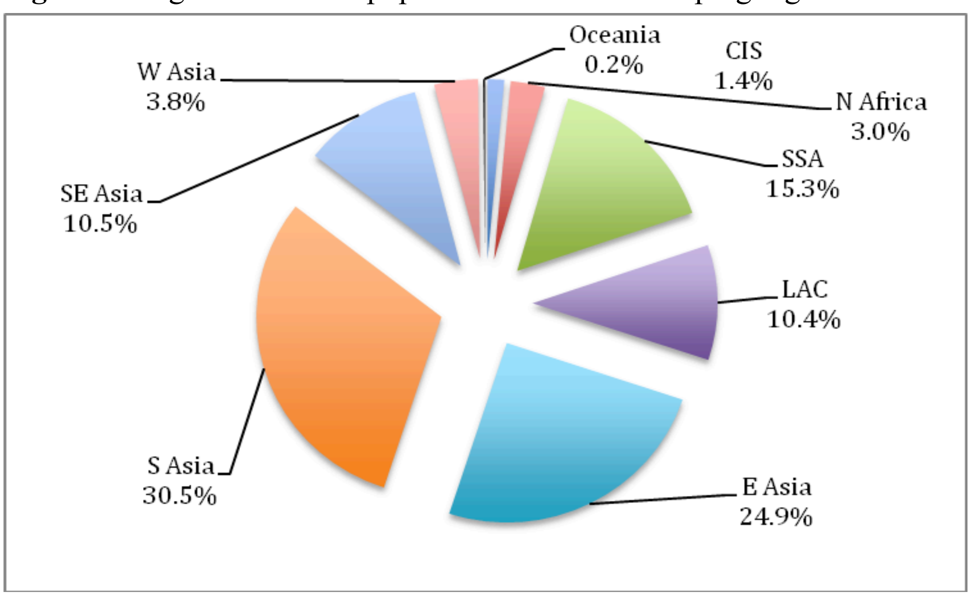
1. Caucasus and Central Asia (CCA)
2. North Africa (N Africa)
3. Sub-Saharan Africa (SSA)
4. Latin America and the Caribbean (LAC)
5. Eastern Asia (E Asia)
6. Southern Asia (S Asia)
7. South-eastern Asia (SE Asia)
8. Western Asia (W Asia)
9. Oceania

2.3 Demographics and WSS coverage

Population size for rural and urban areas was sourced from UN Statistics for the MDG baseline year (1990) and 2008[8], as well as projections for 2010 and 2015. Figure 1 shows the population distribution of the included countries across nine developing regions. The 136 countries included represent 5.6 billion of the world's projected 6.7 billion population in 2010, and 6.0 billion of the world's projected 7.3 billion population in 2015. This reflects an additional 300 million population covered in this study compared to previous cost study [5, 7], on account of the additional countries included. The countries are listed in Annex A.

In 2010, the urban share of total population of MDG regions 1-9 ranged from under 30% in SSA, Oceania and E, S and SE Asian countries, to above 60% in LAC and W Asian countries, compared to a global average of 45% living in urban areas.

Figure 1. Regional share of population of nine developing regions in 2008



[8] 2008 was the latest year with available data, at the time the study was conducted.

It is recognized that a single rural versus urban area breakdown does not reflect the global diversity of settlement types and densities. Previously, a cost study conducted under the World Bank initiative Africa Infrastructure Country Diagnostic (AICD) distinguished between large urban, secondary urban, rural hinterland and deep rural areas which enabled more accurate cost estimates, based on more specifically defined WSS options [9][9]. However, as this present study draws on the only global database of WSS coverage - the JMP - it is limited by the singular rural/urban distinction of its datasets. Instead, this study explores the potential for cost variation in low and high technology scenarios, which provide lower and upper limits on costs.

For the health impact analysis, populations are disaggregated into three age groups (0-4 years, 5-14 years and 15+ years) due to the differential information available for these groups and the differing disease and mortality rates.

WSS coverage data were sourced from the WHO/UNICEF JMP [2]. The main data points used in this analysis are coverage for the MDG baseline year (1990) and the latest year for which JMP data are available (2010). The 1990 baseline data are essential to estimate the target coverage in 2015, with the global MDG target applied in each country individually[10]. The analysis utilises coverage definitions of the JMP (see Table 2). This introduces some issues of interpretation of cost estimates, which will need to be dealt with at country level based on each country's own definitions of improved versus unimproved WSS services, and the extent to which they diverge from the JMP definitions. For example, some national authorities consider adequate certain types of pit latrine or shared toilets that are categorised as 'unimproved' by the JMP. On the other hand, some types of basic facility that fall within the JMP's 'improved' category may be considered inadequate according to some national standards.

In order to model future costs, population projections to the target year (2015) were sourced from the United Nations Population Division (2008 revision). The total population of the 136 countries included is predicted to grow from 5.6 billion in 2010 to 6.0 billion in 2015. Therefore, a coverage assumption (improved or unimproved service/facilities?) is needed for this additional population of 400 million. In theory, assuming household sizes stay the same, additions to the population will need to be covered by new dwellings. However, the challenge lies in estimating the additional (incremental) costs of investing in improved drinking-water systems and sanitation facilities that are paid for in new dwellings, given that these facilities are difficult to separate from the infrastructure costs of the dwelling itself. In practice, in the shorter term, population increments happen through infants being 'born' into the type of WSS coverage available in their dwelling. Therefore, this study assumes the 'new' population is covered by water and sanitation services according to the latest coverage year of 2010. This assumption will underestimate true, longer-term costs of building toilets in new dwellings.

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[9] Unit costs are given not just for each type of technology, but also adjusted for the population distribution among six urban categories (the size of city or town) and two rural categories (distance from nearest town) and the population density. This aims to take into account the greater per capita costs of investments in smaller towns, less densely populated areas and more remote rural areas.

[10] Although country application of the global proportional reduction in unserved population was not intended by the United Nations, this approach is adopted due to the absence of any other allocation rule communicated by the United Nations on how the global target was intended to be met.

In some countries, especially CCA countries, the opposite is occurring, as populations are expected to decline from 2010 to 2015. In these countries, where coverage targets for 2015 are very high (close to 100%) – there is no growth in coverage required from 2010 to 2015 to meet universal coverage. Hence in these countries the cost of achieving universal coverage is estimated to be zero.

Any cost estimate of attaining universal access in the future carries with it a considerable uncertainty about when countries will attain this status. This study therefore estimates the financial capital costs of achieving universal coverage in 2015; the annual capital costs can thus be estimated based on how many years it is expected for a particular country to achieve universal coverage. However this analysis does not take into account population growth beyond 2015 – hence the cost estimates to achieve universal access by 2015 will underestimate the true costs of achieving universal access after 2015 in countries where populations are still growing. Given the already existing uncertainties in the cost estimates, further uncertainties of unknown population growth, future prices of WSS services and the impact of climate change (and requirements for costs of more resilient WSS systems), projections beyond 2015 were not considered appropriate for this study.

2.4 WSS interventions and costs

Similar to the previous global cost-benefit study conducted by WHO in 2004 [5, 7], the costs and benefits of WSS interventions are estimated under the achievement of different targets by the year 2015, compared to a baseline of no change in coverage, as follows:

1. Sanitation MDG target, labelled '*Sanitation MDG*'.
2. Drinking-water supply MDG target, labelled '*Water MDG*'.
3. Combined drinking-water supply and sanitation MDG target, labelled '*WSS MDG*'.
4. Universal sanitation access, labelled '*Universal sanitation access*'.
5. Universal improved drinking-water supply, labelled '*Universal water access*'
6. Universal improved drinking-water supply and sanitation, labelled '*Universal WSS*'.

Rural and urban are considered separately. For example, if a country has surpassed its MDG target for urban sanitation but is off-track to meet the target applied to rural areas, the excess urban coverage does not balance out the rural deficit. The effect is that costs of meeting MDG targets are higher for some countries than would be the case if taken at the national level; this is important to ensure greater equity between rural and urban residents.

In meeting these six coverage scenarios, the total population benefiting from improved coverage is shown in Table 1. The 'universal' scenarios are additional population to be reached compared to the MDG scenario. A further 985 million people need to be provided with improved sanitation to meet the MDG sanitation target, compared with 215 million for the MDG water target[11]. A further 1.89 billion must be covered to reach universal sanitation coverage, and a further 900 million for universal water access.

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[11] Although the water MDG has been met as a global total, many countries have still not reached the global target applied at country level; hence, there are 215 million still to be covered in countries not yet meeting the water component of the MDG target.

Table 1. Population receiving interventions, by region and intervention (in thousands)

Region	Total population in 2015 (thousands)	Population to be reached, per intervention (thousands)			
		Sanitation MDG target	Water MDG target	Universal sanitation[1]	Universal water access[1]
CCA	85,005	3,273	4,429	7,881	9,782
N Africa	182,239	3,958	9,689	26,869	19,131
SSA	968,973	330,598	137,350	380,918	292,279
LAC	613,107	41,173	6,802	103,872	56,878
E Asia	1,448,006	135,401	124	434,037	132,240
S Asia	1,843,389	417,674	21,528	724,333	279,676
SE Asia	622,468	41,660	18,111	164,925	85,059
W Asia	235,716	9,377	14,821	39,899	29,122
Oceania	10,193	2,421	2,358	2,942	2,945
All[2]	**6,009,096**	**985,534**	**215,212**	**1,885,676**	**907,112**

[1] Incremental population to be covered over and above the population reached by achieving the MDG target. The estimates are based on population in 2015. Refers to improved drinking-water sources and sanitation.
[2] Includes 136 developing countries (see Annex A).

The entire analysis presented in this paper is based on people moving from unimproved to improved technology options of drinking-water supply and sanitation, as defined by the WHO/UNICEF JMP. Table 2 presents these categories. Note that the interventions can be defined as unimproved not only if they are unsafe, but also if they typically involve a higher cost drinking-water supply or unreliable access (e.g. bottled water or water provided by tanker truck), or if they require travel, waiting time or a fee in the case of sanitation (e.g. open defecation or public toilets).

Table 2. Definition of 'improved' and 'unimproved' sanitation and water supply

Intervention	Improved	Unimproved[1]

Sanitation	• Flush or pour-flush to:
	  • Piped sewer system
	  • Septic tank
	  • Pit latrine
	• Ventilated Improved Pit-latrine
	• Pit latrine with slab
	• Composting toilet
		• Flush or pour-flush to elsewhere
		• Pit latrine without slab or open pit
		• Bucket
		• Hanging toilet or hanging latrines
		• No facilities or bush or field

Water supply	• Piped water into dwelling, plot, or yard • Public tap/standpipe • Tubewell/borehole • Protected dug well • Protected spring • Rainwater collection	• Unprotected dug well • Unprotected spring • Cart with small tank/drum • Tanker truck • Bottled water • Surface water (river, dam, lake, pond, stream, canal, irrigation channels)

Source: This table reflects the updated definition of improved and unimproved sanitation and water supply presented in the 2006 JMP report [10].
[1] Defined as being unimproved due to being unsafe or costly, or in the case of sanitation, non-private.

A challenge in modelling the future costs of meeting global WSS targets is that the types of technology, and the way they are delivered or demanded, will vary from country to country, as well as within countries. Due to the global nature of this study, detailed assessments were not possible of the specific types of technology currently popular in different countries. This study therefore uses the simplifying assumption that in rural areas basic sanitation involves an improved wet pit latrine with a lifespan of eight years, and basic water supply involves a borehole with a lifespan of 30 years. In urban areas, improved sanitation technologies in this study reflect a mixture of septic tank (with and without off-site treatment) as well as sewerage with wastewater management – all with expected lifespan of 20 years. Improved water sources in urban areas were assumed to be piped household connection to a water treatment plant, also with an expected lifespan of 20 years. Given the low rates of capital maintenance throughout the developing world, the conditions are considered to be absent for exploiting the potentially longer life spans of these technologies. Where a unit cost study utilized context-specific different expected life spans based on local conditions, these were used instead.

An incremental cost analysis was carried out, with an estimate of the costs of extending access to water supply and sanitation for those currently not having access. Incremental costs consist of all resources required to put in place and maintain an intervention, as well as other costs that result from an intervention. These are estimated separately for capital investment and recurrent costs. Investment costs ideally include: planning and supervision, hardware, construction and house alteration, protection of water sources and education that accompanies an investment in hardware. Recurrent costs ideally include: operating materials to provide a service, maintenance of hardware and replacement of parts, emptying of septic tanks and latrines, regulation and control of water supply, ongoing protection and monitoring of water sources, water treatment and distribution, and continuous education activities. However, different unit cost studies include different elements in the costs. In particular the costs of capital maintenance are omitted from many costing studies. Recent initiatives, such as the IRC WASHCost project, have attempted to record maintenance costs more systematically. However, as proper capital maintenance is rarely conducted, it is difficult to measure its costs in real field settings.

Several unit cost studies in the past five years have added greater precision to the cost estimates for countries where these studies have been conducted [11-14]. In addition to these studies, unit costs used in the recently conducted AMCOW Country Status Overviews in Africa were reviewed and selectively utilized [15]. However, there remain major gaps in unit cost evidence, especially for countries of CCA, LAC, W Asia and Oceania. When unit cost data were not available for a country, data from the most similar country were extrapolated. Unit cost data used are presented by country in Annex B.

When estimating the total costs of providing improved WSS technologies to populations, four major uncertainties are to be distinguished:

1. The level of technology chosen. Each technology has different investment and O&M costs, and the life span varies for each (and hence annualized costs).
2. The actual life span will vary from the expected (engineered) life span. The actual life span is a function of the quality of the hardware and the amount of correct usage and maintenance. The present study opted for the engineered life span, using unit

cost data that imperfectly capture the required maintenance costs. Hence, this gives an optimistic picture of the costs of providing and sustaining the technologies selected.

3. Extrapolation between settings. Unit costs gathered for selected countries are assumed to represent unit costs for those entire countries, which may be unrealistic. Also, for countries with no unit cost data, extrapolation from other countries with data represents a major uncertainty.
4. Uncertain future scenarios due to environmental and climate change. Increased risk of flooding as well as drought will require WSS services to be more resilient. There is limited experience with climate adaptation in the WSS sector, and guidelines on optimal technology options do not yet exist. In the World, Health Organization's "Vision 2030", different WSS options are classified according to their resilience to climate change [16]. For sanitation, pit latrines and low flush septic systems are classified as "potentially resilient to all expected climate changes". For water supply, utility piped water supply and tube well are likewise considered the most resilient systems. However, there still remains considerable uncertainty, and lack of data on the costs of ‘climate proofing’ water supply and sanitation services. This is an issue with more relevance to the post-2015 period, as countries progress towards universal coverage.

In order to deal simultaneously with these four sources of uncertainty, lower and upper bounds are placed on investment and recurrent costs. This provides a plausible range for the actual costs, but this range can only be truly known based on country-specific costing studies. Table 3 shows the WSS options included in the low cost, high cost and baseline scenarios.

Table 3. Technology options 'given' to the unserved population

Location	'Low' cost scenario	Baseline scenario	'High' cost scenario
Sanitation			
Rural	Dry pit	Wet pit	Septic tank
Urban	Wet pit	Septic tank or sewerage with treatment (according to current coverage)	Sewerage with treatment for all
Water			
Rural	Dug well	Borehole	Household connection
Urban	Borehole	Piped treated household water supply or borehole (according to current coverage)	Piped treated household water supply for all

2.5 Benefit overview

A large range of economic and social benefits can result from improved WSS services. Table 4 presents the main ones, indicating those that have been included in this study, and those excluded. As is evident from the table, more benefits have been excluded than included: for many, the lack of evidence impedes a credible global assessment. However, a reduction in the diarrhoeal disease burden (as the main health impact) and time benefits (i.e. opportunity costs saved) are expected to account for a large share of total benefits.

Table 4. Benefits of improved sanitation and drinking water supply

Benefit	Sanitation	Water
	Included Benefits	
Health	• Averted cases of diarrhoeal disease • Averted cases of helminths • Malnutrition-related diseases [17] • Health-related quality of life impacts	• Averted cases of diarrhoeal disease • Malnutrition-related diseases [17] • Health-related quality of life impacts
Health economic	• Costs related to diseases such as health care, productivity, mortality [3, 8, 17]	• Costs related to diseases such as health care, productivity, mortality [3, 8, 17]
Time value	• Travel and waiting time averted	• Travel and waiting time averted for collecting water
	Excluded Benefits	
Other health	• Dehydration from not drinking due to poor latrine access (especially women) • Less flood-related health impacts	• Dehydration from lack of access to water • Less flood-related health impacts (better water management)
Nutrients	• Use of human feces or sludge as soil conditioner and fertilizer in agriculture	
Energy	• Use of human (and animal) waste as input to biogas digester leading to fuel cost savings and income opportunities	
Education	• Improved educational levels due to higher school enrolment and attendance rates • Impact on education of childhood malnutrition	• Improved educational levels due to higher school enrolment and attendance rates • Impact of childhood malnutrition on education
Water treatment	• Less household time spent treating drinking water, including boiling, maintaining rain water collection systems [17]	
Water security	• Safe treated wastewater for use in agriculture	
Environment	• Improved quality of water supply and related savings	
Leisure and quality of life / intangibles	• Safety, privacy, dignity, comfort, status, prestige, aesthetics, gender impacts [17]	• Leisure and non-use values of water resources and reduced effort of averted water hauling and gender impacts
Reduced access fees	• Reduced payment of money paid for toilets with fee	
Property	• Rise in value of property	• Rise in value of property
Income	• Increased incomes due to more tourism income and business opportunities [17] • Productive uses	• Increased incomes due to more tourism income and business opportunities • Productive uses

The majority of valuation studies on water supply and sanitation to date present economic values. Economic values are the sum of financial transactions, hypothetical or actual cash savings, as well as an imputed value for non-market services. Economic values exclude transfer payments such as taxes and subsidies. Once all these values are aggregated, they reflect welfare impact, which is a measure of societal benefit or utility. However, it should be understood that economic values do not reflect the direct financial impact – for example, the cash impact on the household (e.g. coping costs) on the private sector (e.g.

worker productivity), or on the budget of a line ministry (e.g. health care savings). Based on economic figures, it is difficult for the private sector to assess the market potential. Separate analyses on market conditions and willingness to pay are needed to better understand direct financial impacts. As a purely financial analysis will undervalue water and sanitation services, the purpose of this study is to focus on the overall costs and benefits to society – thus informing overall debates on the 'right' level of coverage and resource allocation, and the 'right' technologies.

2.6 Health benefit estimation

Over recent decades, compelling evidence has been gathered that significant and beneficial health impacts are associated with improvements in access to safe drinking-water and basic sanitation facilities [18]. The routes of pathogens to affect health via the medium of water are many and diverse. Five different routes of infection for water-related diseases are distinguished: waterborne diseases (e.g. cholera, typhoid), water-washed diseases (e.g. trachoma), water-based diseases (e.g. schistosomiasis), water-related vector-borne diseases (e.g. malaria, filariasis and dengue), and water-dispersed infections (e.g. legionellosis). While a full analysis of improved water and sanitation services would consider pathogens using all these pathways, the present study focuses on water-borne and water-washed diseases. At the household level, it is the transmission of these diseases that is most closely associated with poor water supply, sanitation and hygiene. Moreover, water-borne and water-washed diseases are responsible for the greatest proportion of the direct-effect water and sanitation-related disease burden.

For the purpose of estimating health benefits from improving water supply and sanitation services, populations are classified into different starting WSS service points, which relate to a given health risk, shown in Table 5. The water, sanitation and combined WSS interventions essentially reduce the health risk of the target populations. Specific water and sanitation health impact assessments help target the least served populations. The relative risks are based on high quality impact assessments only.

In terms of burden of disease, waterborne and water-washed diseases consist mainly of infectious diarrhoea. Infectious diarrhoea includes cholera, salmonellosis, shigellosis, amoebiasis, and other protozoal and viral intestinal infections. These are transmitted by water, person-to-person contact, animal-to-human contact, and foodborne, droplet and aerosol routes. As infectious diarrhoea causes the main global burden of disease resulting from poor access to water supply and sanitation, and as there are data for all regions on its incidence rates and deaths, this analysis estimates the reduction in diarrhoea incidence rates and premature mortality from diarrhoea. In addition, given that environmental risk factors are estimated to account for 50% of undernutrition in the developing world [19], diseases with higher incidence or case fatality due to malnutrition are also included using a method previously applied in countries in Southeast Asia [17]. In this approach, a proportion of cases of respiratory infection and malaria in children 0-5 years old are attributed to poor water supply and sanitation, based on very severe and moderately severe malnutrition rates in the same age group and determined by region-specific attribution factors estimated by Fishman et al [19]. For mortality, the case fatality of respiratory infection, malaria, measles and other infections are affected.

Table 5. Selected exposure scenarios

Description	Corresponding relative risk
No improved water supply and no basic sanitation in a country which is not extensively covered by those services, and where water supply is not routinely controlled	1.0
Improved water supply and no basic sanitation in a country which is not extensively covered by those services, and where water supply is not routinely controlled	0.82[1]
Improved sanitation but no improved water supply in a country which is not extensively covered by those services, and where water supply is not routinely controlled	0.64
Improved water supply and improved sanitation in a country which is not extensively covered by those services, and where water supply is not routinely controlled	0.61[2]

Based on Prüss *et al*. 2002 [20], updated risk reductions from Waddington et al [18]

[1] The relative risk of water supply interventions is selected instead of water quality interventions, as basic water interventions are more focused on delivering adequate water quality than delivering water quality improvements.

[2] Pooled estimates of impact evaluations that assess multiple interventions have a higher relative risk than sanitation interventions alone. This points to underlying weaknesses and a dearth of such impact evaluations. In order not to end up with the counter-intuitive result of sanitation being more effective than sanitation and water supply interventions combined, a slightly lower relative risk of 0.61 is assumed for combined interventions.

Economic benefits related to health impacts of improved WSS services include three main ones, as previously evaluated:

1. Savings related to seeking less health care. Health care savings are estimated as a function of treatment seeking rates, medical practices and unit costs of medical services. Medical practices include the types of treatment given for a disease and the rate of in-patient admission or referral. All these variables fluctuate by disease and country. In addition, patients and their carers incur treatment-seeking costs such as travel costs.
2. Savings related to productive time losses from disease. Productivity losses are estimated based on disease rates, the number of days absent from productive activities, and the unit value of productive time. Given the stringent data requirements to estimate specifically financial losses from lost productive time, an economic value is given instead to time based on the sick person's age. To promote gender equity, men's and women's time are given the same value.
3. Savings related to reductions in premature mortality. Mortality is valued using human capital approach to estimate the value of a premature death averted.

Table 6 shows the data values, or ranges, for each variable used in the analysis.

Table 6. Variables, data sources and values for health economic benefits, for the example of diarrheal diseases

Benefit by sector	Variable	Data source	Data values
Health care costs of disease	Unit cost per treatment	WHO regional unit cost data	US$0.41 - US$135 (cost per visit) US$1 - US$738 (cost per day) Variable by country
	Number of cases of diarrheal disease	DHS	1 to 13 cases per child per year Variable by country
	Visits or days per case	Previous study	1.2 outpatient visits per case seeking care (includes return visits) 5 days for hospitalised cases
	Hospitalisation rate	Previous study	10% of ambulatory cases are hospitalised
	Transport cost per visit	Assumptions	US$0.50 per visit
Welfare gained due to days lost from work avoided	Days off work/ episode	Expert opinion	5 days
	Number of people of working age	UN Statistics	Variable by country
	Opportunity cost of time	World Bank data	30% of hourly monetary income, using GDP per capita as the proxy for time value
Welfare gained due to school absenteeism avoided	Absent days / episode	Expert opinion	5 days
	Number of school age children (5-14)	UN Statistics	Variable by country
	Opportunity cost of time	World Bank data	15% of hourly monetary income, using GDP per capita as the proxy for time value
Welfare gained to parents due to less child illness	Days sick	Expert opinion	5 days
	Number of young children (0-4)	UN Statistics	Variable by country
	Opportunity cost of time	World Bank data	15% of hourly monetary income, using GDP per capita to proxy time value
Value of loss-of-life avoided (life expectancy, discounting future incomes at 8%, assuming average long term growth in national income of 2%)	Discounted productive years lost (0 – 4 years)	WASH study [21]	16.2 years
	Discounted productive years lost (5 – 14 years)	WASH study [21]	21.9 years
	Discounted productive years lost (15+ years)	WASH study [21]	19.0 years
	Opportunity cost per year of life lost	World Bank data	GDP per capita

2.7 Time benefit estimation

Table 7 shows the values and data sources for time savings due to closer physical access and less waiting time for improved WSS services.

Table 7. Variables, data sources and values for 'convenience' time savings

Variable	Data source	Data values
Water collection time saved per household per day for better external access	Expert opinion, and evidence review[1]	0.5 hours per day per household 1.0 hours for sub-Saharan Africa
Water collection time saved per household per day for piped water	Expert opinion, and evidence review[1]	1.0 hours per day per household 1.5 hours for sub-Saharan Africa
Sanitation access time saved per person, moving from OD to private latrine	Expert opinion, studies from Southeast Asia[2]	0.5 hours per day per person
Average household size	UN Statistics	5 people
Opportunity cost of time	World Bank data	30% of hourly GDP per capita for adults 15% of hourly GDP per capita for children

[1] See Hutton and Haller for reviewed studies [8]

[2] From a survey of >5,000 households conducted in five Southeast Asian studies, a single round trip to place of open defecation was found to require at least 10-15 minutes. Hence taking into account an individual may require up to several visits per day, the time lost will be at least 30 minutes per person per day. Shared and public toilets also required greater time to access than private options. See Hutton et al [12].

2.8 Sensitivity analysis

One-way sensitivity analysis was performed on four key variables determining the cost-benefit values. The sources of low and high values are shown in Table 8.

1. Alternative value for averted premature deaths.
2. Opportunity cost of time, for both adults and children.
3. Gains in time (minutes) for improved WSS services.
4. Unit costs of WSS services, covering investment and recurrent costs.

Table 8. Alternative values used in one-way sensitivity analysis

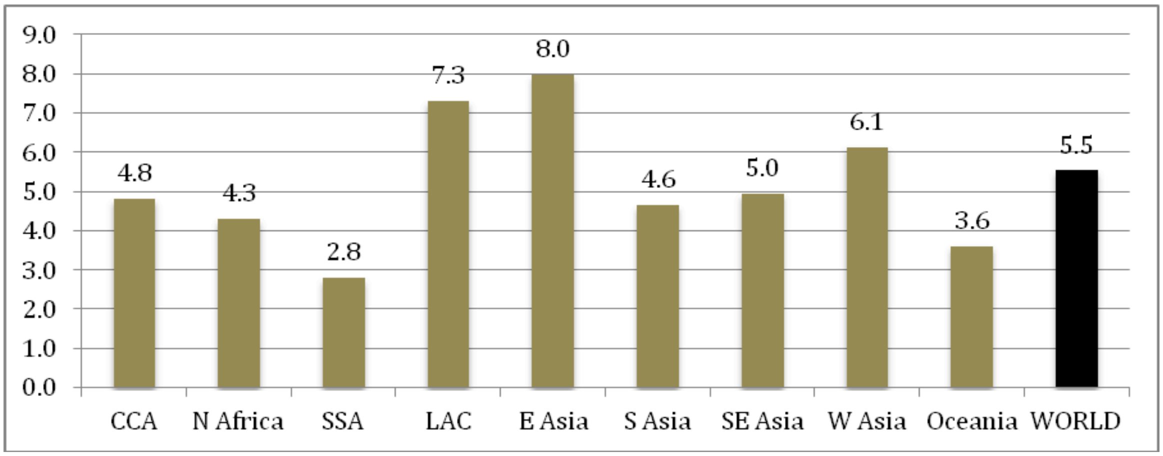
Variable	Detail	Assumption for yielding less favourable BCR	Baseline	Assumption for yielding more favourable BCR
Value of life	All population	Half baseline	Human capital approach	Value-of-statistical life approach
Value of time	Adults	15% of GDP per capita	30% of GDP per capita	100% of GDP per capita
	Children	Zero value of time	15% of GDP per capita	50% of GDP per capita
Access time	All population	Half baseline	Best available values from countries	Twice baseline
Unit costs (see Annex B)	All technologies	Low technology option	Baseline technology option	High technology option
Discount rate	Used to calculate present value of future costs and benefits	12%	8%	3%

3. Results

3.1 Benefit-cost ratios

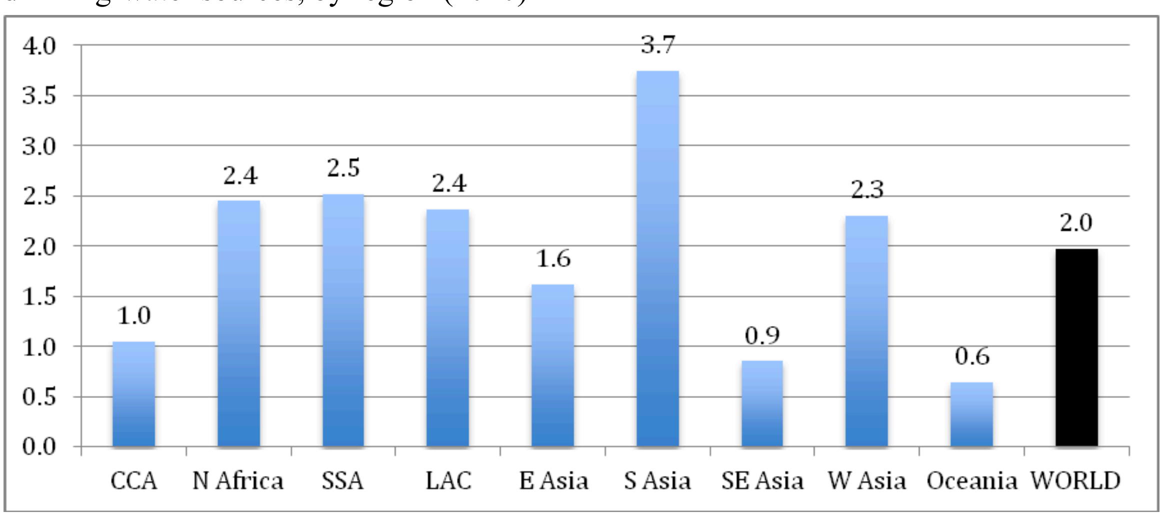
Summary results for attaining universal access to sanitation are shown in Figure 2. Country results are presented in Annex C. The benefit-cost ratio (BCR) for interventions ensuring universal access to sanitation facilities varies from 2.8 in the SSA region to 8.0 in E Asia. The global economic return on sanitation spending is US$ 5.5 per US dollar invested.

Figure 2. Benefit-cost ratios of interventions to attain universal access of improved sanitation, by region (2010)



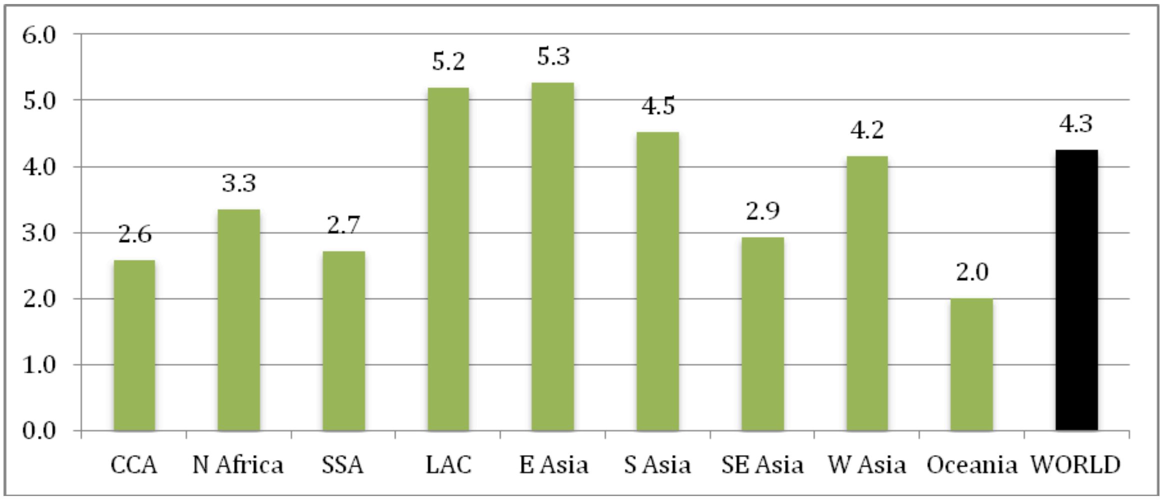
Summary results for attaining universal access to drinking-water are shown in Figure 3. Country results are presented in Annex D. The benefit-cost ratio (BCR) for interventions ensuring universal access to drinking-water varies from 0.6 in Oceania to 3.7 in S Asia. The global economic return on water expenditure is US$ 2.0 per US dollar invested.

Figure 3. Benefit-cost ratios of interventions to attain universal access of improved drinking-water sources, by region (2010)



The benefit-cost ratios were estimated for combined WSS interventions, shown in Figure 4. The BCR varies from 2.0 in Oceania to over 5.0 in the LAC and E Asia regions. The global return on WSS spending to reach universal access is US$4.3 per dollar invested.

Figure 4. Benefit-cost ratios of interventions to attain universal access of improved drinking-water sources and sanitation, by region (2010)



3.2 Economic benefits

The total economic benefits of meeting the six different targets are presented in Figure 5 and Table 9. For the MDG target, the benefits are dominated by sanitation, accounting for US$ 54 billion out of US$ 60 billion of the combined WSS benefits. The three regions for which the benefits are greatest are S Asia, E Asia and SSA. Attaining universal sanitation will more than double the benefits, to US$ 140 billion annually, over and above the benefits from achieving the MDG target. From current coverage, attaining universal WSS access will lead to over US$ 220 billion in benefits annually. Other regions contributing importantly to global benefits for universal access are LAC, SE Asia and W Asia.

Figure 5. Global annual economic value of benefits, by region and intervention (in billions of US$, 2010)

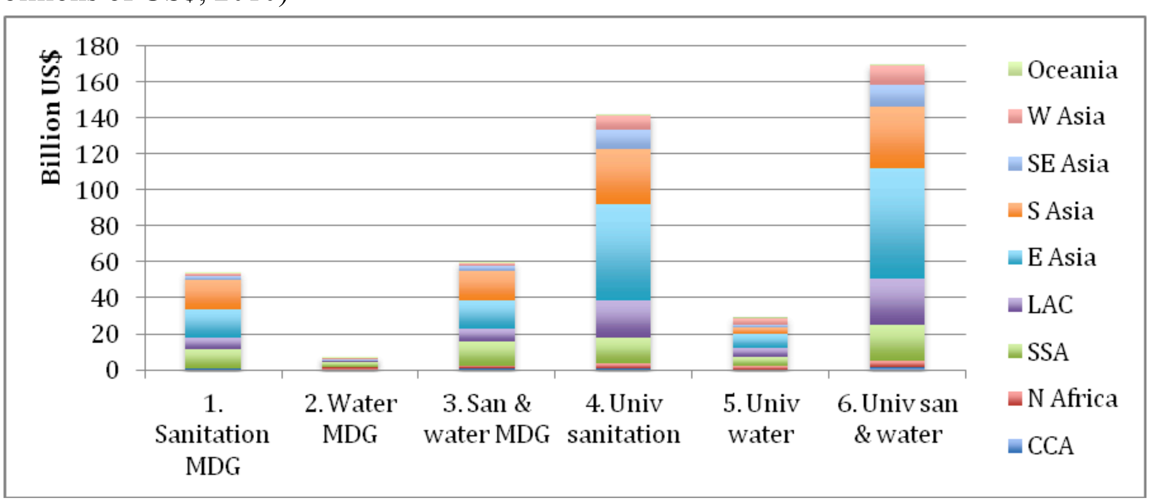


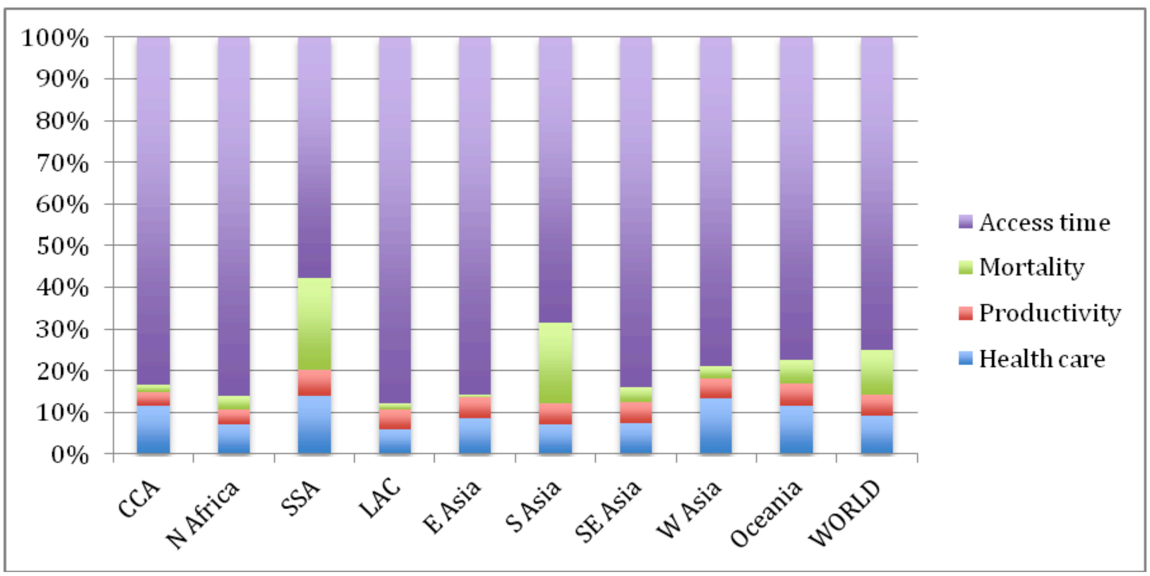
Table 9. Total annual economic value, by region and intervention (in millions of US$)

Region	Intervention					
	Sanitation MDG	Water MDG	WSS MDG	Universal sanitation[1]	Universal water[1]	Universal WSS[1]
CCA	400	100	600	800	300	1,100
N Africa	400	1,000	1,400	2,600	1,600	4,200
SSA	10,600	3,200	13,900	14,400	5,000	19,400
LAC	6,500	500	7,000	20,800	5,000	25,800
E Asia	15,500	0	15,500	53,500	8,000	61,500
S Asia	16,300	200	16,500	30,800	3,700	34,400
SE Asia	2,600	400	3,000	10,600	1,800	12,300
W Asia	1,100	600	1,700	7,700	3,100	10,700
Oceania	90	30	120	150	30	180
All	**53,600**	**6,100**	**59,700**	**141,300**	**28,300**	**169,600**

[1] Reflects value in addition to reaching the MDG target. Totals may not equal exactly sum of components due to rounding.

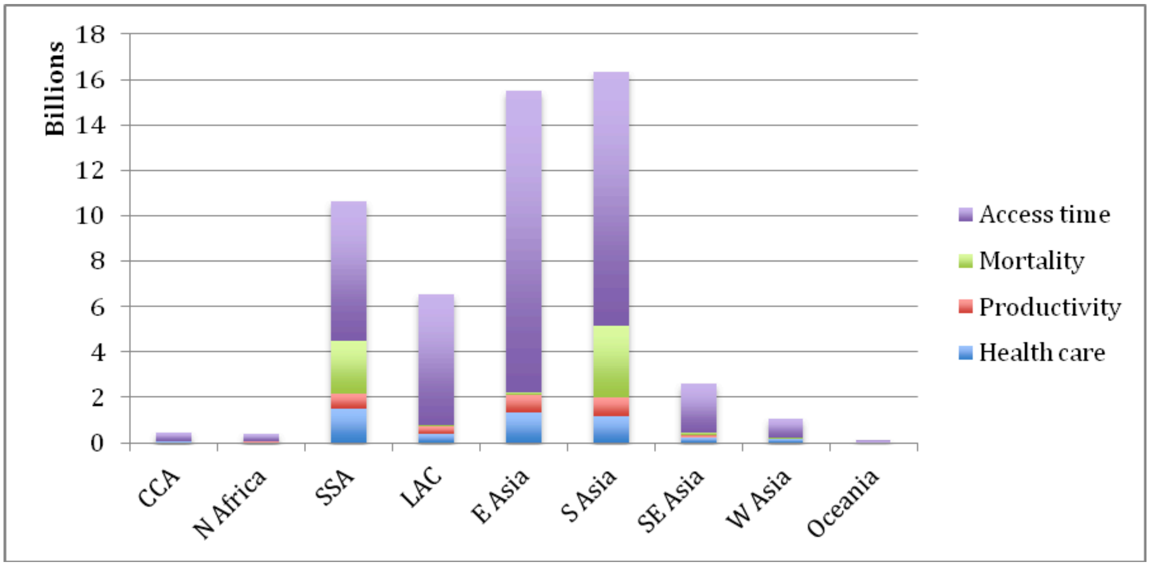
The contribution of each economic benefit to the overall benefit of achieving the MDG sanitation target is shown in Figure 6 (by proportion) and Figure 7 (by value). The value of time savings accounts for more than 70% of total benefits in all regions, and is as high as 80% to 90% of total benefits in most regions. In SSA and S Asia an important contribution is from health benefits, especially the value of saved lives. Health care savings – which tend to be financial in nature – vary across regions between 5% and 13% of total benefits.

Figure 6. Contribution of economic benefits to total benefit in achieving the MDG sanitation target (%)



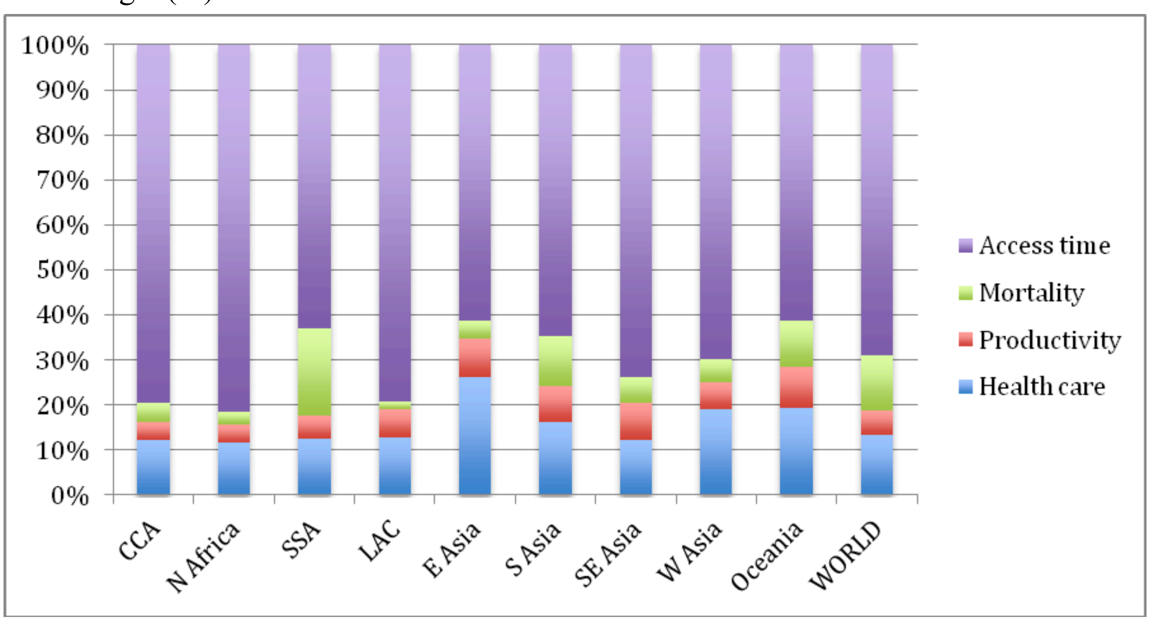
In terms of overall value, the global picture of sanitation benefits is dominated by E Asia and S Asia, with a combined benefit of over US$ 30 billion. SSA contributes an important saving with US$ 10 billion annually.

Figure 7. Value of economic benefits by benefit type in achieving the MDG sanitation target (in billions of US$)



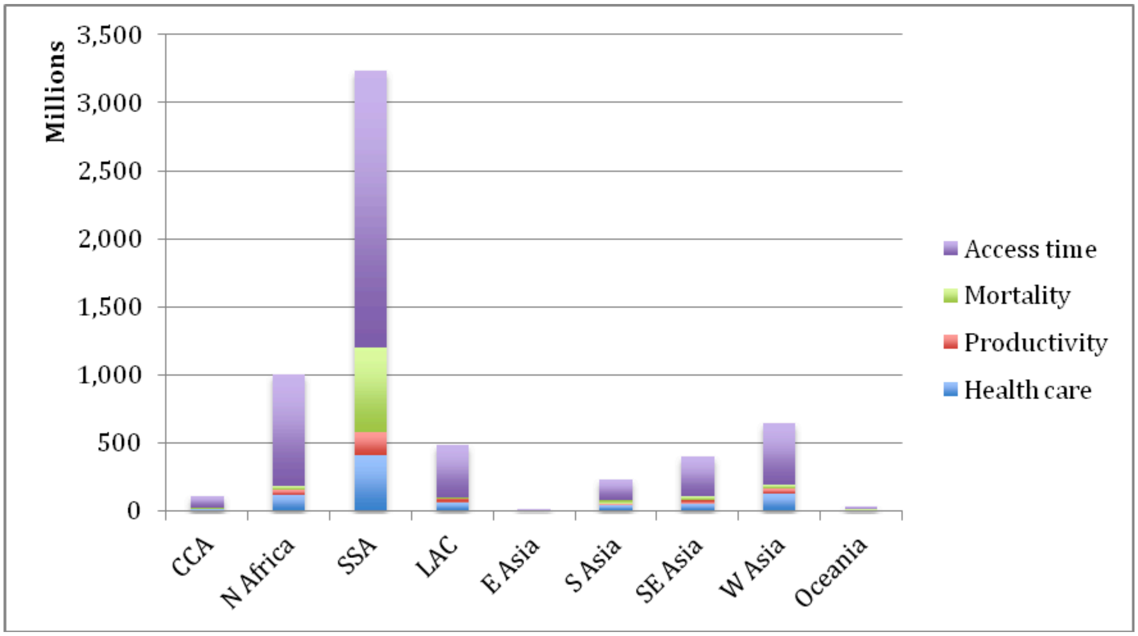
The contribution of each economic benefit to the overall benefit of drinking-water systems and services is shown in Figure 8 (by proportion) and Figure 9 (by value). The value of time savings accounts for almost 70% of total benefits in all regions, and is as high as 80% in the CCA, LAC and N Africa regions. In SSA, S Asia and E Asia the health benefits contribute to at least 35% of the overall benefit. Health care savings account for more than 10% of the total benefit in all regions, rising to as high as 25% in E Asia.

Figure 8. Contribution of economic benefits to total benefit in achieving the water supply MDG target (%)



In terms of overall value, the global picture of water benefits is dominated by those in the SSA region, with a value of over US$ 3.2 billion, followed by N Africa with US$ 1 billion, W Asia with US$ 0.6 billion and LAC with US$ 0.5 billion. The economic benefits in E Asia are negligible because two of the three E Asian countries (China and Republic of Korea) have already met the MDG target for water.

Figure 9. Value of economic benefits by benefit type in achieving the MDG drinking-water target (in billions of US$)



The major share of health care gains is the reduced costs of treating patients in formal health care facilities, shown in Table 10. The estimated global savings for meeting the MDG target are US$ 5.7 billion per year, contributed by SSA with over US$ 1.9 billion, followed by E Asia and S Asia. There will also be costs that are not fully reflected here, such as for patients seeking treatment from informal and traditional health practitioners. The averted health care costs from improved water supply services are a small proportion of the benefits as the MDG target is already met in many countries. The cost savings of attaining universal coverage are estimated to be more than twice that of achieving the MDG target, exceeding US$ 15 billion per year globally for combined WSS services.

Table 10. Annual value of health care gains, by region and intervention (in millions of US$, 2010)

Region	Intervention					
	Sanitation MDG	**Water MDG**	**WSS MDG**	**Universal sanitation[1]**	**Universal water[1]**	**Universal WSS[1]**
CCA	50	10	70	80	40	120
N Africa	30	120	140	240	140	380
SSA	1,500	410	1,910	1,790	850	2,640
LAC	390	60	450	1,390	500	1,890
E Asia	1,350	0	1,350	4,360	800	5,160
S Asia	1,180	40	1,220	2,090	530	2,620
SE Asia	200	50	240	770	240	1,010
W Asia	140	120	270	780	390	1,160
Oceania	10	10	6	16	13	7
All	**4,900**	**800**	**5,700**	**11,500**	**3,500**	**15,000**

[1] Reflects value in addition to reaching the MDG target. Totals may not equal exactly sum of components due to rounding.

The value of averted mortality is shown by region and intervention in Table 11. The annual gains of US$ 6.5 billion from meeting the MDG target and a further US$ 12 billion from attaining universal coverage are largely accounted for by sanitation improvements in the SSA and S Asia regions.

Table 11. Annual value of mortality reductions, by region and intervention (in millions of US$, 2010)

Region	Intervention					
	Sanitation MDG	**Water MDG**	**WSS MDG**	**Universal sanitation[1]**	**Universal water[1]**	**Universal WSS[1]**
CCA	10	0	10	20	10	30
N Africa	10	30	40	70	30	90
SSA	2,320	620	2,950	2,900	1,380	4,280
LAC	90	10	100	240	80	310
E Asia	80	0	80	240	40	290
S Asia	3,160	30	3,180	5,260	1,140	6,400
SE Asia	90	20	110	280	90	370
W Asia	30	30	70	120	50	170
Oceania	10	5	3	8	6	4
All	**5,800**	**750**	**6,500**	**9,100**	**2,800**	**12,000**

[1] Reflects value in addition to reaching the MDG target. Totals may not equal exactly sum of components due to rounding.

The value of productivity gains due to reduced morbidity is shown by region and intervention in Table 12. The annual gains of US$ 3.1 billion from meeting the MDG target and further US$ 8.3 billion from attaining universal coverage are largely accounted for by sanitation improvements in the SSA, S Asia and E Asia regions. For universal coverage, LAC also makes an important contribution.

Table 12. Annual value of health-related productivity, by region and intervention (in millions of US$, 2010)

Region	Intervention					
	Sanitation MDG	Water MDG	WSS MDG	Universal sanitation[1]	Universal water[1]	Universal WSS[1]
CCA	10	0	20	20	10	40
N Africa	10	40	50	110	50	160
SSA	660	170	830	800	370	1,170
LAC	310	30	340	930	290	1,230
E Asia	770	0	770	2,500	460	2,970
S Asia	800	20	820	1,390	320	1,720
SE Asia	130	30	160	490	150	630
W Asia	50	40	90	270	130	410
Oceania	20	5	3	8	7	4
All	**2,760**	**330**	**3,080**	**6,520**	**1,790**	**8,330**

[1] Reflects value in addition to reaching the MDG target. Totals may not equal exactly sum of components due to rounding.

The value of averted access time is shown by region and intervention in Table 13. This benefit has by far the greatest economic value out of the quantified impacts of improved water and sanitation services. Benefits of US$ 44 billion annually accrue from meeting the MDG target and a further benefit of US$ 134 billion from attaining universal access. More than 85% of the total benefit of attaining universal coverage are due to sanitation improvements.

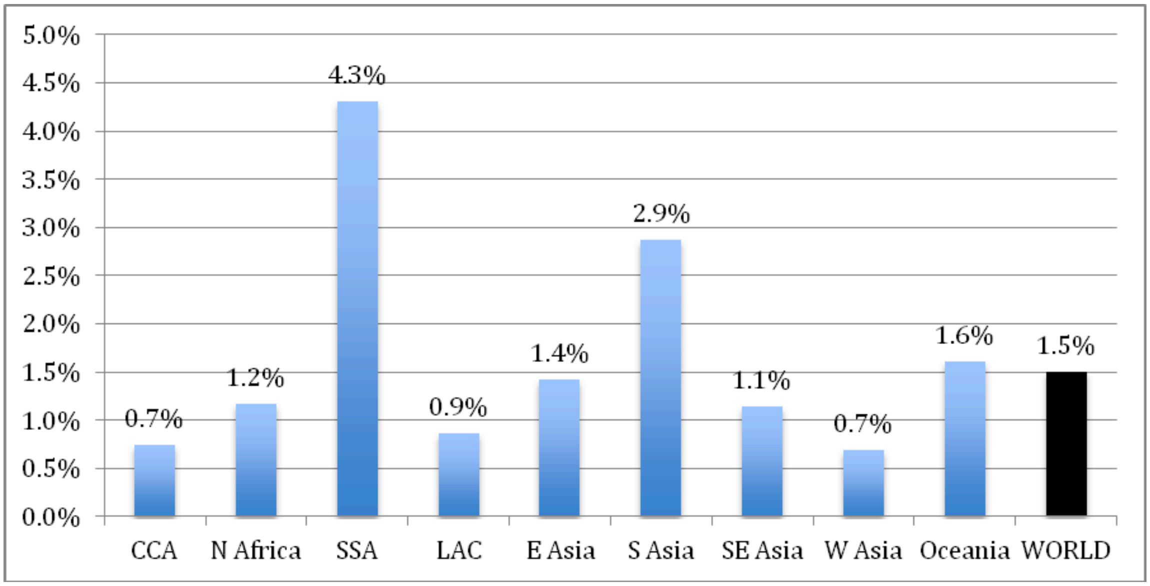
Table 13. Total time value, by region and intervention (in millions of US$, 2010)

Region	Intervention					
	Sanitation MDG	Water MDG	WSS MDG	Universal sanitation[1]	Universal water[1]	Universal WSS[1]
CCA	400	100	500	700	200	900
N Africa	300	800	1,100	2,200	1,400	3,600
SSA	6,100	2,000	8,200	8,900	2,400	11,300
LAC	5,700	400	6,100	18,300	4,100	22,400
E Asia	13,300	0	13,300	46,400	6,700	53,100
S Asia	11,200	100	11,300	22,000	1,700	23,700
SE Asia	2,200	300	2,500	9,000	1,300	10,300
W Asia	800	400	1,300	6,500	2,500	9,000
Oceania	70	20	90	120	20	140
All	**40,070**	**4,120**	**44,390**	**114,120**	**20,320**	**134,440**

[1] Reflects value in addition to reaching the MDG target. Totals may not equal exactly sum of components due to rounding.

The economic benefit calculations are based on underlying economic losses due to inadequate water supply and sanitation. The total economic losses associated with inadequate water supply and sanitation were estimated at US$ 260 billion annually, or 1.5% of Gross Domestic Product of the countries included in this study. Economic losses as a proportion of GDP vary between 0.5% and 4.3% of GDP between regions, the highest impact being in sub-Saharan Africa (Figure 10). Note that these figures include the impacts of inadequate drinking-water supply, hence the figures are not directly comparable with estimates from country-level studies that focus on inadequate sanitation alone [17].

Figure 10. Economic losses associated with inadequate water supply and sanitation by region, as a percentage of Gross Domestic Product



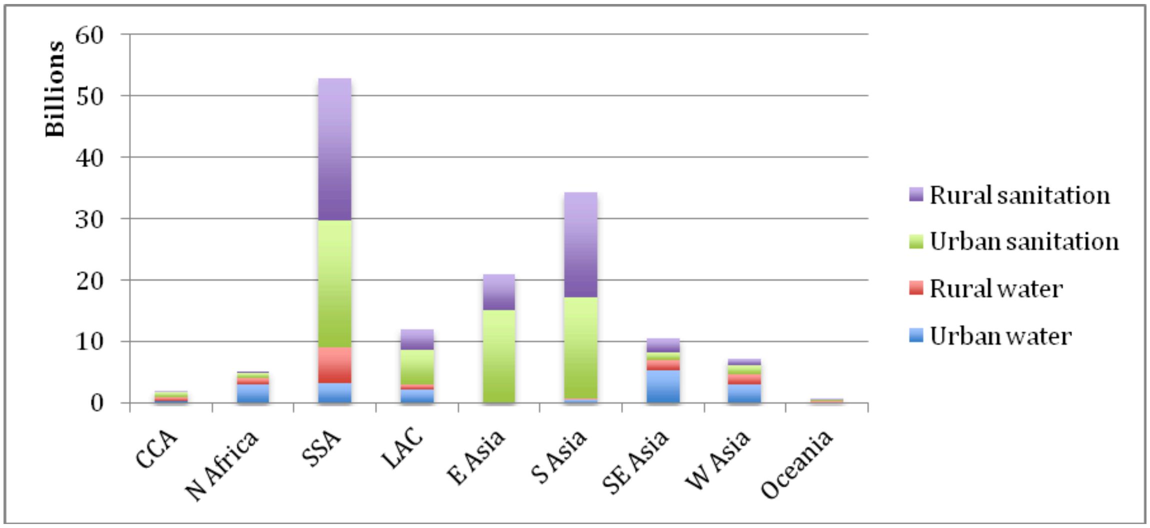
3.3 Costs

3.3.1 Total financial costs of expanding new coverage to achieve WSS targets

Figure 11 and Table 14 show the total financial capital costs of achieving the drinking-water and sanitation MDG target. The sanitation costs are estimated at US$ 115 billion, or US$ 23 billion per year from 2010 to 2015; 54% of these costs are for urban areas, and 46% for rural areas. The majority of global costs are incurred in three regions: SSA, S Asia and E Asia. The drinking-water costs are estimated at US$ 30 billion, or US$ 6 billion per year from 2010 to 2015[12] and 59% of these costs are for urban areas. The regions with the greatest water investment needs are SSA, SE Asia, W Asia, and LAC. In SSA the greatest investment needs for drinking-water are in rural areas, while in other regions urban areas dominate. Looking at drinking-water and sanitation investment needs together, global costs of US$ 145 billion over the period 2010-2015 are dominated by SSA with US$ 53 billion – which represents over one-third of the global investment needs.

[12] Note that for the estimation of benefit-cost ratios, a direct comparison of annual economic benefits should **not** be made with annual financial costs, given that the investment lasts longer than the remaining five-year MDG period 2010-2015. Instead, the benefits are to be compared with annualized financial cost, using a depreciation method taking into account the duration of life of the infrastructure, and adding recurrent costs.

Figure 11. Total financial capital costs to expand coverage to achieve the MDG WSS target, from 2011-2015 in billions of US$)



The investment needs are dominated by capital costs, shown in Table 14[13]. The global recurrent costs, including those incurred by operation and maintenance, are estimated at US$ 13 billion for sanitation and US$ 3 billion for water, over the period 2010-2015. Therefore, US$ 16 billion out of the total WSS costs of US$ 161 billion to meet the MDG target – that is, 10% – are estimated to be for operation and maintenance costs.

Table 14. Total financial capital costs to expand coverage to achieve MDG WSS target, from 2011-2015 (in millions of US$, 2010)

Region	**Water supply**			**Sanitation**		
	Urban	**Rural**	**Total**	**Urban**	**Rural**	**Total**
CCA	294	635	929	769	117	886
N Africa	3,104	1,001	4,105	766	83	849
SSA	3,226	5,762	8,988	20,714	23,083	43,798
LAC	2,256	740	2,996	5,713	3,197	8,910
E Asia	0	19	19	15,140	5,769	20,909
S Asia	422	354	776	16,336	17,299	33,636
SE Asia	5,404	1,609	7,013	1,290	2,164	3,454
W Asia	2,956	1,647	4,603	1,575	997	2,572
Oceania	39	322	361	68	226	294
All	**17,700**	**12,090**	**29,790**	**62,373**	**52,936**	**115,308**

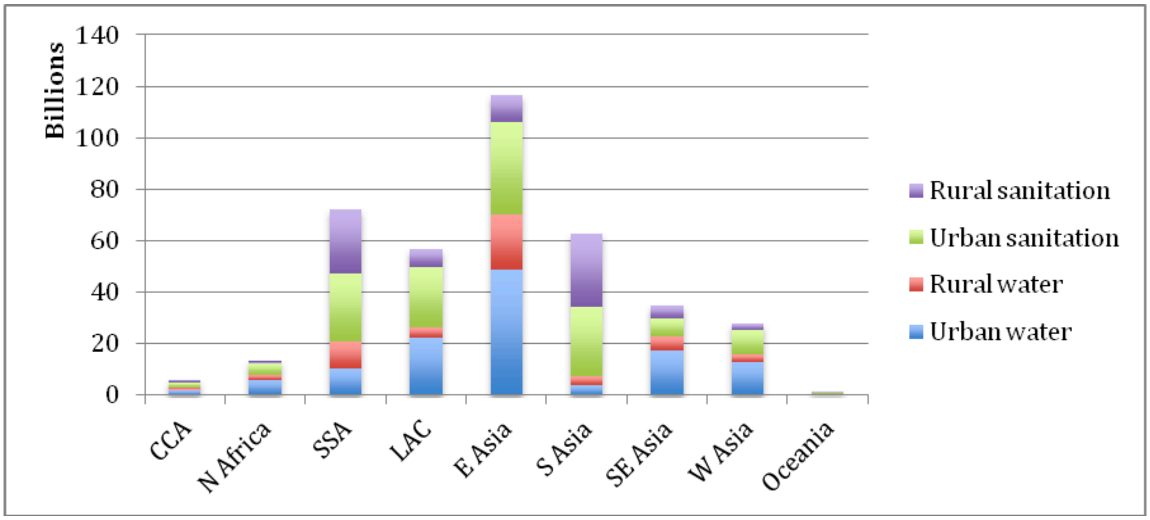
Totals may not equal exactly sum of components due to rounding.

Achieving the MDG target is a stepping-stone in the process of attaining universal coverage. However, attaining the goal of universal coverage will have different time horizons in different countries. In this report the cost estimation of attaining universal coverage ignores the timescale and simply estimates the costs of reaching the unserved

[13] Software costs such as demand raising measures are largely excluded from the unit cost data.

by using current unit costs of water and sanitation services. Recurrent costs are excluded. The incremental (i.e. additional after the achievement of the MDG target) capital costs of attaining universal coverage are presented in Figure 12 and Table 15.

Figure 12. Total financial capital costs to expand coverage to attain universal access of improved drinking-water sources and sanitation (incremental costs after achieving the MDG target), from 2011-2015 (in billions of US$)



Globally, the costs amount to US$ 217 billion for sanitation and US$ 174 billion for drinking-water, over the five-year period 2010-2015. The costs are more equally spread across the regions, based on numbers of population still unserved, with E Asia accounting for almost US$ 120 billion of the global water supply and sanitation investment requirements of almost US$ 400 billion. While globally sanitation capital requirements exceed those of drinking-water, in some regions water capital requirements dominate. Regions with capital investment needs exceeding US$ 40 billion are SSA, S Asia and LAC. SE Asia and W Asia contribute important costs at over US$ 25 billion each. Urban investment needs dominate rural ones across all regions in both water and sanitation.

Table 15. Total financial capital costs to expand coverage to attain universal access of improved drinking-water sources and sanitation (including costs of achieving MDG targets), from 2011-2015 (in millions of US$, 2010)

Region	Water supply			Sanitation		
	Urban	Rural	Total	Urban	Rural	Total
CCA	1,715	1,201	2,915	1,959	716	2,675
N Africa	5,738	2,055	7,793	4,269	1,251	5,520
SSA	10,394	10,248	20,642	26,312	25,114	51,426
LAC	22,489	3,624	26,113	23,432	6,991	30,423
E Asia	48,902	21,327	70,229	35,672	10,838	46,510
S Asia	3,765	3,290	7,055	27,400	28,161	55,561
SE Asia	17,431	5,103	22,534	6,960	5,437	12,397
W Asia	12,790	2,977	15,767	9,435	2,768	12,203
Oceania	124	378	502	114	254	368
All	**123,347**	**50,203**	**173,550**	**135,553**	**81,529**	**217,083**

Table 16 presents the total costs of attaining universal coverage from 2010, the baseline year of the analysis. The figures reflect the sum of Tables 14 and 15. In total, investment requirements are in excess of US$ 535 billion, split US$ 332 billion for sanitation and US$ 203 billion for water. Urban costs dominate rural with US$ 339 billion for urban and US$ 197 billion for rural, for water and sanitation combined.

Table 16. Total financial capital costs to expand coverage to achieve universal access of improved drinking-water sources and sanitation (including costs of achieving MDG targets), from 2011-2015 (in millions of US$, 2010)

Region	Water supply			Sanitation		
	Urban	Rural	Total	Urban	Rural	Total
CCA	2,009	1,836	3,845	2,729	833	3,562
N Africa	8,842	3,057	11,898	5,036	1,333	6,369
SSA	13,620	16,010	29,629	47,026	48,198	95,224
LAC	24,745	4,364	29,109	29,144	10,188	39,332
E Asia	48,902	21,346	70,248	50,812	16,607	67,419
S Asia	4,187	3,644	7,831	43,736	45,460	89,197
SE Asia	22,835	6,712	29,547	8,250	7,602	15,852
W Asia	15,746	4,624	20,370	11,010	3,765	14,775
Oceania	163	700	864	182	480	662
All	**141,049**	**62,293**	**203,341**	**197,925**	**134,466**	**332,392**

Totals may not equal exactly sum of components due to rounding.

3.3.2 Annual financial costs of meeting MDG target – capital versus recurrent

Figure 13 compares annual recurrent costs with annual financial capital costs to meet the MDG target. Recurrent costs make up 12% of total financial costs globally, varying from 7% in SSA to 14% in W Asia. However, maintenance costs are underestimated in these figures, due to their partial omission in the underlying unit cost studies.

Figure 13. Annual financial costs of meeting new coverage needs to achieve the MDG WSS target (capital and recurrent) – water versus sanitation, rural versus urban (in billions of US$)

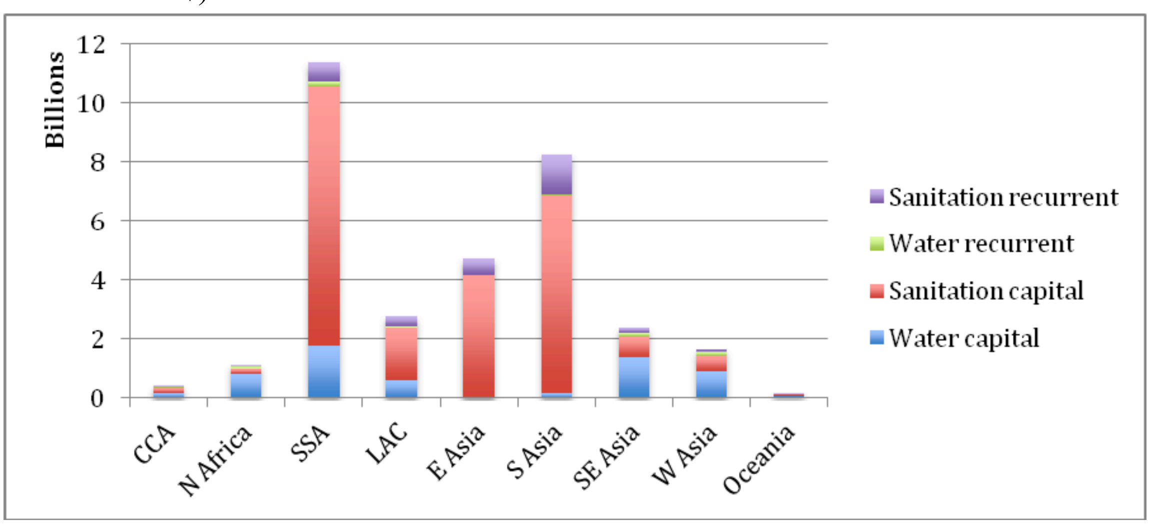


Figure 14 shows the rural/urban split for capital and recurrent costs for sanitation alone. Recurrent costs are as high as 20% of total financial costs in N Africa and SE Asia.

Figure 14. Annual financial costs of meeting new coverage needs to achieve sanitation MDG target – capital versus recurrent, rural versus urban (in billions of US$)

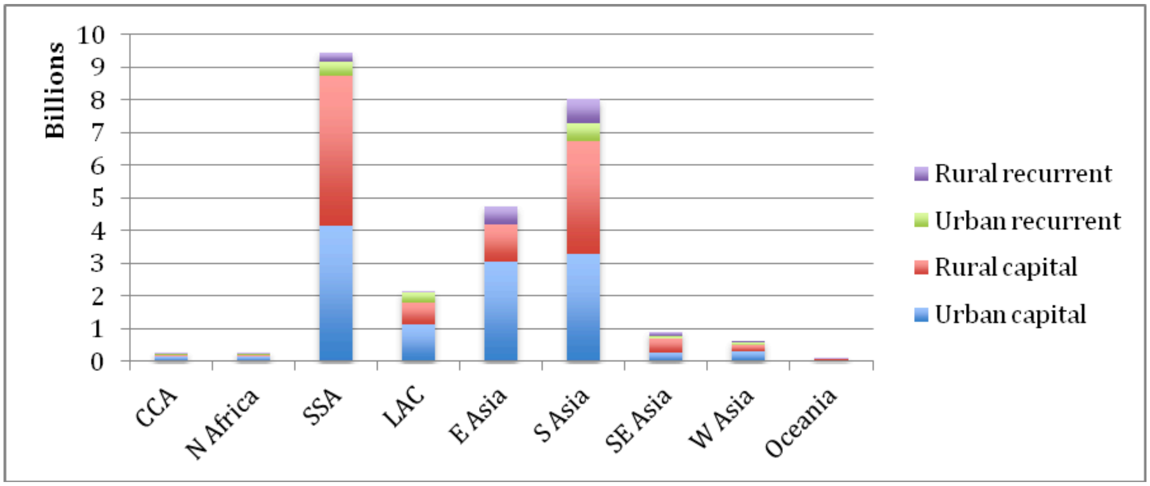
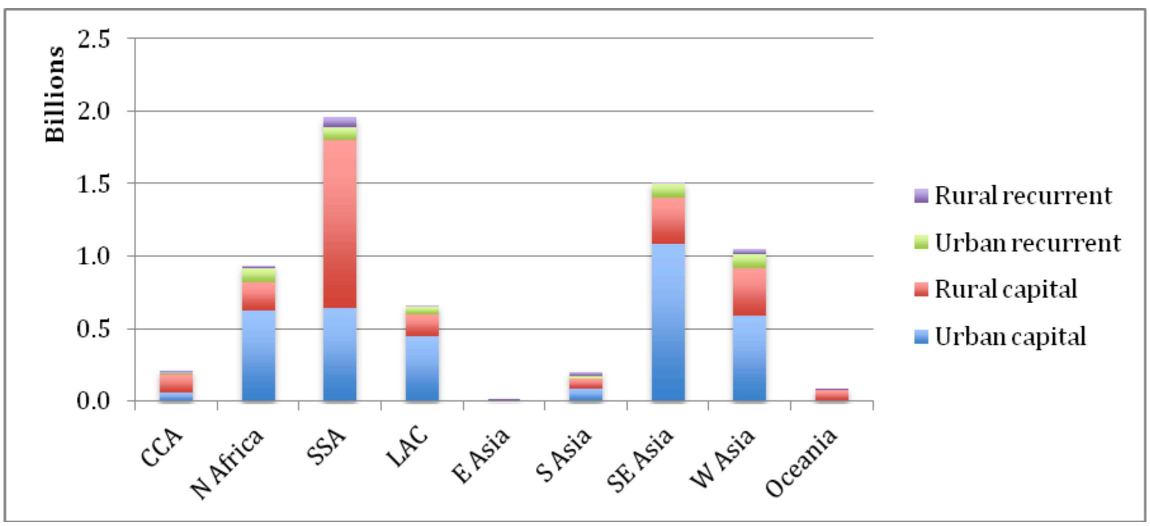


Figure 15 shows the rural/urban split for capital and recurrent costs for water alone. Recurrent costs are as high as 21% of total financial costs in S Asia, with a global average of 10%

Figure 15. Annual financial costs of meeting new coverage needs to achieve water MDG – capital versus recurrent, rural versus urban (in billions of US$)

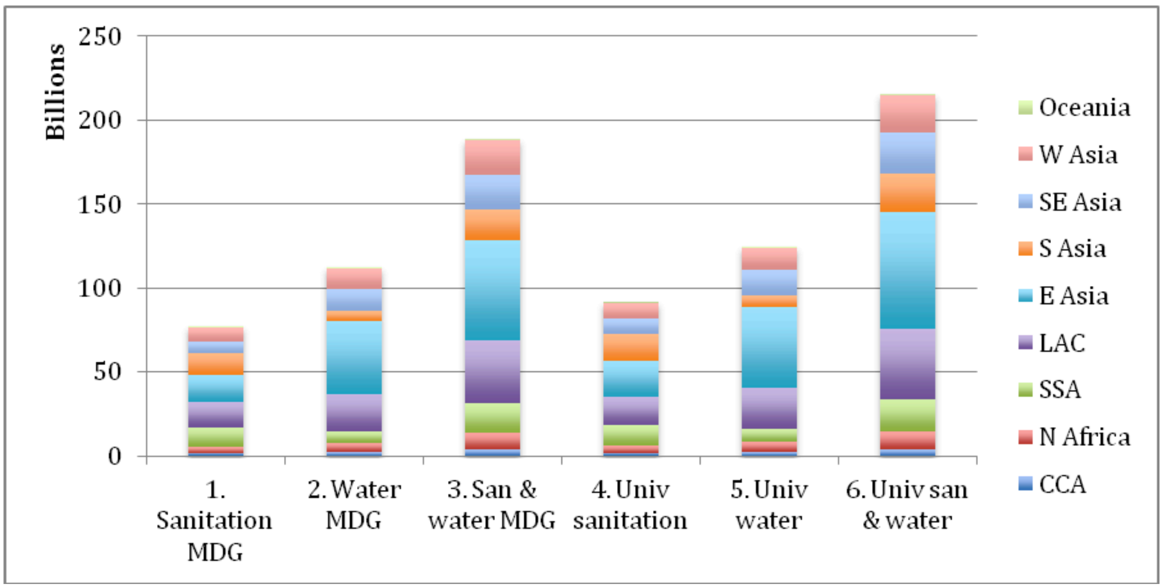


3.3.3 Costs of maintaining existing coverage

Economic costs indicate the value of the average annual investment needed over the lifetime of the technologies being installed. The previous sections presented the investment costs required to boost coverage to meet the MDG target and to attain universal coverage, but these figures reflect capital costs and cover the five-year period remaining for the MDG target. The resulting cost estimates do not take into account the lifespan of the technologies. The financial costs presented earlier in section 3.3 also ignored the required spending to maintain existing coverage, when infrastructure needs to be replaced at the end of its life. Water and sanitation infrastructure need constant renewal to prevent populations from falling back to unimproved coverage, as facilities fall into disrepair.

Figure 16 presents the annual costs, including service extension and maintenance, to meet the MDG target as well as attain universal access. The annual costs of achieving the MDG drinking-water and sanitation target **and** of maintaining existing coverage are estimated at US$ 190 billion per year, or US$ 950 billion over the five years 2010-2015. Further coverage expansion to attain universal coverage is marginally higher at US$ 215 billion per year. Over the same time span as that of the MDG target, the annual cost to attain and maintain universal access is estimated at US$ 400 billion per year, or US$ 2 trillion from 2011 to 2015.

Figure 16. Total annual economic costs by WSS target, including costs of meeting new and maintaining existing coverage (in billions of US$)[1]



[1] Final three columns show MDG plus universal coverage

Figure 17 and Figure 18 show the costs of financing new coverage versus maintaining existing coverage for sanitation and water supply, respectively. The majority of financing needs to be raised for maintaining and replacing existing infrastructure, especially in the case of drinking-water supply.

Figure 17. Total economic costs of achieving sanitation MDG target: costs of meeting new coverage versus costs of maintaining existing coverage (in billions of US$)

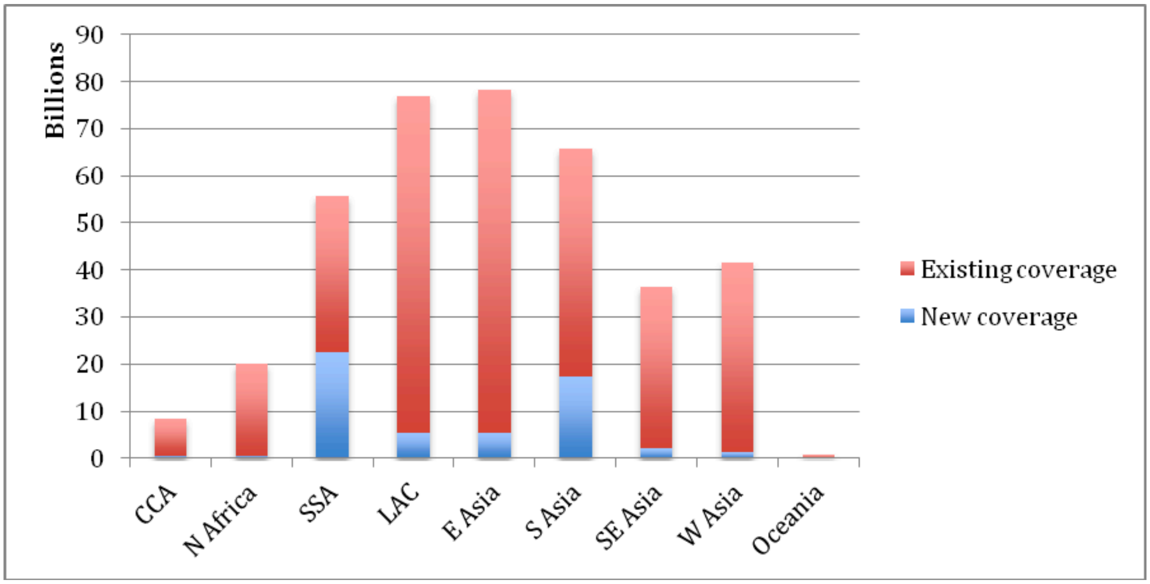
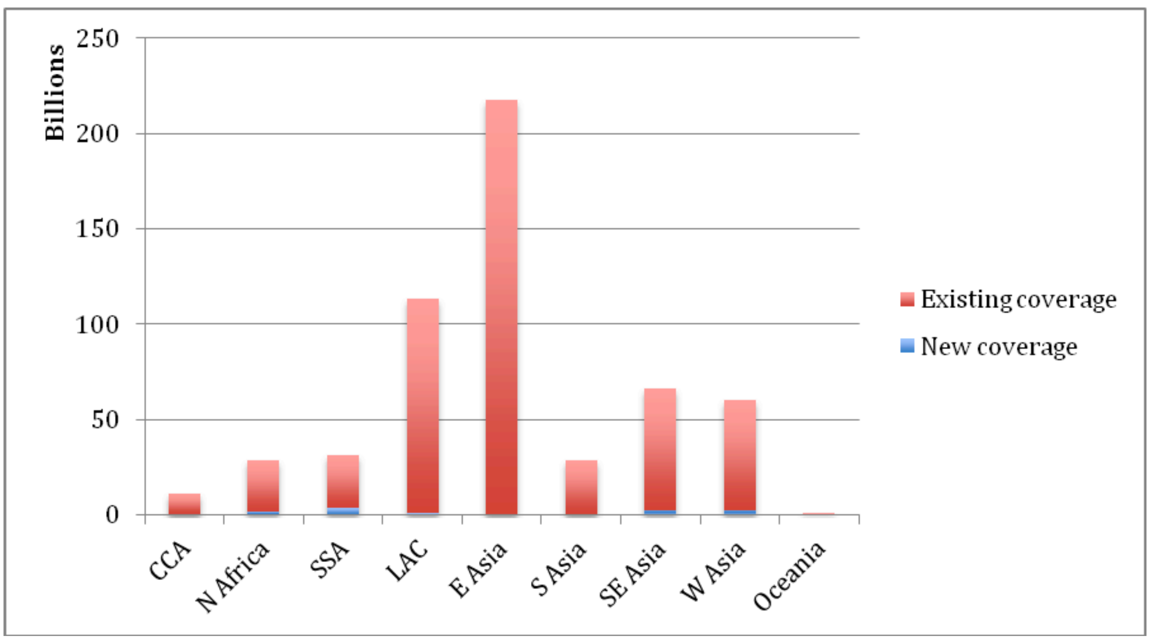


Figure 18. Total economic costs of achieving the MDG drinking-water target: costs of meeting new coverage versus costs of maintaining existing coverage (in billions of US$)

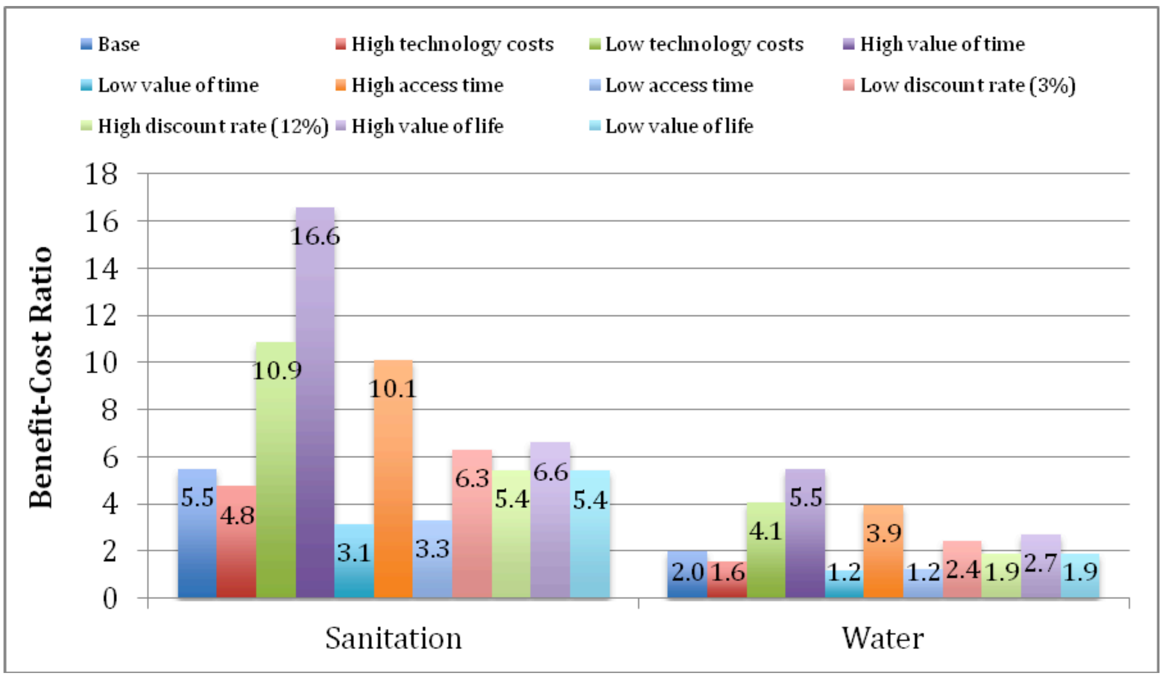


The results of this analysis underline the importance of avoiding omission of expenditure requirements on existing infrastructure and services, given that the pricing policies of most utilities in the developing world do not allow for capital costs or depreciation, and hence replacement or major capital maintenance of existing infrastructure is not assured.

3.4 Sensitivity analysis

A global economic analysis of this nature has a number of uncertainties and weaknesses. One-way sensitivity analysis illustrates the sensitivity of the base-case results to key areas of uncertainty. From source studies, there was insufficient information on the distribution of input values over lower to higher values, and on how uncertainties of different parameters may combine with each other. Hence multi-way and probabilistic sensitivity analyses were not performed. For some key variables determining benefit-cost ratios, such as unit costs of WSS facilities and service access time, upper and lower values were taken from the literature or assumed. For other key economic variables, such as time value, mortality value and discount rates, conventional economic approaches were adopted in the base-case analysis. Where robust data were lacking, such as the value of time and the value of avoided premature mortality, the base-case parameter values were selected to be conservative. Alternative methodologies were explored in sensitivity analysis. For some variables, such as mortality and morbidity rates, data available from surveys from most countries were more robust, and hence were not submitted to a sensitivity analysis. Figure 19 presents a summary of the results of the one-way sensitivity analysis at global level. Data tables showing ranges on benefit-cost ratios under optimistic and pessimistic parameter values are provided in Annex E.

Figure 19. Global benefit-cost ratios under high and low parameter values



The sensitivity analysis shows that the results are most sensitive for the approach chosen to value time. When time is valued at 100% of the GDP per capita instead of 30%, the global benefit-cost ratio increases to 16.6 for sanitation and 5.5 for water supply. This variable is important because a large proportion (>80%) of the quantified economic benefits are the opportunity costs of time spent to access WSS services. The BCR results are also sensitive to the unit costs of WSS services, varying between 4.8 and 10.9 for high and low sanitation costs and 1.6 and 4.1 for high and low water supply costs. The value of life has a smaller impact on benefit-cost ratios, from 5.4 to 6.6 and from 1.9 to 2.7 for sanitation and drinking-water respectively. Variations in the discount rate for future costs and benefits from 3% to 12% have an even smaller impact. In no cases does the uncertainty in a single parameter lead to a BCR of below 1, at which point the intervention would fall below the return to make it economically viable. However, given the benefits omitted, it is unlikely – even under pessimistic values for several parameters simultaneously – that the interventions would become economically unviable.

Figure 20 further explores the impact of using a different methodology for valuing premature death. The human capital approach is considered to be a conservative approach for valuing life, and many governments use the value of statistical life as a better reflection of the value of life. The higher economic benefits of using VSL compared to human capital approach are shown, with major impacts especially for SSA and S Asia where the majority of lives are saved from meeting the water and sanitation MDG target. In SSA, for example, the value of averted deaths increased from US$ 2.3 billion to US$ 11.3 billion per year. Table 17 shows the impact of using VSL on the benefit-cost ratio by region. Globally, the benefit-cost ratios increased to 6.6 for sanitation and 2.7 for water.

Figure 20. Comparison of value of lives saved using two methods for achieving the MDG sanitation target

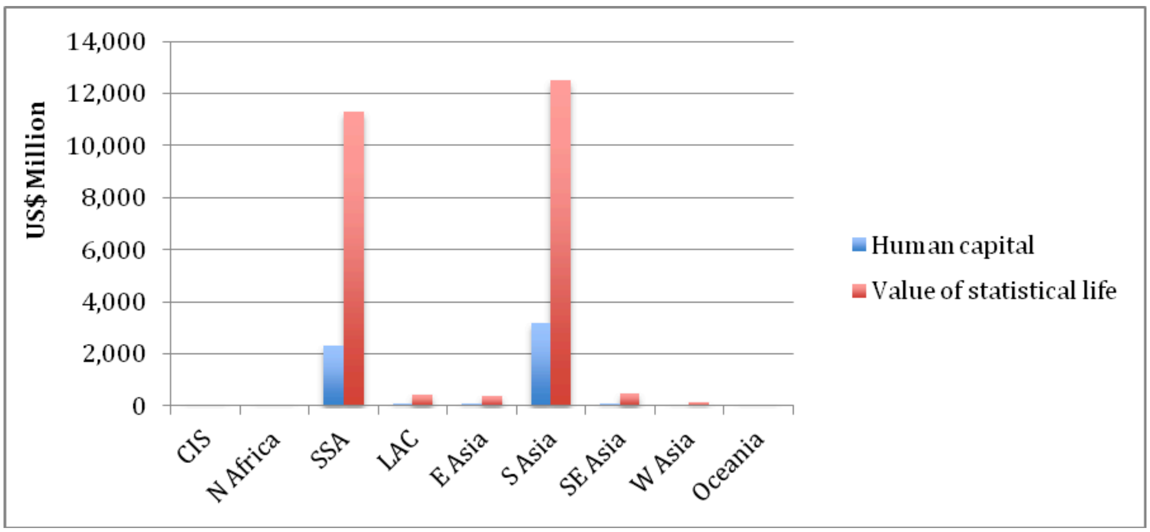


Table 17. Benefit-cost ratios using value-of-a-statistical life for avoided premature death

Region	**Universal coverage**		
	Sanitation	**Water**	**WSS**
CCA	5.2	1.2	2.9
N Africa	4.7	2.6	3.6
SSA	4.8	5.2	4.9
LAC	7.5	2.5	5.4
E Asia	8.1	1.7	5.3
S Asia	6.7	7.4	6.8
SE Asia	5.4	1.0	3.2
W Asia	6.5	2.5	4.4
Oceania	4.2	1.0	2.5
All	**6.6**	**2.7**	**5.2**

4. Conclusions and recommendations

This study on the global costs and benefits of options for progress in access to drinking-water and sanitation has led to the following conclusions:

1. Improved methodology and new datasets give more precise estimates of costs and cost-benefits. This study provides new estimates of the costs and economic returns on basic water supply and sanitation interventions. A similar methodology to the previously published economic studies of the World Health Organization has been applied, updated with more recent data for several key parameters of the model, as well as expanded to include additional health benefits. Furthermore, as well as regional and global averages, this present study provided country level results, thus increasing its utility for national advocacy, resource leveraging and decision making efforts.

2. The economic returns of water supply and sanitation services are more conservative than those observed in previous studies. From using updated data inputs and a fine-tuned methodology, the results are different from those of previous global economic studies. Globally, the benefit-cost ratio for water has declined from 4.4 in the original study to 2.0 in the new study, and from 9.1 to 5.5 for sanitation [4]. This has occurred chiefly because of the higher investment cost estimates in this new study, and the more complete inclusion of operation and maintenance costs; in addition, the assumption for the economic value of time – at 30% of the GDP per capita – is more conservative than that used in previous analyses. Therefore, these new values – 2.0 for water supply and 5.5 for sanitation – are based on more conservative estimates of some model parameters, and are hence more likely to be bare minimum estimates of economic rates of return. Hence, advocacy messages can confidently state that economic returns are at least two-fold for investments in drinking-water supply and at least five-fold for investments in sanitation.

3. With returns shown in this study, economic arguments remain highly relevant to help the majority of low- and middle-income countries further expand WSS coverage. Many countries have not yet met the MDG target – neither the drinking-water nor the sanitation components of the target [1]. Many countries are on course to meet both sub-components of the target, mainly in the LAC, N Africa, SE Asia and E Asia regions. Some countries are on track to meet the drinking-water component of the target but not its sanitation component, such as countries in S Asia. Other countries, mainly in SSA and some in Central Asia (CCA), are unlikely to meet either component at current rates of progress. Only a small number of countries in the MDG developing regions have achieved universal coverage of both WSS services, mainly small island states. In other countries where there is close to universal access there are still some pockets of populations without access, such as slum areas, ethnic groups and migrant populations. For all countries therefore, economic arguments can continue to be used in support of greater resource allocations and strengthened WASH policies. This study has further underlined and confirmed that drinking-water supply and sanitation continue to be economically viable.

4. Due to insufficient progress towards the MDG target, annual financing requirements for water and sanitation have increased over time. An equally crucial component of the cost-benefit analysis is the estimation of global and regional costs of meeting the MDG target and attaining universal access. While the water component of the global MDG target was achieved in 2010, a country-by-country analysis of the target indicates significant investments are still needed in expanding access to drinking-water to meet the MDG target in a large number of countries. A previous global cost study estimated the total costs of extending coverage to meet the MDG target to be US$ 184 billion, or US$ 18 billion per year from 2005 to 2015. This previous estimate compares with US$ 145 billion capital cost plus US$ 16 billion recurrent cost, to be achieved in the period 2010-2015, or US$ 160 billion total. Hence in total value terms, the global price tag has reduced over the intervening period 2005 to 2010. However, in annual terms, the amount has increased, from US$ 18 billion to US$ 32 billion per year. This increase is partly due to the slow progress, especially in sanitation; it is also due to the higher unit costs used in the present study. On the other hand, the cost estimates for many countries may still be conservative (i.e. low) values: recurrent costs are not fully inclusive of all the costs necessary for regulated water supply and wastewater systems, including capital maintenance. Also, for those countries with growing populations, the costs of new facilities required each year for the population increments have not been fully included[14]. For community water sources, it means greater pressure on these sources, and eventually – as pressure becomes too great – investment is required in new infrastructure. For new dwellings with piped water and sanitation facility, it means higher housing prices paid for by the house owners. Furthermore, in the coming decades it will become increasingly important to invest in more climate-resilient WSS systems, hence further increasing the investment and recurrent costs of water supply and sanitation.

5. Targeting additional finances on the unserved populations risks the loss of services to the existing served populations. While it should be a priority of governments and service providers to extend coverage to unserved populations, there is a very real risk that funds are diverted away from the operation, maintenance and replacement of existing infrastructure. To understand the financing needs for this component, the present study estimated the costs of keeping those populations covered – i.e. to prevent them from slipping back to unimproved categories of service. The study shows that the costs to keep these populations served will exceed the costs of new coverage to meet the MDG target by 50 times for drinking-water supply and by six times for sanitation. The fact that these services exist and are demanded will ensure the majority will continue to be financed, although financing may be inadequate for full functioning and sustainability. On the other hand, it will be important to identify those services that do not have sustainable financing guaranteed, to propose alternative financing mechanisms or to argue for targeting of subsidies to those services.

6. Financing from current sources needs to be further increased, and new financing sources explored. Knowing the global price tag is only the first step. Next is how that

[14] The assumption was made that population increments are covered with WSS services according to current coverage levels.

price is to be paid for. No agency currently compiles comprehensive financing data at the global level, including funds from donors, governments, private sector, NGOs and households. In particular total spending data by households, arguably the most important financing source, is not compiled at global level due to incomplete underlying data sources. Some agencies such as OECD compile commitments and spending of donor agencies on an annual basis. More recently, the WHO Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS), which draws on the OECD database and its own surveys, estimated that in 2009 external support agencies contributed US$ 8.9 billion to drinking water and sanitation. However, the report also finds that the majority of these funds are spent either in countries that are not in greatest need (i.e. middle-income countries that are on-track to meet the MDG target), or not on basic systems. Hence, comparing current external agency spending with the annual costs of meeting the MDG target and sustaining the current served population – of US$ 200 billion annually – is a multiple of more than 20 times the aid budget. Hence, given that aid money is unlikely to increase significantly in the next five years, clearly governments and households will have to meet a large proportion of the funding gap. The exploitation of alternative financing sources to fill this gap, such as private equity markets, impact investing funds (e.g. social impact bonds) and pension funds, can be supported by the evidence on economic returns presented in this report.

7. Focus should be on meeting the MDG target in all countries, while universal access is achievable in the longer-term with the prospects of continuing economic growth and increased demand for WSS services. Considering the massive financing needs just to meet the MDG target, it is perhaps premature to start talking about universal drinking-water and sanitation coverage as a global policy target. Clearly there has to be a longer time horizon for attaining universal access. An additional US$ 390 billion are required to meet the capital costs of the unserved getting access to drinking-water and sanitation. On the short term, arriving at this funding volume is not feasible, nor would recipient countries be able to absorb this level of capital influx. However, over 20 or 30 years, universal access may be feasible with progressive coverage increases supported by economic growth, a growing tax base for the poorest countries and successful advocacy. Over 20 years for example, it requires US$ 20 billion annually to extend coverage. However, this does not take into consideration further population growth, price increases above the average rate of inflation, and the expectations of populations for 'higher' levels of service than those assumed in the baseline assessment of this present cost study.

8. Economic research on WSS should be conducted in all countries to better support local decision making processes, with evidence compiled and shared internationally. A global study with disaggregation at country level will be imprecise, unless considerably more resources are put into collecting more detailed input data for each and every country. However, a global study such as this one can be used to motivate countries to generate their own estimates of economic return and financial cost of increasing investments in water supply and sanitation. National studies should be conducted within the context of national policy processes, demanded by – even contracted by – the users of the information, to ensure that the studies generate policy-relevant information. Clearly large research gaps remain at global as well as national levels, including, among others:

- The economic values associated with health gains needs further work at country level. In the past five years, more economic work at country level has provided valuable insights into costs and determinants of economic efficiency, such as the IRC WASHCost project and the WSP Economics of Sanitation Initiative. However, such data collection, compilation and analysis exercises should become more common in countries, to provide essential evidence for decision makers and make them more aware of how economic information can be utilized to improve sector spending efficiency.

A large number of economic benefits remain to be explored, as detailed in Table 4:

- Some benefits are highly setting-specific and are therefore not amenable to a global analysis. Important benefits to further explore and quantify include reuse and energy benefits obtainable from sanitation; intangible benefits such as private and social benefits; and environmental benefits of averted pollution due to improved sanitation and wastewater management.
- Health impacts of different sub-types of water supply and sanitation technology and services, and coverage levels achieved. For example, what additional health gains can a community receive that has become open-defecation free, compared to one that has high but incomplete coverage of latrines? What are the health improvements associated with shared latrines, compared to private latrines? What are the additional downstream health gains associated with sewerage and wastewater management?
- Moving beyond economics as a modeling exercise with theoretical economic returns, but linking economic returns to programmatic performance. Recent research has shown that the performance of sanitation programmes can differ significantly. In many instances, a proportion of the target population is not reached with a service (e.g. some households do not connect to a sewerage system) and hence the costs per household reached are higher than the planned costs. Also, behavior of communities may be changed in the short-term but may not be sustained, if behaviour change activities and supply chain strengthening components are withdrawn too early. Hence, not all the expected benefits accrue, and further activities must be planned to increase effectiveness and sustainability.

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Annex A. Countries included in the study, by region

MDG Region	Country
Caucasus and Central Asia[1]	Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
North Africa	Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Tunisia
Sub-Saharan Africa	Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte D'Ivoire, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe
Latin America and the Caribbean	Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Suriname, Trinidad and Tobago, Uruguay, Venezuela
Eastern Asia	China, Mongolia, Republic of Korea
Southern Asia	Afghanistan, Bangladesh, Bhutan, India, Iran (Islamic Republic of), Maldives, Nepal, Pakistan, Sri Lanka
South-eastern Asia	Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Viet Nam
Western Asia	Iraq, Jordan, Kuwait, Lebanon, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Turkey, United Arab Emirates, Yemen
Oceania	Fiji, French Polynesia, Guam, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu

[1] Formerly CIS – Commonwealth of Independent States; the Russian Federation, Belarus and Ukraine have joined the group of developed countries.

Annex B. Unit Cost Data

Values in US$, 2010. HC – house connection; ST – septic tank; SEW – sewerage connection.

Country	Region	Water Supply								Sanitation							
		Annual Capital Cost				Annual Recurrent Cost				Annual Capital Cost				Annual Recurrent Cost			
		Rural		Urban		Rural		Urban		Rural		Urban		Rural		Urban	
		HC	Well	HC	Well	HC	Well	HC	Well	ST	Pit	SEW	ST	ST	Pit	SEW	ST
Armenia	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Azerbaijan	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Georgia	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Kazakhstan	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Kyrgyzstan	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Rep. of Moldova	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Tajikistan	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Turkmenistan	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Uzbekistan	1	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Algeria	2	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Egypt	2	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	11.8	18.8	19.1	6.0	1.2	16.1	16.1
Libyan Arab Jam.	2	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Morocco	2	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Tunisia	2	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Angola	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	12.1	4.3	13.3	12.1	1.8	0.4	4.6	1.8
Benin	3	15.1	6.7	6.5	2.3	5.1	0.7	1.3	0.5	16.5	10.0	18.6	16.5	2.5	1.0	6.5	2.5
Botswana	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	12.1	4.3	13.3	12.1	1.8	0.4	4.6	1.8
Burkina Faso	3	13.5	3.2	5.0	2.3	5.1	0.5	5.1	0.5	26.0	5.7	15.3	26.0	6.6	0.5	5.4	6.6
Burundi	3	4.2	3.4	12.6	2.3	1.7	0.3	1.6	0.5	10.1	4.6	20.4	10.1	1.5	0.8	7.1	1.5
Cameroon	3	4.5	5.0	2.7	5.0	1.8	0.5	1.1	0.5	4.0	5.7	5.1	4.0	3.4	1.9	6.5	3.4
Cape Verde	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	12.1	4.3	13.3	12.1	1.8	0.4	4.6	1.8
Cent African Rep.	3	8.4	5.9	11.2	5.9	3.4	0.6	4.5	0.6	5.2	4.7	15.3	5.2	0.8	0.5	5.4	0.8
Chad	3	12.8	5.2	10.2	7.0	5.1	0.5	4.1	0.7	33.6	14.2	26.5	33.6	5.0	1.4	9.3	5.0
Comoros	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	12.1	4.3	13.3	12.1	1.8	0.4	4.6	1.8
Congo	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	18.3	7.8	13.3	18.3	2.8	0.8	4.6	2.8
Côte d'Ivoire	3	13.3	10.8	15.3	2.3	5.3	1.1	6.1	0.5	6.7	7.1	15.3	6.7	1.0	0.7	5.4	1.0
Dem. Rep. Congo	3	5.1	3.4	7.7	2.3	2.0	0.3	3.1	0.5	18.3	7.8	13.3	18.3	2.8	0.8	4.6	2.8
Djibouti	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	12.1	4.3	13.3	12.1	1.8	0.4	4.6	1.8
Equat. Guinea	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	24.9	9.6	24.1	22.9	3.4	1.0	6.5	3.4
Eritrea	3	9.2	5.5	9.2	2.3	3.7	0.5	3.7	0.5	24.9	4.2	24.1	4.0	3.4	0.4	6.5	3.4
Ethiopia	3	9.2	5.5	9.2	2.3	3.7	0.5	3.7	0.5	24.9	4.2	24.1	4.0	3.4	0.4	6.5	3.4
Gabon	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	24.0	18.8	25.1	24.0	3.4	1.9	6.5	3.4
Gambia	3	2.6	1.7	6.4	2.3	1.0	0.2	2.6	0.5	7.2	2.8	6.3	7.2	1.1	0.3	2.2	1.1
Ghana	3	13.5	1.6	6.5	2.3	5.1	0.2	1.3	0.5	16.5	9.5	18.6	22.9	2.5	1.0	6.5	3.4
Guinea	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	4.0	9.6	5.1	4.0	3.4	1.0	6.5	3.4
Guinea-Bissau	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	4.0	6.0	5.1	4.0	3.4	0.6	6.5	3.4
Kenya	3	3.6	2.7	13.8	2.3	1.4	0.3	5.5	0.5	14.9	7.1	18.6	22.9	6.3	1.9	6.3	6.3
Lesotho	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	0.5	10.1	8.5	15.3	10.1	1.5	0.9	5.4	1.5
Liberia	3	5.5	5.3	11.3	2.3	2.2	0.5	4.5	0.5	4.0	5.7	5.1	4.0	3.4	1.7	6.5	3.4
Madagascar	3	5.6	0.4	2.4	2.3	2.2	0.3	3.8	0.5	10.1	8.5	15.3	10.1	1.5	0.9	5.4	1.5
Malawi	3	1.8	1.8	6.1	2.3	0.7	0.2	2.4	0.5	6.7	2.3	17.9	6.7	1.0	0.2	6.2	1.0
Mali	3	7.7	5.4	10.2	2.3	3.1	0.5	4.1	0.5	10.1	7.1	25.5	10.1	1.5	0.7	8.9	1.5
Mauritania	3	12.8	10.8	10.2	2.3	5.1	1.1	4.1	0.5	10.1	7.1	25.5	10.1	1.5	0.7	8.9	1.5

Country	Region	Water Supply								Sanitation							
		Annual Capital Cost				Annual Recurrent Cost				Annual Capital Cost				Annual Recurrent Cost			
		Rural		Urban		Rural		Urban		Rural		Urban		Rural		Urban	
		HC	Well	HC	Well	HC	Well	HC	Well	ST	Pit	SEW	ST	ST	Pit	SEW	ST
Mauritius	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	12.1	4.3	13.3	12.1	1.8	0.4	4.6	1.8
Mozambique	3	5.6	0.4	2.4	2.3	2.2	0.3	3.8	0.5	10.1	8.5	15.3	10.1	1.5	0.9	5.4	1.5
Namibia	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	12.1	4.3	13.3	12.1	1.8	0.4	4.6	1.8
Niger	3	7.7	5.4	12.8	2.3	3.1	0.5	5.1	0.5	6.7	7.1	15.3	6.7	1.0	0.7	5.4	1.0
Nigeria	3	7.7	4.2	8.0	2.3	4.2	0.9	3.2	0.5	13.4	12.8	15.3	13.4	2.0	2.3	5.4	2.0
Rwanda	3	6.6	4.0	4.0	2.3	2.7	0.4	1.6	0.5	10.1	7.6	20.4	10.1	1.5	0.8	7.1	1.5
Sao Tome & Prin	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	12.1	4.3	13.3	12.1	1.8	0.4	4.6	1.8
Senegal	3	7.7	5.4	10.2	2.3	3.1	0.5	3.2	0.5	4.0	5.7	5.1	4.0	0.6	0.6	1.8	0.6
Sierra Leone	3	5.5	6.7	6.5	2.3	2.2	0.7	1.3	0.5	10.1	14.2	10.2	10.1	1.5	1.4	3.6	1.5
Somalia	3	9.2	5.5	9.2	2.3	3.7	0.5	3.7	0.5	24.9	4.2	24.1	4.0	3.4	0.4	6.5	3.4
South Africa	3	10.1	6.7	28.9	6.7	4.0	0.7	18.6	0.5	14.9	28.5	26.5	14.9	2.2	2.8	9.3	2.2
Sudan	3	7.7	1.7	10.4	1.7	4.2	0.2	10.2	0.5	33.6	14.2	26.5	33.6	5.0	1.4	9.3	5.0
Swaziland	3	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	10.1	8.5	15.3	10.1	1.5	0.9	5.4	1.5
Togo	3	3.6	4.0	3.8	4.0	1.4	0.4	1.5	0.5	16.5	11.7	18.6	16.5	2.5	1.2	6.5	2.5
Uganda	3	4.6	3.9	10.4	3.9	1.8	0.4	4.1	0.5	6.7	14.2	22.0	6.7	1.0	1.4	7.7	1.0
U. Rep. Tanzania	3	3.1	3.4	20.2	3.4	1.2	0.3	8.1	0.5	6.7	7.1	17.9	6.7	1.0	0.7	6.2	1.0
Zambia	3	11.2	5.2	16.8	7.0	4.5	0.5	6.7	0.7	6.7	10.3	17.9	6.7	1.0	1.0	6.2	1.0
Zimbabwe	3	11.2	3.2	16.8	3.2	4.5	0.3	6.7	0.5	10.1	5.0	7.7	10.1	1.0	1.2	6.2	1.0
Argentina	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Bahamas	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Barbados	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Belize	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Bolivia	4	15.1	12.4	7.6	12.8	6.0	1.2	15.1	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Brazil	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Chile	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Colombia	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Costa Rica	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Cuba	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Dominican Rep.	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Ecuador	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	27.0	18.8	20.1	1.9	2.7	16.1	3.0
El Salvador	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	13.4	18.8	20.1	1.9	1.3	16.1	3.0
French Guiana	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Grenada	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Guadeloupe	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Guatemala	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	5.9	18.8	20.1	1.9	0.6	16.1	3.0
Guyana	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Haiti	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	20.9	18.8	20.1	1.9	2.1	16.1	3.0
Honduras	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.7	18.8	20.1	1.9	1.5	16.1	3.0
Jamaica	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Mexico	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Nicaragua	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	39.7	18.8	20.1	1.9	4.0	16.1	3.0
Panama	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Paraguay	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	13.2	18.8	20.1	1.9	1.3	16.1	3.0
Peru	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	8.9	18.8	20.1	1.9	0.9	16.1	3.0
Saint Lucia	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Suriname	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Trin. & Tobago	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0

Country	Region	Water Supply								Sanitation							
		Annual Capital Cost				Annual Recurrent Cost				Annual Capital Cost				Annual Recurrent Cost			
		Rural		Urban		Rural		Urban		Rural		Urban		Rural		Urban	
		HC	Well	HC	Well	HC	Well	HC	Well	ST	Pit	SEW	ST	ST	Pit	SEW	ST
Uruguay	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
Venezuela	4	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	20.1	14.3	18.8	20.1	1.9	1.4	16.1	3.0
China	5	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	5.9	3.3	7.9	8.1	6.6	3.0	15.2	9.6
Mongolia	5	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	5.9	3.3	7.9	8.1	6.6	3.0	15.2	9.6
Rep. of Korea	5	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	5.9	3.3	7.9	8.1	6.6	3.0	15.2	9.6
Afghanistan	6	2.8	0.8	2.8	0.8	2.9	1.9	2.9	0.1	8.8	8.8	11.1	8.0	0.9	0.9	5.8	3.2
Bangladesh	6	2.8	0.8	2.8	0.8	2.9	1.9	2.9	0.1	4.3	4.3	7.9	8.1	0.4	0.4	15.2	9.6
Bhutan	6	2.8	0.8	2.8	0.8	2.9	1.9	2.9	0.1	3.8	4.5	11.1	8.0	0.6	2.7	5.8	4.8
India	6	2.8	0.8	2.8	0.8	2.9	1.9	2.9	0.1	3.8	4.5	11.1	8.0	0.6	2.7	5.8	4.8
Iran (Islamic Rep)	6	5.6	1.7	5.6	1.7	5.7	3.8	5.7	0.2	8.8	8.8	11.1	8.0	0.9	0.9	5.8	3.2
Maldives	6	2.8	0.8	2.8	0.8	2.9	1.9	2.9	0.1	3.8	4.5	11.1	8.0	0.6	2.7	5.8	4.8
Nepal	6	2.8	7.6	30.2	6.8	2.9	0.8	12.1	1.7	9.4	7.4	7.0	11.5	1.4	0.5	2.4	1.7
Pakistan	6	2.8	0.8	2.8	0.8	2.9	1.9	2.9	0.1	7.3	7.3	11.1	8.0	0.7	0.7	5.8	4.8
Sri Lanka	6	2.8	0.8	2.8	0.8	2.9	1.9	2.9	0.1	8.5	8.5	11.1	8.0	0.9	0.9	5.8	3.2
Cambodia	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	14.1	14.1	6.0	6.1	7.7	1.0	8.5	5.8
Indonesia	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	12.0	5.6	6.0	6.1	7.7	4.3	8.5	5.8
Lao PDR	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	14.1	14.1	6.0	6.1	7.7	1.0	8.5	5.8
Malaysia	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	15.7	18.8	19.1	6.0	1.6	16.1	16.1
Myanmar	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	14.1	14.1	6.0	6.1	7.7	1.0	8.5	5.8
Philippines	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	14.1	4.4	11.1	8.0	8.3	2.0	5.8	3.2
Singapore	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	0.0	0.0	18.8	19.1	0.0	0.0	16.1	16.1
Thailand	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	15.7	18.8	19.1	6.0	1.6	16.1	16.1
Timor-Leste	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	12.0	6.0	6.0	6.1	7.7	0.6	8.5	5.8
Viet Nam	7	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Cyprus	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Iraq	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Israel	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Jordan	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Kuwait	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Lebanon	8	30.1	24.9	57.8	25.6	12.0	2.5	37.1	2.6	23.4	11.6	37.6	38.1	11.9	6.9	32.1	32.1
Occ. Pal. Terr.	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Oman	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Qatar	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Saudi Arabia	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Syrian Arab Rep.	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Turkey	8	30.1	24.9	57.8	25.6	12.0	2.5	37.1	2.6	23.4	11.6	37.6	38.1	11.9	6.9	32.1	32.1
Unit. Arab Emir.	8	90.3	74.6	173.4	76.9	36.1	7.5	111.4	7.7	35.0	17.3	56.3	57.2	17.9	10.3	48.2	48.2
Yemen	8	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Fiji	9	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
French Polynesia	9	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Guam	9	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	32.1	32.1
Papua New Guin.	9	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Samoa	9	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Solomon Islands	9	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1
Tonga	9	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	23.4	11.6	37.6	38.1	11.9	6.9	32.1	32.1
Vanuatu	9	15.1	12.4	28.9	12.8	6.0	1.2	18.6	1.3	11.7	5.8	18.8	19.1	6.0	3.4	16.1	16.1

Annex C. Sanitation – country results

Country	MDG Region	Coverage (2010)		Population to cover		Total financial capital costs:		Benefit-cost ratio
		Rural	Urban	MDG	Universal	MDG	Universal	
		%		Thousand people		Million US$, 2010		
Armenia	1	80%	95%	124	248	25	49	4.26
Azerbaijan	1	39%	51%	2,516	2,866	724	536	8.56
Georgia	1	93%	96%	140	4	26	2	2.11
Kazakhstan	1	98%	97%	131	813	37	285	6.73
Kyrgyzstan	1	93%	94%	195	501	29	99	1.27
Tajikistan	1	94%	95%	32	1,060	9	127	1.52
Turkmenistan	1	97%	99%	54	383	7	104	3.84
Uzbekistan	1	100%	100%	0	1,662	0	376	1.44
Algeria	2	88%	98%	455	4,106	149	1,315	4.84
Egypt	2	93%	97%	0	11,771	0	2,151	3.20
Libyan Arab Jam.	2	96%	97%	115	708	33	232	10.58
Morocco	2	52%	83%	3,141	8,655	638	1,633	4.51
Tunisia	2	68%	96%	247	1,628	29	190	5.98
Angola	3	19%	85%	2,763	7,985	133	732	20.34
Benin	3	5%	25%	4,206	5,206	557	702	2.03
Botswana	3	41%	75%	196	688	21	102	16.31
Burkina Faso	3	7%	55%	6,843	9,434	832	1,059	2.05
Burundi	3	46%	49%	2,394	3,073	135	196	1.23
Cameroon	3	36%	58%	6,019	6,401	407	396	5.44
Cape Verde	3	43%	73%	52	181	16	29	8.09
Cent. African Rep.	3	28%	43%	1,068	2,335	84	222	2.61
Chad	3	6%	30%	5,303	6,363	1,698	1,891	1.38
Comoros	3	30%	50%	177	344	10	23	4.43
Congo	3	15%	20%	1,916	1,628	227	269	5.86
Côte d'Ivoire	3	11%	36%	9,117	10,016	982	1,094	4.59
Dem. Rep. Congo	3	24%	24%	24,514	36,626	3,562	4,676	0.78
Djibouti	3	10%	63%	263	192	32	24	3.16
Equatorial Guinea	3	46%	50%	220	230	32	42	40.49
Eritrea	3	4%	51%	2,501	2,769	164	187	2.20
Ethiopia	3	8%	29%	38,849	47,457	1,859	2,320	2.89
Gabon	3	30%	33%	604	546	56	50	24.44
Gambia	3	65%	70%	226	570	13	33	3.01
Ghana	3	8%	19%	10,736	12,865	1,966	2,388	2.25
Guinea	3	11%	32%	4,296	5,645	395	560	1.58
Guinea-Bissau	3	9%	44%	695	832	40	50	3.88
Kenya	3	33%	34%	13,882	18,975	2,154	2,768	2.11
Lesotho	3	24%	32%	848	776	74	75	2.59
Liberia	3	7%	29%	1,683	2,140	104	119	1.38

Country	MDG Region	Coverage (2010)		Population to cover		Total financial capital costs:		Benefit-cost ratio
		Rural	Urban	MDG	Universal	MDG	Universal	
		%		Thousand people		Million US$, 2010		
Madagascar	3	13%	21%	8,846	10,902	881	973	1.67
Malawi	3	56%	50%	3,035	6,362	103	215	3.90
Mali	3	15%	41%	5,904	5,935	331	530	3.43
Mauritania	3	9%	51%	1,173	1,671	111	185	3.44
Mauritius	3	88%	91%	85	95	8	14	17.75
Mozambique	3	5%	38%	10,330	11,489	946	1,047	1.71
Namibia	3	17%	57%	791	910	144	169	11.33
Niger	3	4%	34%	8,279	9,441	857	995	2.60
Nigeria	3	27%	35%	66,028	60,864	13,539	12,281	2.41
Rwanda	3	56%	52%	840	5,225	114	557	2.09
Sao Tome & Princ.	3	19%	30%	61	76	9	11	3.37
Senegal	3	39%	70%	2,481	5,319	135	297	6.83
Sierra Leone	3	6%	23%	2,755	3,071	344	390	1.17
Somalia	3	6%	52%	4,033	4,525	242	362	2.23
South Africa	3	67%	86%	3,550	8,385	1,351	2,624	7.49
Sudan	3	14%	44%	20,316	15,507	3,710	3,533	2.11
Swaziland	3	55%	64%	200	398	25	43	8.40
Togo	3	3%	26%	3,361	3,364	472	464	1.17
Uganda	3	34%	34%	14,153	14,066	1,349	2,309	1.55
Un Rep of Tanzania	3	7%	20%	26,743	20,669	2,810	3,447	1.32
Zambia	3	43%	57%	3,690	4,927	533	702	3.54
Zimbabwe	3	32%	52%	4,575	4,440	233	272	2.58
Argentina	4	78%	91%	2,427	3,517	729	1,075	8.20
Bahamas	4	100%	100%	0	20	0	8	18.80
Barbados	4	100%	100%	0	8	0	3	12.45
Belize	4	87%	93%	1	61	0	12	5.65
Bolivia	4	10%	35%	3,659	4,523	1,130	1,431	2.15
Brazil	4	44%	85%	15,450	32,099	2,835	9,305	8.93
Chile	4	90%	98%	0	1,284	0	350	8.99
Colombia	4	63%	82%	4,009	9,603	1,712	3,150	5.73
Costa Rica	4	96%	95%	66	466	15	101	8.15
Cuba	4	81%	94%	0	1,008	0	249	6.91
Dominican Rep.	4	75%	87%	518	1,816	97	359	6.94
Ecuador	4	84%	96%	0	1,919	0	439	4.82
El Salvador	4	83%	89%	201	813	52	158	5.12
French Guiana	4	57%	85%	28	52	7	15	21.65
Grenada	4	97%	96%	2	5	0	1	8.49
Guadeloupe	4	60%	95%	10	26	2	7	24.37
Guatemala	4	70%	87%	850	4,104	58	851	5.03
Guyana	4	82%	88%	37	80	9	13	4.69
Haiti	4	10%	24%	5,333	3,899	1,206	849	1.02
Honduras	4	64%	81%	129	2,750	44	637	2.73

Country	MDG Region	Coverage (2010)		Population to cover		Total financial capital costs:		Benefit-cost ratio
		Rural	Urban	MDG	Universal	MDG	Universal	
		%		Thousand people		Million US$, 2010		
Jamaica	4	82%	78%	319	288	49	64	6.04
Mexico	4	79%	87%	0	18,482	0	6,140	9.09
Nicaragua	4	37%	63%	1,278	1,965	441	690	0.96
Panama	4	53%	75%	480	857	117	213	8.95
Paraguay	4	40%	90%	437	2,000	43	309	3.76
Peru	4	37%	81%	2,821	8,165	285	2,622	5.84
Saint Lucia	4	63%	71%	53	16	2	4	7.27
Suriname	4	66%	90%	41	65	11	20	6.76
Trinidad & Tobago	4	92%	92%	62	70	12	18	20.23
Uruguay	4	99%	100%	0	71	0	18	11.09
Venezuela	4	60%	96%	190	3,843	52	1,311	11.77
China	5	50%	75%	134,689	432,132	20,861	46,286	7.92
Mongolia	5	29%	64%	712	816	48	53	4.51
Republic of Korea	5	100%	100%	0	1,089	0	171	23.32
Afghanistan	6	30%	60%	8,545	14,801	748	1,498	2.91
Bangladesh	6	55%	57%	26,693	57,168	1,944	3,279	2.17
Bhutan	6	29%	73%	279	170	8	16	5.91
India	6	23%	58%	336,915	550,150	24,713	38,729	5.11
Iran (Islamic Rep.)	6	100%	100%	0	4,922	943	1,658	9.21
Maldives	6	97%	98%	0	30	0	6	9.08
Nepal	6	27%	48%	8,470	14,831	667	1,329	1.74
Pakistan	6	34%	72%	36,619	80,071	4,595	8,859	3.59
Sri Lanka	6	93%	88%	150	2,190	19	187	6.36
Cambodia	7	20%	73%	3,929	7,599	715	1,218	1.73
Indonesia	7	39%	73%	30,861	80,206	2,333	4,682	6.88
Lao PDR	7	50%	89%	0	2,977	55	362	2.19
Malaysia	7	95%	96%	0	3,415	0	694	6.38
Myanmar	7	73%	83%	0	13,763	0	755	1.13
Philippines	7	69%	79%	5,485	25,440	256	1,919	5.73
Singapore	7	0%	100%	0	222	0	83	31.22
Thailand	7	96%	95%	379	4,377	85	655	4.12
Timor-Leste	7	37%	73%	256	491	10	35	2.00
Viet Nam	7	68%	94%	0	26,434	0	1,993	2.57
Iraq	8	67%	76%	3,135	9,786	966	2,039	3.56
Jordan	8	98%	98%	55	559	18	155	4.27
Kuwait	8	100%	100%	0	327	0	122	48.01
Lebanon	8	87%	100%	35	207	10	143	4.02
Occ. Palestinian T.	8	92%	92%	130	904	78	277	2.30
Oman	8	95%	100%	0	334	37	124	18.44
Qatar	8	100%	100%	0	122	0	45	62.33
Saudi Arabia	8	100%	100%	0	2,687	0	717	13.61
Syrian Arab Rep.	8	93%	96%	139	3,055	52	831	2.83

Country	MDG Region	Coverage (2010)		Population to cover		Total financial capital costs:		Benefit-cost ratio
		Rural	Urban	MDG	Universal	MDG	Universal	
		%		Thousand people		Million US$, 2010		
Turkey	8	75%	97%	2,374	9,213	1,167	5,936	4.61
United Arab Em.	8	95%	98%	68	543	44	408	16.46
Yemen	8	34%	93%	3,441	11,579	200	1,194	2.87
Fiji	9	71%	94%	10	153	9	22	5.90
French Polynesia	9	97%	99%	3	19	0	5	17.37
Guam	9	98%	99%	1	12	0	4	14.44
Papua New Guinea	9	41%	71%	2,183	2,411	265	294	2.98
Samoa	9	98%	98%	0	4	0	1	2.67
Solomon Islands	9	18%	98%	196	226	15	21	3.18
Tonga	9	96%	98%	2	3	0	2	1.32
Vanuatu	9	54%	64%	24	114	4	18	5.00

Annex D. Water – country results

Country	MDG Region	Coverage (2010)		Population to cover		Total financial capital costs:		Benefit-cost ratio
		Rural	Urban	MDG	Universal	MDG	Universal	
		%		Thousand people		Million US$, 2010		
Armenia	1	97%	99%	10	92	17	46	1.1
Azerbaijan	1	71%	88%	456	1,834	180	543	2.0
Georgia	1	96%	100%	0	0	0	0	-
Kazakhstan	1	90%	99%	437	845	91	355	2.4
Kyrgyzstan	1	85%	99%	0	875	0	227	0.4
Tajikistan	1	54%	92%	902	2,325	76	580	0.5
Turkmenistan	1	72%	97%	414	728	94	245	1.4
Uzbekistan	1	81%	98%	2,155	3,042	404	913	0.4
Algeria	2	79%	85%	5,713	2,978	2,826	1,475	2.4
Egypt	2	99%	100%	0	7,787	0	3,136	1.9
Libyan Arab Jam.	2	55%	54%	1,639	1,970	854	1,036	5.8
Morocco	2	61%	98%	2,337	5,443	426	1,768	1.6
Tunisia	2	89%	99%	0	953	0	378	2.1
Angola	3	38%	60%	3,279	8,749	491	2,722	3.9
Benin	3	68%	84%	420	3,344	14	230	1.9
Botswana	3	92%	99%	29	173	13	81	3.2
Burkina Faso	3	74%	96%	0	6,229	0	204	2.4
Burundi	3	71%	83%	1,254	1,999	68	98	0.7
Cameroon	3	52%	95%	1,133	5,646	50	296	3.9
Cape Verde	3	85%	90%	18	79	13	25	2.2
Cent. African Rep.	3	51%	92%	661	1,249	39	77	1.2
Chad	3	44%	70%	2,348	4,883	136	355	2.1
Comoros	3	97%	91%	18	90	9	20	0.7
Congo	3	32%	95%	492	1,059	65	243	2.2
Côte d'Ivoire	3	68%	91%	2,265	4,789	309	925	1.6
Dem. Rep. Congo	3	27%	79%	22,137	24,547	925	1,065	1.0
Djibouti	3	54%	99%	30	99	5	41	0.6
Equatorial Guinea	3	42%	45%	222	259	44	52	14.9
Eritrea	3	61%	77%	445	2,197	28	151	0.7
Ethiopia	3	47%	98%	5,431	43,260	1,105	2,420	0.8
Gabon	3	41%	95%	107	219	25	69	6.0
Gambia	3	85%	92%	6	420	0	23	2.1
Ghana	3	80%	91%	148	5,933	8	262	5.8
Guinea	3	65%	90%	451	3,769	100	624	0.4
Guinea-Bissau	3	53%	91%	197	590	33	98	0.7
Kenya	3	54%	85%	5,404	16,153	367	853	2.8
Lesotho	3	73%	91%	103	443	0	80	0.4
Liberia	3	60%	88%	266	1,231	24	46	1.2
Madagascar	3	32%	76%	4,982	8,748	117	173	3.2

Country	MDG Region	Coverage (2010)		Population to cover		Total financial capital costs:		Benefit-cost ratio
		Rural	Urban	MDG	Universal	MDG	Universal	
		%		Thousand people		Million US$, 2010		
Malawi	3	80%	95%	0	4,979	0	119	2.1
Mali	3	51%	87%	952	5,647	80	399	2.0
Mauritania	3	48%	52%	576	1,485	78	222	1.6
Mauritius	3	99%	100%	4	44	1	22	4.2
Mozambique	3	29%	77%	6,131	8,721	72	135	3.3
Namibia	3	90%	99%	5	341	2	98	2.8
Niger	3	39%	100%	4,185	7,151	236	443	1.3
Nigeria	3	43%	74%	32,602	50,841	1,314	2,120	4.4
Rwanda	3	63%	76%	2,397	2,620	100	105	1.5
Sao Tome & Princ.	3	88%	89%	3	30	1	8	1.0
Senegal	3	56%	93%	1,309	3,974	139	433	2.2
Sierra Leone	3	35%	87%	1,750	1,599	150	86	1.3
Somalia	3	7%	66%	3,894	4,115	246	334	0.9
South Africa	3	79%	99%	741	4,823	90	1,520	4.7
Sudan	3	52%	67%	12,534	9,806	1,445	926	3.1
Swaziland	3	65%	91%	20	406	7	93	2.3
Togo	3	40%	89%	1,148	2,304	45	97	1.6
Uganda	3	68%	95%	510	15,005	34	664	1.7
Un Rep of Tanzania	3	44%	79%	13,455	14,678	762	821	1.4
Zambia	3	46%	87%	1,879	5,063	141	410	1.9
Zimbabwe	3	69%	98%	1,412	2,490	58	350	0.7
Argentina	4	82%	98%	314	2,876	130	1,420	2.5
Bahamas	4	86%	98%	7	26	2	11	7.5
Barbados	4	100%	100%	0	8	0	5	3.9
Belize	4	99%	98%	0	36	0	13	1.4
Bolivia	4	71%	96%	0	2,063	9	414	1.4
Brazil	4	85%	100%	0	11,391	0	6,917	2.5
Chile	4	81%	99%	81	1,221	47	621	3.2
Colombia	4	72%	99%	1,389	5,275	299	2,357	2.1
Costa Rica	4	91%	100%	33	433	5	224	2.3
Cuba	4	89%	96%	43	605	22	216	2.0
Dominican Rep.	4	84%	87%	1,074	987	583	463	1.7
Ecuador	4	89%	96%	0	1,691		630	1.6
El Salvador	4	76%	94%	111	881	5	319	1.6
French Guiana	4	71%	88%	21	46	9	22	7.4
Grenada	4	93%	97%	3	6	1	2	3.6
Guadeloupe	4	93%	98%	5	14	3	8	6.0
Guatemala	4	87%	98%	39	2,897	0	1,090	1.5
Guyana	4	93%	98%	0	35	0	8	1.5
Haiti	4	51%	85%	949	3,095	229	658	0.4
Honduras	4	78%	95%	83	1,731	6	710	1.1
Jamaica	4	88%	98%	90	147	22	61	1.7

Country	MDG Region	Coverage (2010)		Population to cover		Total financial capital costs:		Benefit-cost ratio
		Rural	Urban	MDG	Universal	MDG	Universal	
		%		Thousand people		Million US$, 2010		
Mexico	4	91%	97%	0	9,674	512	4,981	3.0
Nicaragua	4	68%	98%	231	1,073	35	336	0.5
Panama	4	87%	97%	74	385	58	197	2.6
Paraguay	4	66%	99%	0	1,433	0	391	1.1
Peru	4	65%	91%	1,322	5,208	558	2,052	1.9
Saint Lucia	4	95%	98%	6	10	1	4	2.7
Suriname	4	81%	97%	13	46	6	18	2.4
Trinidad & Tobago	4	93%	98%	12	97	0	34	8.6
Uruguay	4	100%	100%	0	71	0	41	2.8
Venezuela	4	75%	94%	904	3,416	455	1,891	3.7
China	5	89%	99%	0	129,966	0	69,414	1.6
Mongolia	5	53%	100%	124	570	19	100	0.6
Republic of Korea	5	88%	100%	0	1,704	0	715	6.5
Afghanistan	6	42%	78%	1,999	17,419	8	165	4.6
Bangladesh	6	80%	85%	14,557	26,812	219	355	1.4
Bhutan	6	94%	100%	0	88	1	4	5.4
India	6	89%	96%	0	187,759	0	4,036	4.2
Iran (Islamic Rep.)	6	92%	97%	1,142	6,632	244	729	5.8
Maldives	6	96%	100%	0	31	0	2	11.6
Nepal	6	88%	93%	340	5,620	154	835	0.3
Pakistan	6	89%	96%	3,490	32,794	150	876	3.4
Sri Lanka	6	90%	99%	0	2,520	0	54	4.2
Cambodia	7	58%	87%	1,028	5,604	161	1,232	0.4
Indonesia	7	74%	92%	12,807	36,852	4,539	9,122	0.9
Lao PDR	7	51%	72%	1,116	2,180	336	544	0.3
Malaysia	7	99%	100%	0	2,610	0	1,403	2.1
Myanmar	7	78%	93%	0	11,033	894	1,828	0.2
Philippines	7	92%	93%	2,477	12,508	1,060	5,077	0.7
Singapore	7	0%	100%	0	222	0	128	9.6
Thailand	7	95%	97%	379	4,364	0	1,254	1.4
Timor-Leste	7	60%	91%	205	375	24	71	0.3
Viet Nam	7	93%	99%	0	9,310	0	1,874	0.4
Iraq	8	56%	91%	3,713	7,238	1,572	2,945	1.4
Jordan	8	92%	98%	134	564	64	279	1.5
Kuwait	8	99%	99%	17	341	10	196	15.6
Lebanon	8	100%	100%	0	179	0	208	1.2
Occ. Palestinian T.	8	81%	86%	657	702	221	315	1.0
Oman	8	78%	93%	71	549	13	216	5.7
Qatar	8	100%	100%	0	122	0	70	19.8
Saudi Arabia	8	63%	97%	1,263	3,811	472	1,915	5.8
Syrian Arab Rep.	8	86%	93%	854	3,421	391	1,464	1.2
Turkey	8	99%	100%	0	4,748	0	4,804	1.2

Country	MDG Region	Coverage (2010)		Population to cover		Total financial capital costs:		Benefit-cost ratio
		Rural	Urban	MDG	Universal	MDG	Universal	
		%		Thousand people		Million US$, 2010		
United Arab Em.	8	100%	100%	0	486	0	1,327	2.7
Yemen	8	47%	72%	8,112	6,377	1,858	1,700	0.7
Fiji	9	95%	100%	0	48	4	16	1.3
French Polynesia	9	100%	100%	0	17	0	8	5.8
Guam	9	100%	100%	0	11	0	6	6.8
Papua New Guinea	9	33%	87%	2,279	2,660	341	422	0.5
Samoa	9	96%	96%	0	8	5	3	1.2
Solomon Islands	9	65%	94%	77	144	11	28	0.4
Tonga	9	100%	100%	0	2	0	1	1.0
Vanuatu	9	87%	98%	0	56	0	18	1.3

Annex E. Sensitivity analysis results

Benefit-cost ratios under one-way sensitivity analysis on key parameters

BASE CASE RESULTS	Sanitation	Water	WSS
CCA	4.8	1.0	2.6
N Africa	4.3	2.4	3.3
SSA	2.8	2.5	2.7
LAC	7.3	2.4	5.2
E Asia	8.0	1.6	5.3
S Asia	4.6	3.7	4.5
SE Asia	5.0	0.9	2.9
W Asia	6.1	2.3	4.2
Oceania	3.6	0.6	2.0
WORLD	**5.5**	**2.0**	**4.3**

High unit costs	Sanitation	Water	WSS
CCA	3.6	0.8	2.2
N Africa	3.8	2.3	3.1
SSA	1.9	1.4	1.7
LAC	6.5	2.2	4.7
E Asia	6.8	1.6	4.8
S Asia	5.2	2.2	4.6
SE Asia	3.4	0.6	2.0
W Asia	5.6	2.2	3.9
Oceania	2.5	0.4	1.4
WORLD	**4.8**	**1.6**	**3.6**

Low unit costs	Sanitation	Water	WSS
CCA	26.0	3.2	8.6
N Africa	13.5	6.5	9.6
SSA	4.4	4.9	4.5
LAC	14.3	6.7	11.8
E Asia	18.2	4.5	13.0
S Asia	9.6	2.1	7.0
SE Asia	7.5	2.1	5.5
W Asia	13.0	6.4	10.1
Oceania	4.9	1.2	3.2
WORLD	**10.9**	**4.1**	**8.5**

Time value 100% of GDP per capita	Sanitation	Water	WSS
CCA	10.0	2.5	5.5
N Africa	13.1	7.5	10.2
SSA	7.0	5.6	6.6
LAC	22.9	7.2	16.2
E Asia	24.9	5.0	16.4
S Asia	12.7	8.1	12.1
SE Asia	15.2	2.4	8.9
W Asia	18.7	6.9	12.6
Oceania	10.9	1.6	5.8
WORLD	**16.6**	**5.5**	**12.6**

Time value 15% of GDP per capita (adults)	Sanitation	Water	WSS
CCA	3.7	0.7	1.9
N Africa	2.3	1.3	1.8
SSA	1.8	1.8	1.8
LAC	3.8	1.3	2.7
E Asia	4.3	0.9	2.8
S Asia	2.8	2.7	2.8
SE Asia	2.7	0.5	1.6
W Asia	3.3	1.3	2.3
Oceania	2.0	0.4	1.1
WORLD	**3.1**	**1.2**	**2.4**

WSS access time doubled	Sanitation	Water	WSS
CCA	6.2	1.5	4.0
N Africa	8.0	5.5	6.7
SSA	4.5	5.0	4.6
LAC	13.7	4.7	9.9
E Asia	14.9	3.4	10.0
S Asia	8.0	6.4	7.8
SE Asia	9.2	1.8	5.5
W Asia	11.3	4.5	7.8
Oceania	6.6	1.1	3.6
WORLD	**10.1**	**3.9**	**7.9**

WSS access time halved	Sanitation	Water	WSS
CCA	4.0	0.7	1.9
N Africa	2.5	1.3	1.9
SSA	1.9	1.8	1.9
LAC	4.1	1.3	2.9
E Asia	4.5	0.9	3.0
S Asia	3.0	2.8	3.0
SE Asia	2.8	0.5	1.7
W Asia	3.5	1.3	2.4
Oceania	2.1	0.5	1.2
WORLD	**3.3**	**1.2**	**2.6**

3% discount rate for future values	Sanitation	Water	WSS
CCA	5.0	1.1	2.7
N Africa	4.6	2.5	3.5
SSA	4.3	4.4	4.3
LAC	7.5	2.4	5.3
E Asia	8.1	1.6	5.3
S Asia	5.9	5.8	5.9
SE Asia	5.3	1.0	3.2
W Asia	6.4	2.4	4.3
Oceania	4.1	0.9	2.3
WORLD	**6.3**	**2.4**	**4.9**

12% discount rate for future values	Sanitation	Water	WSS
CCA	4.6	0.9	2.5
N Africa	4.3	2.4	3.3
SSA	2.5	2.2	2.4
LAC	7.3	2.3	5.2
E Asia	8.0	1.6	5.3
S Asia	4.3	3.3	4.2
SE Asia	4.9	0.8	2.9
W Asia	6.1	2.3	4.1
Oceania	3.5	0.6	1.9
WORLD	5.4	1.9	4.2

Deaths valued at half of base case	Sanitation	Water	WSS
CCA	4.0	0.8	2.3
N Africa	4.3	2.4	3.3
SSA	2.5	2.2	2.4
LAC	7.3	2.3	5.2
E Asia	8.0	1.6	5.3
S Asia	4.2	3.2	4.1
SE Asia	4.9	0.8	2.9
W Asia	6.1	2.3	4.1
Oceania	3.5	0.6	1.9
WORLD	5.4	1.9	4.1

Deaths valued using value-of-statistical life	Sanitation	Water	WSS
CCA	5.2	1.2	2.9
N Africa	4.7	2.6	3.6
SSA	4.8	5.2	4.9
LAC	7.5	2.5	5.4
E Asia	8.1	1.7	5.3
S Asia	6.7	7.4	6.8
SE Asia	5.4	1.0	3.2
W Asia	6.5	2.5	4.4
Oceania	4.2	1.0	2.5
WORLD	**6.6**	**2.7**	**5.2**