Assessment of Economic Impacts in Water Supply and Sanitation

Review Purpose

The present water supply and sanitation literature review is part of UNDP's, Water Governance Programme (WGP) and the Stockholm Environment Institute (SEI), Economics of Water Initiative (EWI). EWI is a collaborative initiative to promote water supply and sanitation investments and scale up of access to WSS for the poor. To this extent, the review aims to provide useful data to analyze the linkages between water supply and sanitation and the economic benefits that can be drawn from investments and improvements in the sector.

The review is a compilation of existing studies, methodologies and useful sites in the WSS field. It is a resource tool for policy-makers, researchers and practitioners interested in the subject. It includes relevant information at the global, regional and country level and it is divided into three sections: 1) paper and studies 2) surveys and methodologies and 3) related web sites.

Paper and Studies

1. Hutton, G., Rodriguez, UE., Napitupulu, L., Thang P, Kov, P. Economic Impacts of Sanitation in South Asia. World Bank. 2008.
http://www.wsp.org/UserFiles/file/Sanitation_Impact_Synthesis_1.pdf

This study examined the major health, water, environmental, tourism and other welfare **impacts associated with poor sanitation in Cambodia, Indonesia, the Philippines and Vietnam**. It is based on evidence from other investigations, surveys and databases. The impact measurement reported in the study focuses mainly on a narrow definition of sanitation − human excreta management and related hygiene practices. The measurement of water resource impact also includes grey water, and the measurement of environmental impact includes solid waste management.

This is the first **regional study** at the Bank to compile economic evidence on a range of impacts of poor sanitation at country level, in four countries of SE Asia. Many of these impacts are quantifiable in economic terms. Other impacts that are less tangible or less easy to evaluate are also potentially important for economic development, quality of life, and political decision-making.

The **focus in the study was on sanitation, and not water per se**. This was justified due to the fact that water has historically received greater emphasis than sanitation, in terms of research, policy development, programmatic support and resource allocation. The WHO/UNICEF Joint Monitoring Programme estimates that in the 1990s, water received US$12.6 billion annually, while sanitation received US$3.1 billion, a factor difference of 4 times.

Recent estimates on improved sanitation coverage for the four countries being analyzed in this study are at 28% in Cambodia, 57% in Indonesia, 76% in the Philippines and 69% in Vietnam, far below the universal sanitation coverage achieved in other Southeast Asian countries such as Thailand and Singapore. This study provides important evidence to support further **investment in sanitation** in these countries by examining the economic impacts of poor sanitation, and the potential gains from improved sanitation.

Cambodia, Indonesia, the Philippines and Vietnam lose an estimated US$9 billion a year because of poor sanitation (based on 2005 prices). That is approximately 2% of their combined Gross Domestic Product, varying from 1.3% in Vietnam, 1.5% in the Philippines, 2.3% in

Indonesia and 7.2% in Cambodia. The annual **economic impact** is approximately US$6.3 billion in Indonesia, US$1.4 billion in the Philippines, US$780 million in Vietnam and US$450 million in Cambodia.

Annual per capita losses range from US$9.30 in Vietnam, US$16.80 in the Philippines and US$28.60 in Indonesia, to a high of US$32.40 in Cambodia. The study is based on the premise that if governments and households are to be convinced that expenditure on improving sanitation is worthwhile, stronger evidence is needed to better understand the various impacts of poor sanitation: on health, the environment, population welfare, and eventually on economic indicators.

To this extent, and with the aim to assist governments to make informed choices on sanitation policies and resource allocations, the World Bank's Water and Sanitation Program (WSP) in the East Asia and the Pacific region (WSP-EAP) lead the 'Economics of Sanitation Initiative' (ESI), in conjunction with various other agencies, to compile existing evidence and to generate new evidence on socio-economic aspects of sanitation.

The first major activity of the ESI was to conduct a **Sanitation Impact Study**, to examine the economic and social impacts of unimproved sanitation on the populations and economies of Southeast Asia, as well as the potential economic benefits of improving sanitation. A second ESI study, a Sanitation Options Study, will examine the cost-effectiveness and cost-benefit of alternative sanitation improvement options and management approaches in a range of settings in each country.

The current study **took a year and was lead** with cooperation of an extensive team **including** Guy Hutton, WSP-EAP Regional Senior Water and Sanitation Economist), who led the development of the concept and methodology for the ESI, and the management and coordination of the country teams, Isabel Blackett as task team leader, and with feedback and peer reviews from Eddy Perez, Anjali Acharya, Tracey Hart, Pete Kolsky, Elena Strurkova, Bjorn Larsen and Pete Feldman among many others.

The specific goal of this sanitation impact study was to provide decision-makers at country and regional level with better evidence on the negative economic impacts of poor sanitation, and to provide tentative estimates of those negative impacts that can be mitigated by investing in improved sanitation. The target audience is primarily national-level policy makers with influence over the allocation of resources to sanitation, including central ministries (budgeting, economics, finance), line ministries (infrastructure, water, environment, rural development, urban planning) and external funding and technical partners (multilateral, bilateral and non-government agencies).

The results show **disaggregate impacts by provincial groupings for each country**, as well as providing a rural-urban breakdown. Geographical disaggregation of results is presented for some types of economic impact, at the regional level in Cambodia, the Philippines and Vietnam, and at the provincial level in Indonesia. Rural/urban breakdown is provided where feasible. Furthermore, health impacts are disaggregated by age group for selected diseases, and descriptive gender analyses are also conducted. However, to inform local decisions, further studies are needed that disaggregate at provincial, district and city levels, and below.

The study uses a **modeling approach and draws almost exclusively on secondary sources of data** (existing literature methodologies and country household surveys and DHS surveys) Annex A of the paper describes the study methods in more detail. This paper presents impacts in terms of physical units, and converts these to monetary equivalents using conventional economic valuation techniques[1] [Ref 16-25]. Results of economic impact are presented in United States

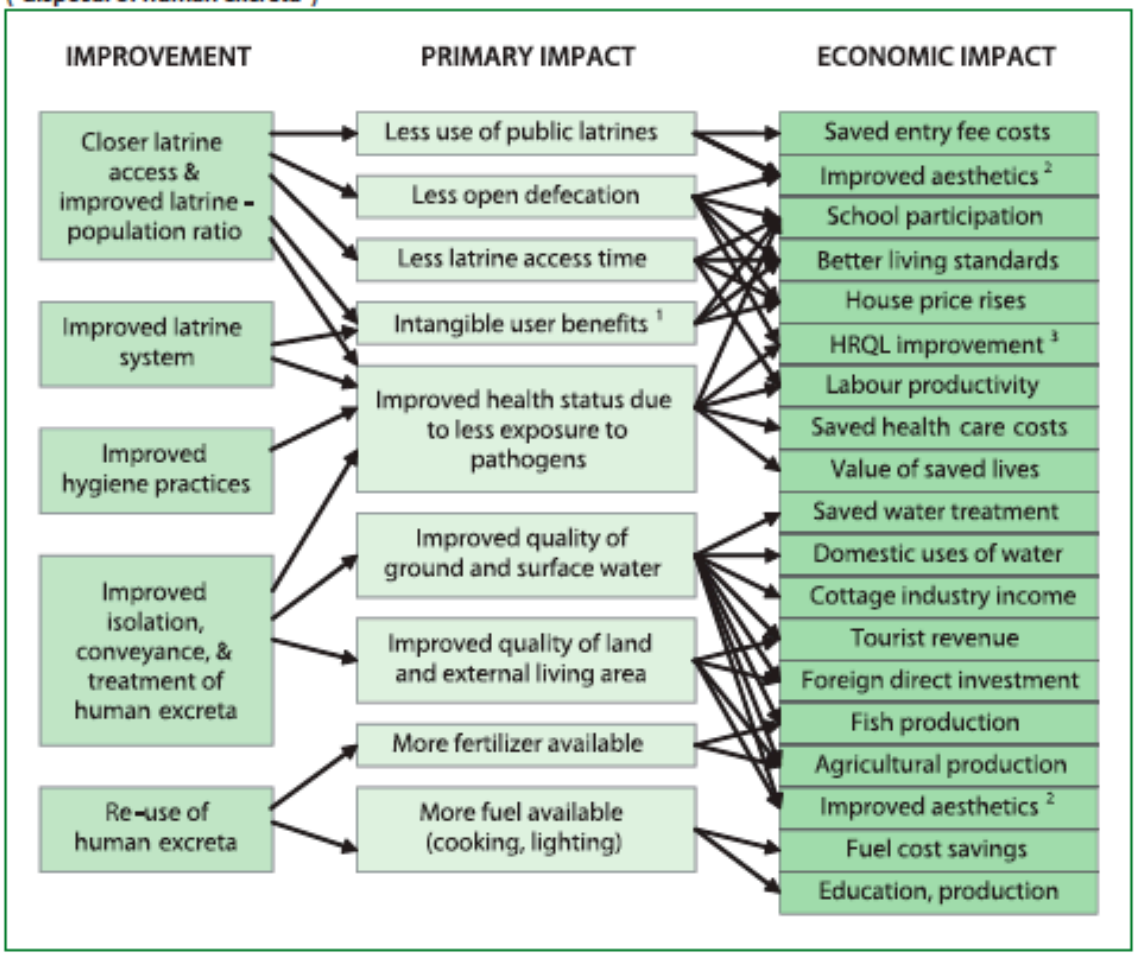
[1] Impacts are based on techniques used in reference papers in Annex Dof the apper. These references include: Curry S and Weiss J. Project Analysis in developing Countries.1993MacMillan. Dixon JA, Scura LF Carpenter RA and Sherman PB. Economic Analysis of Environmental Impacts1986.London: Earth Scan. Drummond MF, O'Brien B, Stoddart Gland Torrance GW. Methods for the Economic Valuation of Health Care Programmes. 1997. Oxford University Press. Second Edition.

dollars (US$) for a single year – the latest available data were for 2005 for most variables, and 2006 for others. Overall impacts are presented in terms of total and per capita impact in US$. Results are also presented in international dollars (I$) to enable cross country comparisons of the relative impact of poor sanitation in countries with different price levels in relation to the US$. Where quantification in economic values is not feasible using secondary data sources, impacts are examined and reported descriptively.

Included sanitation aspects:	Excluded sanitation aspects:
• Human excreta management: • Quality, safety and proximity of latrine • Safe isolation, disposal, conveyance, treatment • Hygiene practices • Gray water management • Household solid waste management • Animal excreta management (Cambodia and Vietnam) and agricultural waste (Vietnam)	• Drainage and general flood control • Industrial, trade village and medical waste • Vector control • Broader food safety • Other agricultural waste • Broader environmental sanitation

To understand better the **nexus between improvements, primary impacts and economic impacts** please refer to **Figure 3, Page 25** of the study. Primary impacts and resulting economic impacts associated with improved sanitation options include: an improvement in closer latrine access and improved latrine population ratio generates a primary impact is terms of less use of public latrines, which in turn provides an economic impact of saving entry fee costs, improving aesthetics. Also, allowing for less open defecation and therefore improving living standards. More detailed associations ca be seen in the figure below.

Figure 3. Primary impacts and resulting economic impacts associated with improved sanitation options ("disposal of human excreta")



[1] Comfort, convenience, security, privacy; [2] Visual effects, smells; [3] HRQL: health-related quality of life

Results showed that **poor sanitation causes considerable financial and economic losses in the four countrie**s. In the case of financial losses – reflecting expenditure or income losses resulting from poor sanitation – there is an average of 0.44% of annual GDP, while overall population welfare losses average 2% of GDP. The majority of economic losses are shared between health (54%) and water resources (25%), and time spent accessing unimproved sanitation facilities (15%).

The major factor explaining the cross-country differences is **population size**. Indonesia dominates the overall impact figures, with 71% of economic cost.

Health and water resources were the only factors assumed to have financial impacts – the greater overall financial cost was attributable to water resources, of which the major contributor was the cost of accessing clean drinking water. The major contributors to overall economic losses were the cost of premature death (mainly of children under five years old), drinking water access, and time spent accessing unimproved sanitation facilities. Tourism losses, health care costs, sickness time, and domestic use of water also contributed to overall economic losses as shown. **(See figure 4 for a breakdown on impacts and links with sanitation)**

Table 4. Justification for choice of impacts included in the study

Impact	Link with sanitation	Justification for inclusion
Health	- Poor sanitation and hygiene cause diseases, which lead to premature mortality and a range of direct and indirect economic effects	- Scientific evidence is available on the causal pathways between unimproved sanitation/hygiene and the causative disease pathogens/hosts - Health information systems, household surveys and economic studies testify to the diseases suffered by the population and the associated costs of disease
Water	- Released human and animal excreta pollutes water resources, which affects their usability or productivity and leads to costly averting behavior and/or production impact	- Unregulated sewage and wastewater release into water bodies is a proven significant contributor to fresh (and marine) water resource pollution - Water is treated or purchased by households, and undergoes costly treatment by piped water providers for domestic and commercial purposes - Households hauling water themselves travel further to reach a cleaner, safer water supply - Fish are unable to reproduce and survive in heavily polluted water. At lower levels of pollution, fish numbers are affected by oxygen depletion and micro-bacteria. Humans are affected when they eat fish that have been exposed to raw sewage
External environment	- Neighborhoods with poorly managed sanitation are less pleasant to live in, and population welfare is thus affected	- Land and building prices are highly sensitive to environmental factors - Poor people tend to live on marginal land - As income rises, households are willing to pay more for better sanitation services
Other welfare	- Poor sanitation results from cultural barriers, low awareness, lack of design options, low income, and lack of home ownership - Poor sanitation in institutions affects life choices, or leads to absenteeism at schools or the workplace	- Household members have to spend time accessing toilet in the open or queuing to use shared or public facilities - Privacy, security and convenience are underestimated 'intangible' aspects in sanitation choices - There exists an income gradient in latrine ownership (i.e. richer households tend to have better sanitation) - Sanitation is more important to people who lack voice in household or community decisions – women and children
Tourism	- Poor sanitation affects the attractiveness of tourist destinations and tourist arrivals; and can lead to holiday sickness	- Tourism is an important source of national income and employment, offering high returns on investment - The most popular tourist destinations (generally) have clean environments, good toilet facilities, and a lower risk of getting sick

Throughout the presentation of results, distinctions were made between financial losses and economic losses. It is largely context-specific whether a loss is felt as a real financial cost (involving monetary impact) or as affecting resource use but non-pecuniary in nature, However, this distinction can be useful in interpreting study results.

The following table summarizes the financial and economic costs of poor sanitation by impact.

Table 6. Financial and economic costs of poor sanitation measured in the study

Impact category	Sub-impacts evaluated	Financial costs attributable to poor sanitation	Economic costs attributable to poor sanitation
1. Health (see Annex A2)	Health care costs	Marginal health-seeking costs, including patient transport, medication cost in public sector, and private sector tariffs	Full costs of health seeking, including full health care and patient transport costs
	Productivity costs	Income loss due to lost adult working days due to sickness	Welfare loss due to adult and child sickness time
	Premature mortality	Short-term household income loss due to adult death (1 year)	Discounted lifetime income losses for adult & child death
2. Water resources (see Annex A3)	Drinking water costs	Water treatment and distribution	*Financial* + Time spent hauling water from less polluted water sources, or fuel for boiling water
	Domestic water uses	Additional expenditure sourcing water from non-polluted sources	*Financial* + Time spent hauling water from less polluted water sources, or fuel for boiling water
	Fish losses	Lost sales value due to reduction in fish catch	Lost sales value due to reduction in fish catch
3. External environment (see Annex A4)	Land quality	-	Economic value of land made unusable by poor sanitation
4. Other welfare (see Annex A5)	Time loss	-	Welfare loss due to adult & child travel/ waiting time for defecation
	Work/school absence	-	Temporary absence of women from work and girls from school
5. Tourism (see Annex A6)	Tourism costs	-	Revenue loss from low occupancy rates and failure to exploit long-term potential tourist capacity

Further survey and research work is recommended by the authors of this study to compensate for the aforementioned gaps in the results.

2. Hutton G, and Haller L. Evaluation of the Non- Health Costs and Benefits of Water and Sanitation Improvements at Global Level. Geneva: WHO. 2004 WHO/SDE/WHS/04.04.
http://www.who.int/water_sanitation_health/en/wsh0404.pdf

The aim of the study was to estimate the economic costs and benefits of a range of selected interventions to improve water and sanitation services, with results presented for **17 WHO sub-regions and at the global level**. The potential productivity and income effects of improved access constitute a significant argument to leverage further resource allocations to water and sanitation.

Evaluated interventions include (1) improvements required to meet the millennium development goals (MDG) for water supply (by halving by 2015 the proportion of those without access to safe drinking water), (2) meet the water MDG plus halving by 2015 the proportion of those without access to adequate sanitation, (3) increasing access to improved water and sanitation for everyone, (4) providing disinfection at point-of-use over and above increasing access to improved water supply and sanitation (5) providing regulated piped water supply in house and sewage connection with partial sewerage for everyone.

The **methodology** used included a **cost-benefit analysis, cost-effectiveness**

analysis and sensitivity analysis. The analysis was carried at the **country level, and the results were aggregated** (weighted by country population size) to give regional averages (17 WHO-sub-regions categorized according to epidemiological indicators).

Results were presented in a **sample of five sub-regions** chosen to reflect a range of results and a range of geographical areas: sub-Saharan Africa epidemiological pattern E (AFRO-E), Americas epidemiological pattern D (AMRO- D), European epidemiological pattern C (EURO-C), South-east Asia epidemiological pattern D (SEARO-D) and Western Pacific Region epidemiological pattern B (WPRO-B1). Together, these five sub-regions account for 55.4% of the world's population in the year 2000, and contain the world's most populous two countries: India (SEARO-D) and China (WPRO-B1).

The analysis is based on changes in water and sanitation service levels. **Services** were categorized into improved and unimproved services and improvements were based on basic improvements where low technology improvements to water and sanitation services were used (e.g., stand post, borehole, septic tank, latrines), further improvements that make water and sanitation services safer or more convenient (e.g., water disinfection at the point of use and personal hygene education) and high technology improvements (e.g., regulate water supply through household connection and household connection to the sewerage system).

The following tables summarize the type of services and exposure scenarios:

Intervention	Improved	Unimproved
Water Supply	• House connection • Standpost/pipe • Borehole • Protected spring or well • Collected rain water • Water disinfected at the point-of-use	• Unprotected well • Unprotected spring • Vendor-provided water • Bottled water • Water provided by tanker truck
Sanitation	• Sewer connection • Septic tank • Pour-flush • Simple pit latrine • Ventilated Improved Pit-latrine	• Service or bucket latrines • Public latrines • Latrines with an open pit

Source: Global Water Supply and Sanitation 2000 Report [2]

Table 3: Selected exposure scenarios

Level	Description	Environmental faecal-oral pathogen load
VI	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	Very high
Vb	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	Very high
Va	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	High
IV	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	High
III	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, plus household water treatment	High
II	Regulated water supply and full sanitation coverage, with partial treatment for sewage, corresponding to a situation typically occurring in developed countries	Medium to low
I	Ideal situation, corresponding to the absence of transmission of diarrhoeal disease through water, sanitation and hygiene	Low

Based on Prüss *et al.* 2002 [5]

Predicted reductions in the incidence of diarrhoeal disease were calculated for each intervention based on the expected population receiving these interventions. The costs of the interventions included the full investment and annual recurring costs. The benefits of the interventions included time savings associated with better access to water and sanitation facilities, the gain in productive time due to less time spent ill, health sector and patients costs saved due to less treatment of diarrhoeal diseases, and the value of prevented deaths.

The **main source of data inputs** into the estimate of the initial investment costs of water and sanitation interventions was the Global Water Supply and Sanitation Assessment 2000 Report[2], which gave the investment cost per person covered in three major world regions (Africa, Latin America and the Caribbean, and Asia/Oceania).

The estimation of recurrent costs was more problematic due to the lack of easily available data sources. Values from the literature were combined with assumptions for the various components of recurrent costs. Cost assumptions were based on the likely recurrent cost as a percentage to the annual investment cost, using values from the literature (World Bank and other international projects).

The **results** show that all water and sanitation improvements were found to be cost-beneficial, and this applied to all world regions. In developing regions, the return on a US$1 investment was in the range US$5 to US$28 for intervention 1, remaining at similar levels for interventions 2, 3 and 4.

Both **health and non-health related benefits** were obtained. In the case of health benefits the study solely focused on water-borne and water-washed diseases. This as a result that at the household level, the transmission of these diseases is the most closely associated with poor water supply, poor sanitation and poor hygiene. Water-borne and water-washed diseases are responsible for the greatest proportion of the direct-effect water and sanitation-related disease burden, which mainly consists of infectious diarrhoea.

Two **indicators** measured the impact of the interventions in this analysis:
- Reduction in incidence rates (number of cases reduced per year),
- Reduction in mortality rates (number of deaths avoided per year)

These indicators were calculated by applying relative risks taken from a literature review (Pruss, Kay, Fewtrell and Bartram 2001[3]) and converted to risk reduction when moving between different exposure scenarios (based on the current water and sanitation situation).

Non-health benefits include reductions in costs and additional benefits resulting from the interventions. For these particular benefits, cost-effectiveness ratio and cost-benefit ratios were calculated.

[2] WHO, UNICEF and Water Supply and Sanitation Colaborative Council, Global Water Supply and Sanitation Assessment 2000 Report. 2000.
[3] Pruss, A., Kay, D., Fewtrell, L., and Bartram, J. Estimating the Global Burden of Disease from Water, Sanitation, and Hygiene at the Global Level. Environmental Health Perspectives, 2002. 110 (5): p. 537-542.

The following table summarizes the economic benefits arising from water and sanitation improvements:

BENEFICIARY	Direct economic benefits of avoiding diarrhoeal disease	Indirect economic benefits related to health improvements	Non-health benefits related to water and sanitation improvement
Health sector	Less expenditure on treatment of diarrhoeal disease	Value of less health workers falling sick with diarrhoea	More efficiently managed water resources and effects on vector bionomics
Patients	- Less expenditure on treatment of diarrhoeal disease and less related costs - Less expenditure on transport in seeking treatment - Less time lost due to	- Value of avoided days lost at work or at school - Value of avoided time lost of parent/ caretaker of sick children - Value of loss of death avoided	More efficiently managed water resources and effects on vector bionomics
Consumers			- Time savings related to water collection or accessing sanitary facilities - Labour-saving devices in household - Switch away from more expensive water sources - Property value rise - Leisure activities and non-use value
Agricultural and industrial sectors	Less expenditure on treatment of employees with diarrhoeal disease	Less impact on productivity of ill- health of workers	- Benefits to agriculture and industry of improved water supply, more efficient management of water resources – time- saving or income-generating technologies and land use changes

It is worth noting that those other benefits tabulated in the final column of this table where not included in the cost-benefit analysis. These relate mainly to improved water supply and they were left out due to a) dependency on local factors in the case of indirect effects of vector borne disease transmission resulting from water and sanitation improvements which could not be then predicted globally, b) inability of quantifying gains excluded for economic reasons like in the case of water purchase from vendors given that they are a transfer method and do not represent gain or loss compared to the use of other resources, c) property value increases, when improving water supply, given that it is hard to estimate previous prices and therefore the exact amount of the increase, and d) quantification of leisure activities given that there is very few available data on these benefits.

The following table summarizes the calculation methodology, data sources and values for economic benefits:

Benefit by sector	Variable	Data source	Data values (+ range)
1. Health sector			
Direct expenditures avoided, due to less illness from diarrhoeal disease	Unit cost per treatment	WHO regional unit cost data	US$4.3-US$9.7 (cost per visit) US$16.1-US$39.7 (cost per day) *Varying by WHO region*
	Number of cases	WHO BoD data	Variable by region
	Visits or days per case	Expert opinion	1 outpatient visit per case (0.5-1.5) 5 days for hospitalised cases (3-7)
	Hospitalisation rate	WHO data	91.8% of cases ambulatory 8.2% of cases hospitalised
2. Patients			
Direct expenditures avoided, due to less illness from diarrhoeal disease	Transport cost per visit	Assumptions	US$0.50 per visit
	% patients use transport	Assumptions	50% of patients use transport (0-100%)
	Non-health care patient costs	Assumptions	US$0.50 ambulatory (US$0.25-1.00) US$2.00 hospitalisation (US$1.0-3.0)
	Number of cases	WHO BoD data	Variable by region
	Visits or days per case	Expert opinion	1 outpatient visit per case (0.5-1.5) 5 days for hospitalised cases (3-7)
	Hospitalisation rate	WHO data	91.8% of cases ambulatory 8.2% of cases hospitalised
Income gained, due to days lost from work avoided	Days off work/ episode	Expert opinion	2 days (1-4)
	Number of people of working age	WHO population data 2002	Variable by region
	Opportunity cost of time	World Bank data	Minimum wage rate (GNP per capita – value added in manufacturing)
Days of school absenteeism avoided	Absent days / episode	Expert opinion	3 (1-5)
	Number of school age children (5-14)	WHO population data 2002	Variable by region
	Opportunity cost of time	World Bank data	Minimum wage rate (GNP per capita – value added in manufacturing)
Productive parent days lost avoided, due to less child illness	Days sick	Expert opinion	5 (3-7)
	Number of babies (0-4)	WHO population data 2002	Variable by region
	Opportunity cost of time	World Bank data	50% minimum wage rate (50% GNP per capita – 50% value added in manufacturing)
Value of loss-of-life avoided (life expectancy, discounting future years at 3%)	Discounted productive years lost (0 – 4 years)	WASH study [16]	16.2 years (9.5 – 29.1)
	Discounted productive years lost (5 – 14 years)	WASH study [16]	21.9 years (15.2 – 33.8)
	Discounted productive years lost (15+ years)	WASH study [16]	19.0 years (16.3 – 22.7)
	Opportunity cost per year of life lost	World Bank data	Minimum wage rate

Benefit by sector	Variable	Data source	Data values (+ range)
3. Consumers			
'Convenience' – time savings	Water collection time saved per household per day for better external access	Expert opinion	0.5 hours (0.25-1.0)
	Water collection time saved per household per day for piped water	Expert opinion	1.5 hours (1.0-2.0)
	Sanitation access time saved per person	Expert opinion	0.5 hours (0.25-0.75)
	Average household size	WHO population data 2002	6 people (4-8)
	Opportunity cost of time	World Bank data	Minimum wage rate (GNP per capita – value added in manufacturing)

The main contributor to benefits was the **saving of time** associated with better access to water supply and sanitation services. When different cost and benefit assumptions were used, the cost-benefit ratios changed considerably, but even under pessimistic scenarios (high cost, low benefits) the potential economic benefits generally outweighed the costs.

Some of the **gaps** in the study include: In terms of costs and benefits, costs are very tangible, whereas benefits were not as much given that at times benefits don't bring immediate money to use or immediate financial gains. The study also omitted various health variables other than diahorreal disease, which underestimated the cost benefit ratios used. Some of the reasons why benefits were left out include: (a) lack of research studies presenting the likely range of benefits per project or per person, (b) lack of valuation methods for estimating the monetary equivalent value of some benefits, such as, for example, the aesthetic value of a reservoir, and (c) some benefits were likely to be small in relation to others. On the other hand, some potential negative impacts of changes to water and sanitation technologies were also omitted, thus leading to the underestimate of cost.

Due to uncertainties in many of the data inputs, the paper recommends to conduct detailed country case studies as a follow-up to this global analysis.

3. Hutton G, Haller L, Bartram J. Economic and Health Effects of Increasing Coverage of Low Cost Water and Sanitation Interventions. Report Prepared for the United Nations Development Programme Human Development Report 2006.
http://www.who.int/water_sanitation_health/economic/mdg10_offtrack.pdf

This study presents the costs and benefits of selected improvements in water supply and sanitation at both global and regional levels, and summarized in the Benefit-Cost Ratio (BCR). It is **based on the methods and model used in the previous report** (Please refer to **Item No. 2** of this review).

There are some important **differences** with the previous report: (a) coverage targets are compared against the predicted coverage for the year 2015, to give greater focus to those countries currently off-track to meet the water supply and sanitation MDG targets; (b) updates of model input data have been done: baseline coverage levels, diarrheal disease incidence rates and health service unit cost data; (c) costs and benefits to reach sanitation coverage targets are presented alone as well as together with the water supply targets; (d) only low cost interventions have been included, hence excluding the more expensive piped and sewerage options for water supply and sanitation, respectively; and (e) **results are aggregated from country level into 6 developing world regions (defined by UNDP) instead of WHO's classification of 14 sub-regions.**

Predicted reductions in the **incidence of diarrhoeal disease** were calculated for each intervention based on the expected population receiving these interventions and the relative risk reductions of populations moving to lower risk exposure scenarios. Deaths averted were estimated based on a **region- and age-specific case** fatality rate for diarrheal disease. The **costs of the interventions** included the full investment and operation and maintenance (O&M) costs of the selected low-cost interventions. The **benefits of the interventions** included time savings associated with better access to water and sanitation, gain in productive time due to less time spent ill, economic gains associated with saved lives, and health sector and patient costs saved due to less health seeking.

The analyses focus on the countries and regions that are off target to reach the water supply and sanitation MDG targets. The baseline scenario is not the current population coverage as compared to the target year in 2015 but it is the predicted population coverage of each country in the year 2015. This predicted population coverage is based on an assumption of a continuation of the average linear increase in coverage from the years 1990 until 2004, taken to the year 2015.[4]

The **cost-benefit analysis results** of the selected water and sanitation coverage goals are highly favourable, standing at between US$3 and US$21 economic benefit per US$1 invested for

[4] Hutton G and Haller L (2004). Evaluation of the non-health costs and benefits of water and sanitation improvements at global level. World Health Organization. WHO/SDE/WSH/04.04.

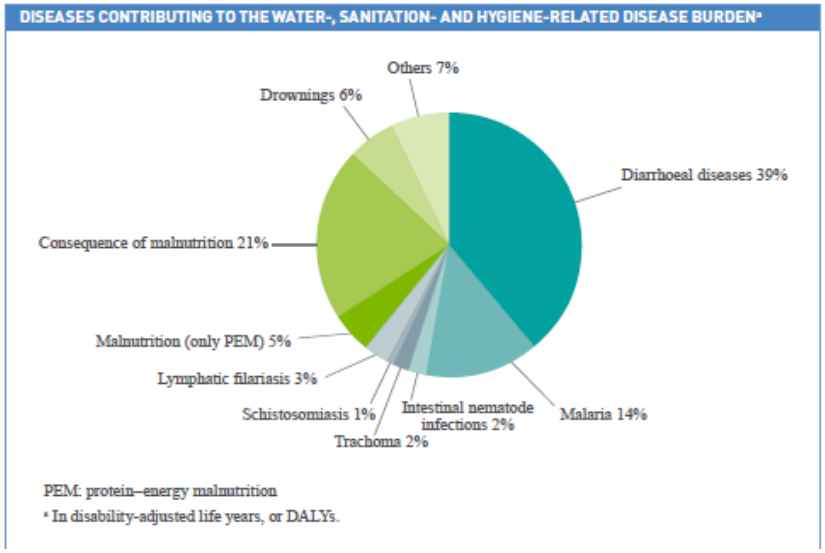
all developing world regions. The **benefit-cost ratio** remains above US$1 even under less optimistic assumptions for some of the key variables in the analysis. These results provide further evidence to support the further investment in value-for-money water supply and sanitation investments.

4. Prüss-Üstün A, Bos R, Gore F, Bartram J. Safer Water, Better Health: Costs, Benefits and Sustainability of Interventions to Protect and Promote Health. WHO, Geneva, 2008.
http://www.who.int/quantifying_ehimpacts/publications/saferwater/en/index.html

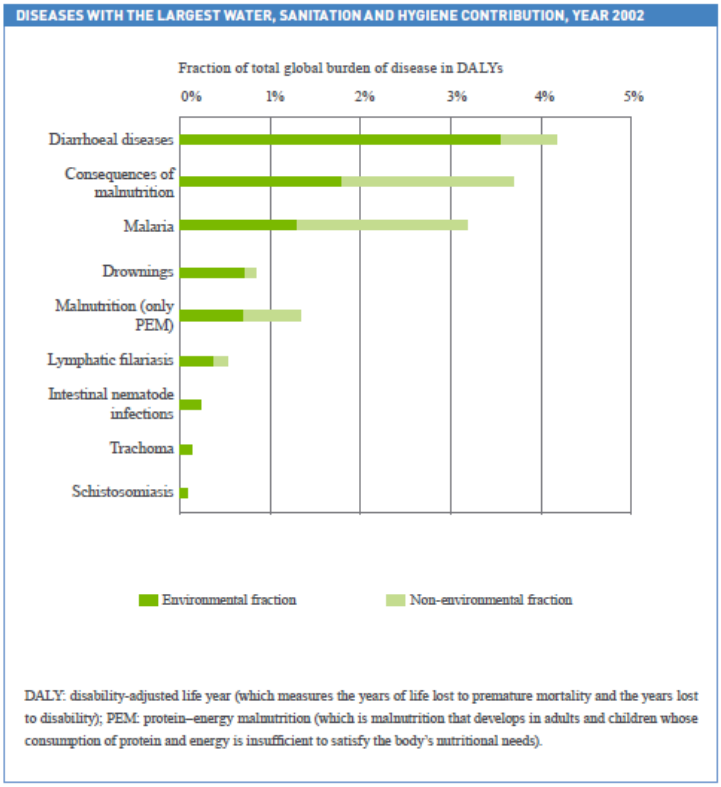
The document includes **country data** of disease burden attributable to unsafe water, inadequate sanitation, insufficient hygiene and inadequate management of water resources. It highlights how much disease could be prevented through increased access to safe water and better hygiene. **Data is based on WHO literature surveys and expert opinions**.

The report provides **epidemiological evidence and economic arguments** for fully integrating water, sanitation and hygiene in countries' disease reduction strategies. It also provides the basis for preventive action by all relevant sectors managing critical water resources and services in support of public health efforts.

The burden of the following **water-related diseases** are described and quantified: diarrhea, malnutrition, intestinal nematode infections, lymphatic filariasis, trachoma, schistosomiasis, malaria and other diseases (dengue, Japanese encephalitis and onchocercisis).

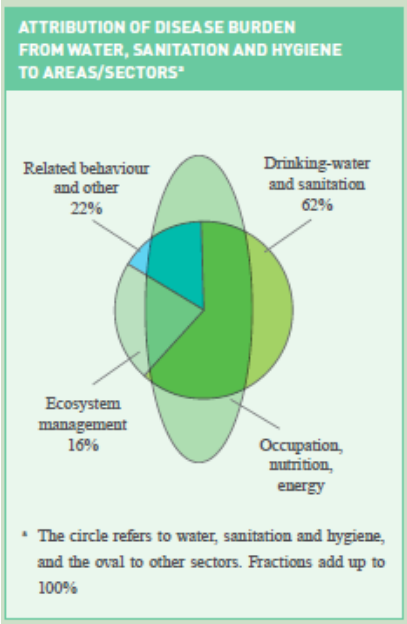


The following graph explains the incidence of water, sanitation and hygiene contributions on various diseases.



Several diseases related to water, sanitation and hygiene could not be specifically addressed in this study because of a **lack of adequate evidence**. This suggests that the reported 9.1% of the disease burden attributable to unsafe water, inadequate sanitation or insufficient hygiene may be an underestimate.

The following graph represents the influence of water, sanitation and hygiene as well as other sectors on the disease burden:



The study suggests further investigation on various factors related to water, sanitation and hygiene. Examples include:

• water hardness, lack of which has been associated with cardiovascular disease;

• fluoride in drinking-water, high concentrations of which are associated with dental and skeletal impairments;
• arsenic content of drinking-water, which is associated with various cancers;
• spinal injury, which is a risk related to recreational water environments;
• legionellosis, which is associated with poorly maintained artificial water systems.

It also suggests that while some health impacts are small at a global level they could reach high local or national importance. It therefore call for **assistance on national-level analysis** is therefore as an important next step.

Impact interventions in various regions were measured through **meta-analysis**. According to Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM Jr (2005) a review of the literature on diarrhoeal disease , 2000 abstracts were screened, and then 50 studies were analysed; of these 50 studies, 38 were used in the meta-analysis.

Results on **Intervention area Reduction in diarrhoea frequency** include[5]:
- Hygiene 37%
- Sanitation 32%
- Water supply 25%
- Water quality 31%
- Multiple 33%

While these results are similar to those included in previous studies, a greater impact in drinking-water quality was discovered. This could be attributed to water consumed as opposed to quality of water at the source.

5. WHO-UNICEF Joint Monitoring Programme for Water Supply and Sanitation. Water for Life: Making it Happen. 2004.[6]
http://www.unicef.org/wes/files/JMP_2005.pdf

This is mainly an advocacy piece that showcases various studies and figures on water and sanitation. It provides indicators and mechanisms to collect information about disparities in access to services, the affordability of services, per capita water quantity use, and the sustainability and reliability of services. It also suggests that efforts are currently under way to test field-based techniques to determine water safety that could be used cost-effectively alongside a household survey, as a cross check on the safety of improved drinking water sources and on safety at point of use.

JPM indicator are currently in evolution to provide for progress in access to and use of drinking water and sanitation services, and the development of new technologies. For example, vendor-supplied water is currently excluded from the category of improved sources, as the regulatory framework to ensure water safety from vendors is absent in most countries and no other guarantees can be given that the water purchased is from a safe source.

The following graphs show both the drinking water and sanitation coverage by region between 1990 and 2002.

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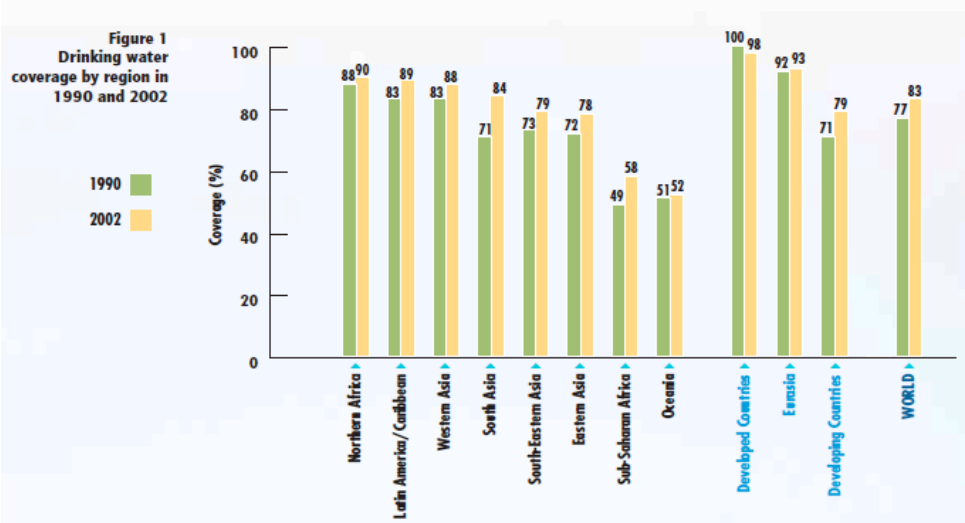
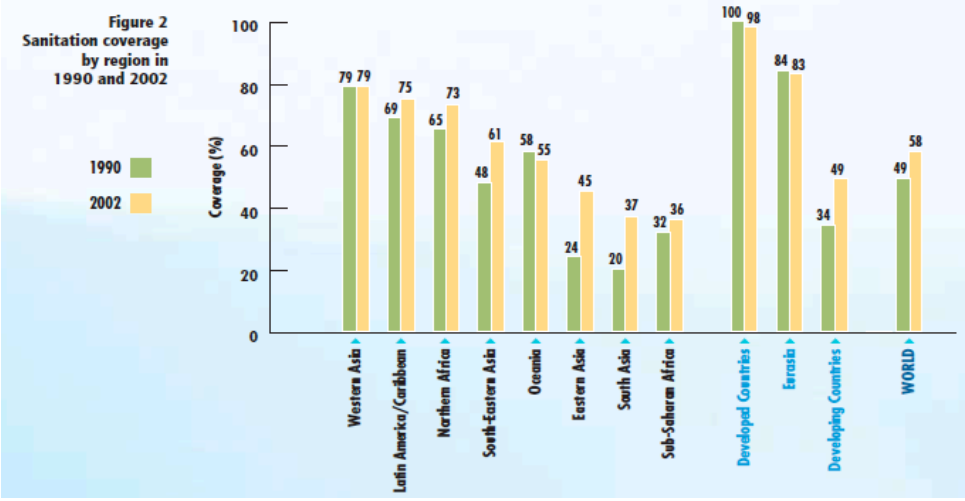
[5] Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM Jr (2005) Water, Sanitationan Hygiene Interventions to reduce Diarrhoea in Less Developed Countries: A Systematic Review and Meta-analysis. The Lancet Infectious Diseases, 5(1): 42-52.

[6] A more recent publication that builds upon this work is: Progress on Drinking Water and Sanitation - Special Focus on Sanitation can be accessible at: http://www.wssinfo.org/en/40_MDG2008.html

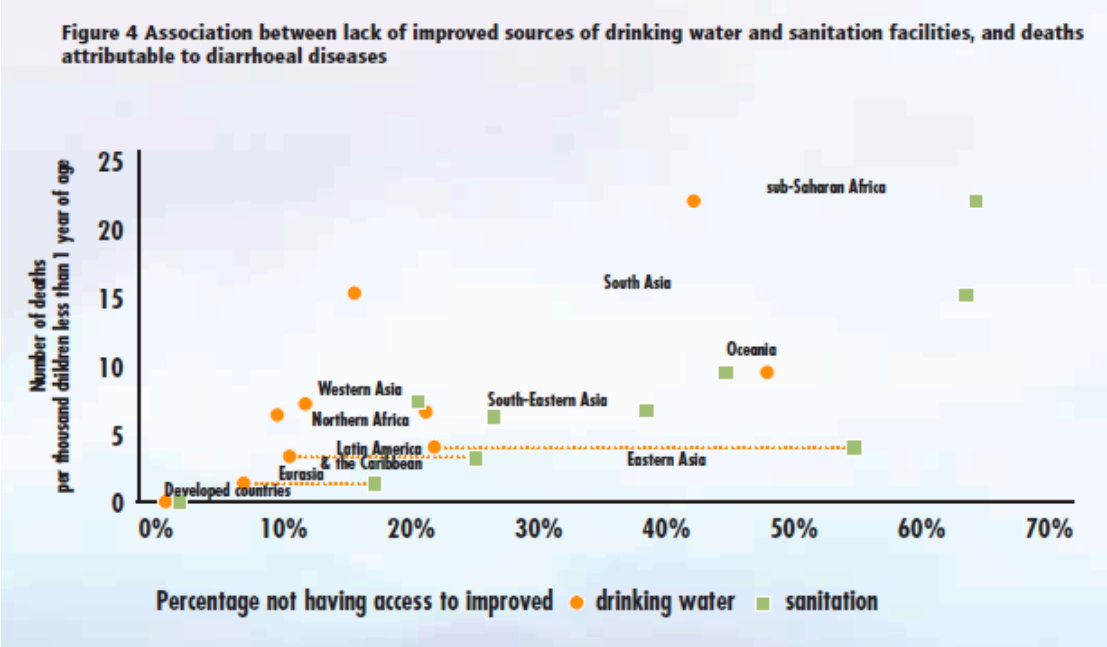


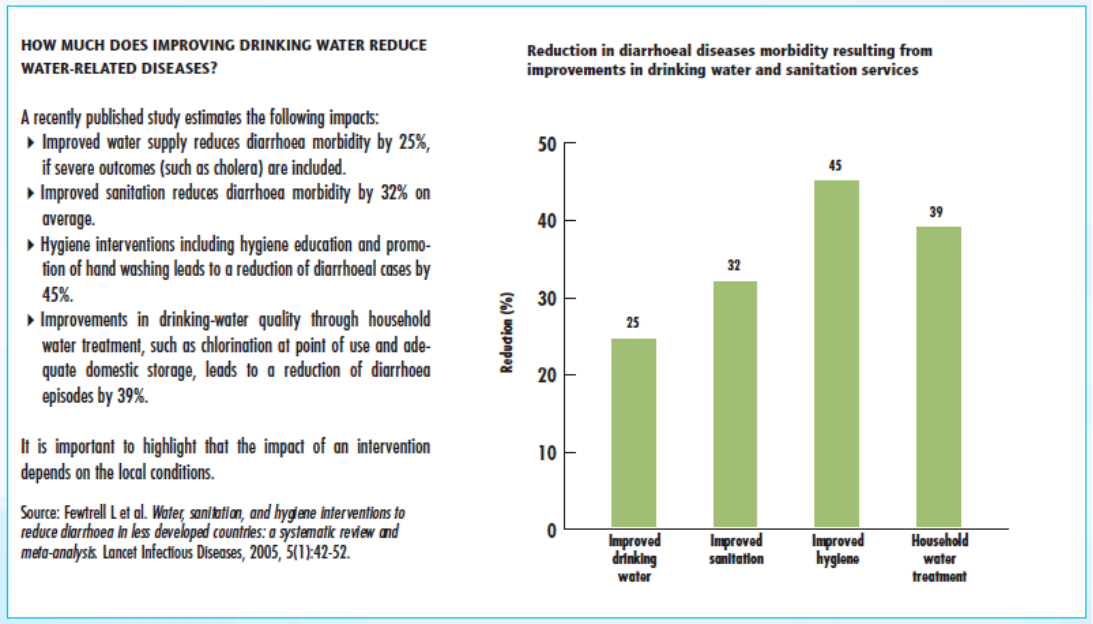


Part I of the report is based under the principle that in different ways and at different ages, access to adequate water and sanitation services influences everybody's health, education, life expectancy, well-being and social development. Based on statistics and expert opinions, the report compares and contrasts the lifestyles and expectations of those with very different levels of water and sanitation services in different age groups. **Case studies** illustrate how actions by communities, governments, nongovernmental organizations and the international community have transformed the lives of millions. **Part II** of the report is more of an advocacy piece on various actions promoted and taken by various institutions working with water and sanitation issues.

The report also looks at **five interventions** for improving drinking water and sanitation services. These include: 1) Meeting basic sanitation demands, 2) significantly increasing access to safe drinking water, 3) focusing on changing key hygiene behaviours, 40 promoting household water treatment and safe storage and 5) ensuring more health for the money. Various institutions currently address these interventions.

Some interesting figures in the report include:





6. MDG Assessment Report 2008. WHO / UNICEF – JMP.
http://www.wssinfo.org/en/40_MDG2008.html

This is the eight report in a series of reports to present the findings within WHO / UNICEF, JMP. It provides information on progress made so far to achieve the MDG target for drinking - water and sanitation and highlight areas to work on in the remainder Water for Life, UN decade, from 2005-2015.

The report has found that the world is not on track to meet the MDG sanitation target. It calls for an immediate acceleration on progress in sanitation particularly in sub-Saharan Africa and Southern Asia and it also suggests positive achievements in terms of the use of the "sanitation ladder" concept, by which people abandon open defecation practices to use in turn sanitation facilities. (Various tables and figures with more specific data can be found in the following pages)

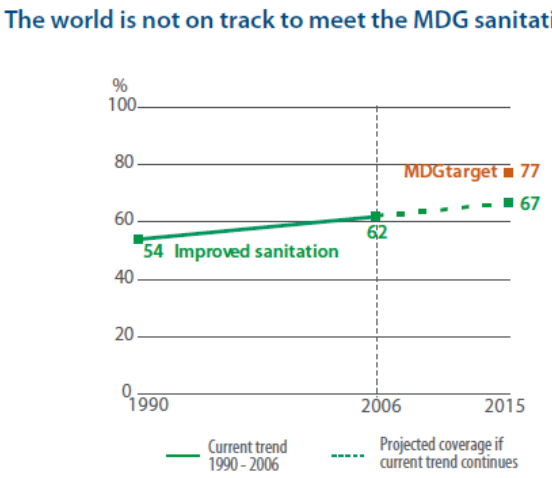


Figure 5 Trends in sanitation coverage 1990-2015

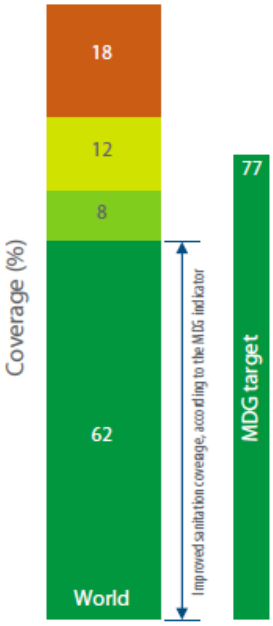
In terms of **water**, there is a much more positive scenario, as the report finds that significant progress has been made in this area as it is the first time where the number of people without improved drinking-water has dropped bellow 1 billion. More than half of the global population now benefits from piped water reaching their homes, and the numbers using unimproved water supplies are going down. (Tables and figures pertaining only to water can be found after the sanitation figures below)

The scope of the report includes **separate assessments at the global, regional and country level** using the sanitation ladder approach. And the trends in drinking-water are also presented following the same format and disaggregated in a drinking water ladder that shows the percentage of the world population that uses piped connections into dwelling, plot or yard as well as other improved and unimproved water sources. Data on time taken to collect water is also presented.

Sanitation ladder:

OPEN DEFECATION	**Open defecation:** Defecation in fields, forests, bushes, bodies of water or other open spaces, or disposal of human faeces with solid waste.
UNIMPROVED	**Unimproved sanitation facilities:** Facilities that do not ensure hygienic separation of human excreta from human contact. Unimproved facilities include pit latrines without a slab or platform, hanging latrines and bucket latrines.
SHARED	**Shared sanitation facilities:** Sanitation facilities of an otherwise acceptable type shared between two or more households. Shared facilities include public toilets.
IMPROVED	**Improved sanitation facilities:** Facilities that ensure hygienic separation of human excreta from human contact. They include: • Flush or pour-flush toilet/latrine to: - piped sewer system - septic tank - pit latrine • Ventilated improved pit (VIP) latrine • Pit latrine with slab • Composting toilet.

The following figure shows the proportion of the world's population using an improved, shared on unimproved sanitation facility or practicing open defecation. (2006)



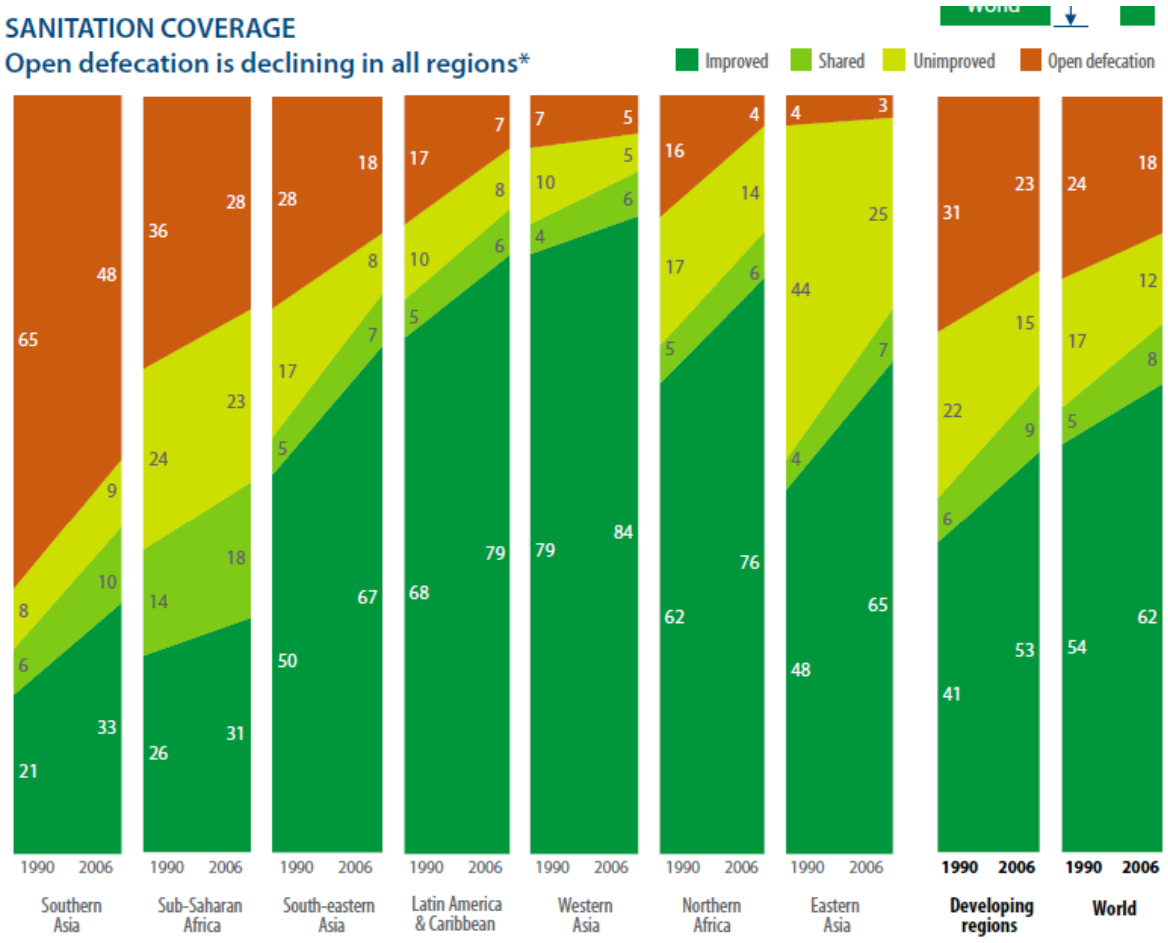


Figure 2 Trends in the proportion of the population using an improved, shared or unimproved sanitation facility or practising open defecation, by MDG regions in 1990 and 2006

*Oceania and the Commonwealth of Independent States are not included due to lack of complete data.

Some relevant figures on sanitation data at the global, regional and country level include:

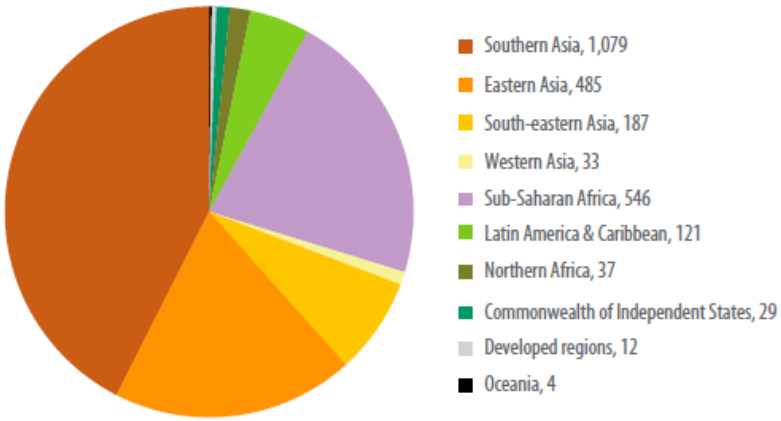


Figure 13 Population without improved sanitation, by region in 2006 (millions)

Table 2 Countries in which coverage with improved sanitation was 33 per cent or less in 2006

Countries with low improved sanitation coverage	Improved sanitation coverage (%)		Number of people who gained access to improved sanitation (thousands)
	1990	2006	1990-2006
Eritrea	3	5	143
Niger	3	7	714
Chad	5	9	640
Ghana	6	10	1,465
Ethiopia	4	11	6,858
Sierra Leone*	-	11	147
Madagascar	8	12	1,353
Togo	13	12	222
Burkina Faso	5	13	1,365
Guinea	13	19	991
Haiti	29	19	-162
Congo	-	20	-
Rwanda	29	23	38
Somalia*	-	23	605
Côte d'Ivoire	20	24	1,905
Mauritania	20	24	340
Sao Tome and Principe*	-	24	11
Micronesia (Federal States of)	29	25	-1
Nepal	9	27	5,922
Cambodia*	-	28	3,026
India	14	28	198,442
Senegal	26	28	1,324
Afghanistan*	-	30	1,894
Benin	12	30	2,025
Nigeria	26	30	18,849
Central African Republic	11	31	982
Democratic Republic of the Congo	15	31	12,660
Mozambique*	-	31	2,993
Liberia	40	32	282
Solomon Islands	29	32	62
Guinea-Bissau*	-	33	190
Kiribati	22	33	15
Uganda	29	33	4,841
United Republic of Tanzania	35	33	4,284

* No 1990 data were available, therefore the estimates are derived from the population that gained access to improved sanitation over the period 1995-2006.

Table 3 Percentage of households sharing a sanitation facility of an acceptable type

Most households sharing a sanitation facility do so with five or fewer households				
Country	Urban (%)		Rural (%)	
	2-5 households	More than 5 households	2-5 households	More than 5 households
Malawi	37	6	26	1
Gambia	32	11	21	2
Mongolia	29	2	21	2
Sierra Leone	26	18	8	5
Somalia	23	5	5	1
Togo	23	21	4	2
Haiti	19	4	5	1
Iraq	19	1	12	1
Central African Republic	18	6	11	4
Jamaica	14	2	12	1
Burundi	14	5	3	1
Bangladesh	14	4	9	0
Côte d'Ivoire	12	13	8	3
Ghana	10	58	4	35

Source: MICS surveys in 37 countries in 2005 and 2006

Table 6 Countries with the largest proportion of population that gained access to improved sanitation, 1990-2006

Countries making the most rapid progress	
Country	Proportion of the population that gained access to improved sanitation since 1990 (%)
Myanmar	68
Syrian Arab Republic	48
Viet Nam	47
Guatemala	44
Philippines	43
Angola	42
Honduras	40
Pakistan	40
Mexico	39

Table 7 Countries not on track to meet the MDG sanitation target with the largest proportion of population that gained access to improved sanitation, 1990-2006

Countries not on track but making rapid progress	
Country	Proportion of the population that gained access to improved sanitation since 1990 (%)
Yemen	39
Benin	30
Cameroon	29
Comoros	29
Mali	29
Zambia	27

Water ladder:

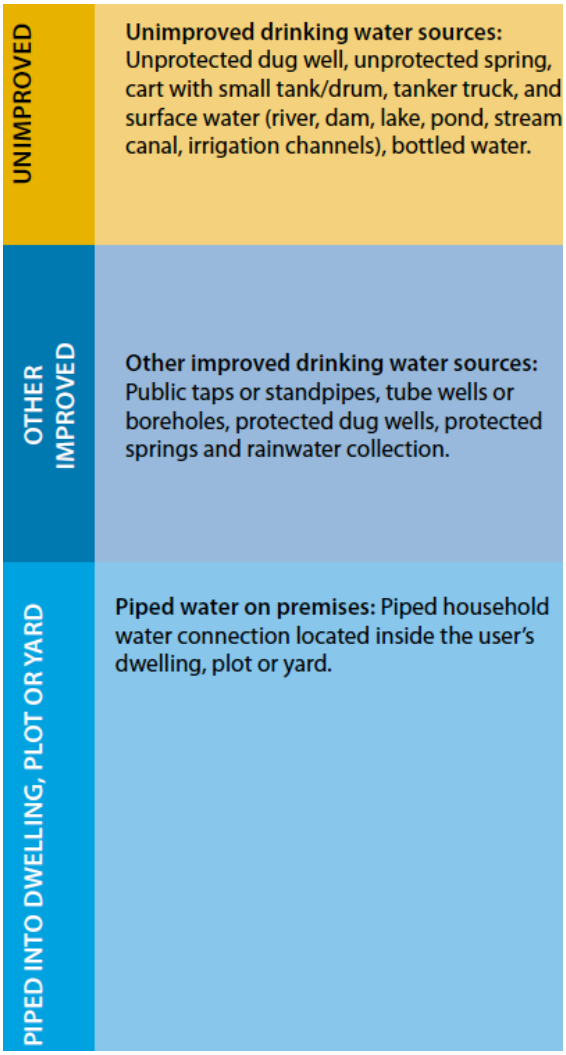
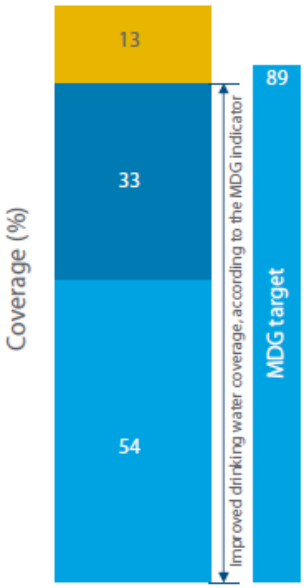


Figure 19

Proportion of the world's population using a piped drinking water connection, another improved drinking water source or an unimproved source, 2006



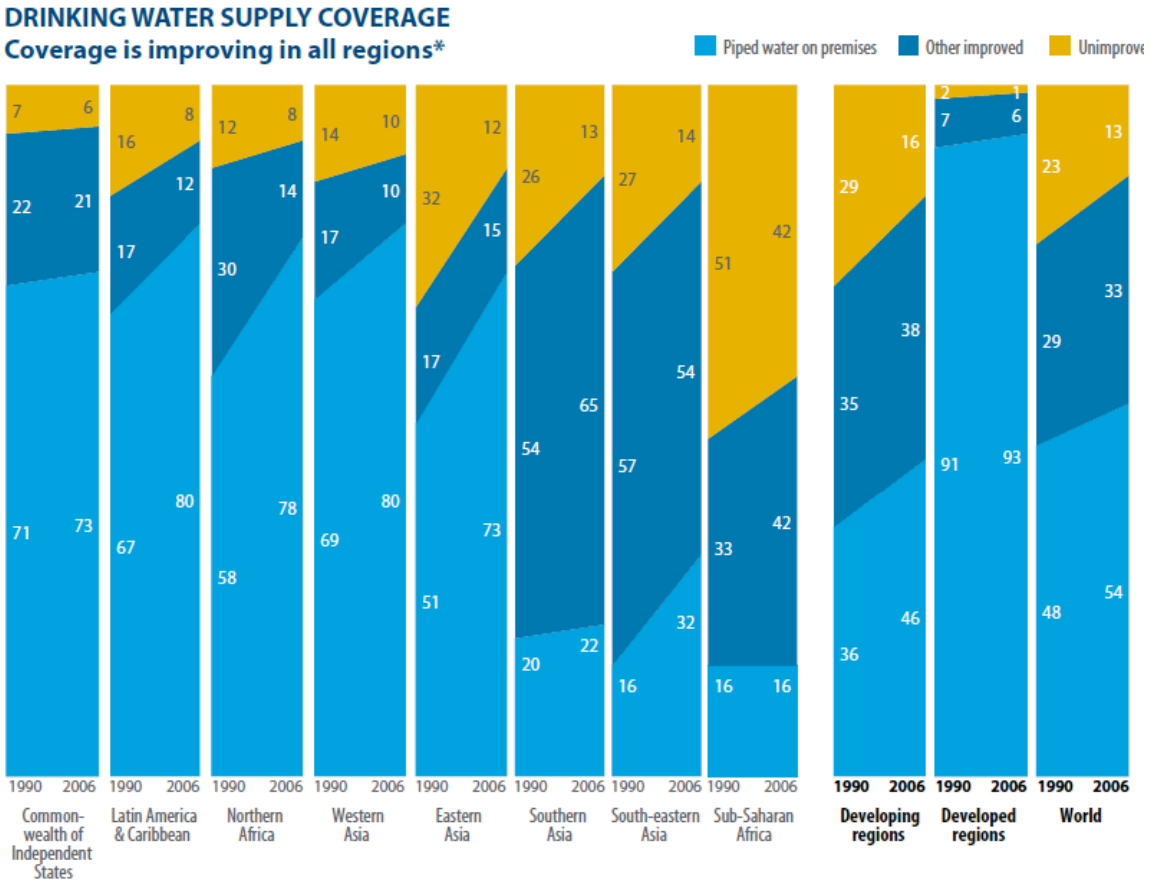


Figure 20 Trends in the proportion of the population using a piped water connection, other improved drinking water sources or an unimproved source, by MDG region in 1990 and 2006

*Oceania is not included due to lack of complete data.

Some relevant figures on drinking-water data at the global, regional and country level include:

Table 8 Regional and global progress towards the MDG drinking water target

Region	Drinking water coverage (%)		Coverage needed to be on track in 2006 (%)	MDG target coverage (%)	Progress
	1990	2006			
Commonwealth of Independent States	93	94	95	97	On track
Northern Africa	88	92	92	94	On track
Latin America & Caribbean	84	92	89	92	On track
Western Asia	86	90	90	93	On track
Eastern Asia	68	88	78	84	On track
Southern Asia	74	87	82	87	On track
South-eastern Asia	73	86	82	87	On track
Developing regions	**71**	**84**	**80**	**86**	**On track**
Developed regions	**98**	**99**	**99**	**99**	**On track**
World	**77**	**87**	**84**	**89**	**On track**
Sub-Saharan Africa	49	58	65	75	Not on track
Oceania	51	50	67	76	Not on track

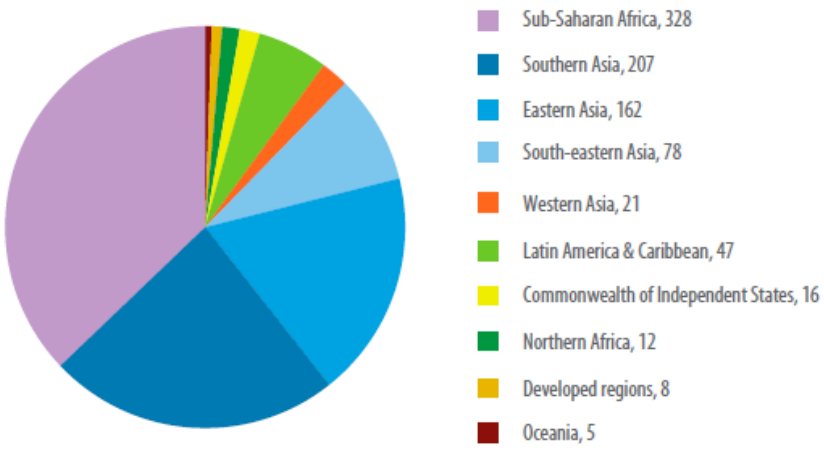


Figure 32 Population using an unimproved drinking water source, by region in 2006 (millions)

Table 10 Countries with the largest proportion of population that gained access to an improved drinking water source, 1990-2006

Countries making the most rapid progress	
Country	**Proportion of the population that gained access to an improved drinking water source since 1990 (%)**
Burkina Faso	66
Namibia	61
Malawi	59
Viet Nam	59
Jordan	53
Guatemala	52
Ghana	51
Uganda	49
Mali	49
Djibouti	47

Table 11 Countries not on track to meet the MDG drinking water target with the largest proportion of population that gained access to an improved drinking water source, 1990-2006

Countries not on track but making rapid progress	
Country	**Proportion of the population that gained access to an improved drinking water source since 1990 (%)**
Benin	37
Angola	33
Comoros	31
Burundi	29
United Republic of Tanzania	28

7. Redhouse, D., Roberts, P., Tukai, R. Every one's a Winner? Economic Valuation of Water Projects. WaterAid.
http://www.wateraid.org/documents/every_ones_a_winner__economic_valuation.pdf

WaterAid has developed **valuation methodologies** that principally focus on how a project's economics affect its beneficiaries. While the health or education valuations can be scaled up to national economy level, WaterAid's methodologies do not capture full macro-economic impacts such as increased productivity and tax takes or reduced health ministry budgets and tax rates. The methodologies are intended primarily for field use in valuing the impacts of individual water and sanitation projects.

Valuation methodologies and WaterAid impact themes covered	Health and hygiene	Livelihoods and incomes	Gender	Education	Community management	Psychological impacts
V1 – Water purchase savings	✓	✓✓✓			✓	✓
V2 – Time saved from fetching water	✓	✓✓✓	✓✓	✓		✓
V3 – Calorie-energy savings	✓	✓✓				
V4 – Improved health	✓✓✓	✓✓		✓✓		✓✓
V5 – Increased agricultural production		✓✓✓			✓✓	
V6 – Avoided days lost from school		✓		✓✓✓	✓✓	
V7 – Avoided days lost from school – girls	✓		✓✓✓	✓✓		✓
V8 – Improved operation and maintenance efficiency and associated gender roles		✓	✓✓		✓✓✓	
V9 – Increased community capital		✓			✓✓✓	
V10 – Psychological benefits		✓	✓			✓✓✓

Number of ✓s represents a generalised predominance; ie ✓✓✓ means this benefit is primarily an most directly covered under this theme. A single ✓ means that this benefit may be considered to cover this theme depending on circumstances. This is general guidance only.

WaterAid investigated the **impacts of** some five- year old **water and sanitation projects** in its 2001 report Looking Back. Participatory assessments were made of projects across **Ethiopia, Ghana, India and Tanzania**. Results are presented in the report for India and Tanzania only.

The identified impacts were grouped into seven themes: 1) livelihoods and incomes, 2) socio- cultural life, 3) health and hygiene 4) psychological impact 5) education 6) gender issues and 7) community management and sustainability. The **principal conclusions** on five initial hypotheses about the impacts of water and sanitation projects were that: livelihood improvements and education attendance were the clearest impacts; women and children received more benefits; there were positive and significant environmental impacts; technical quality and effective management were equally important in operating water schemes; and ongoing support for communities increased their ability to sustain both supply systems and also hygiene behavior changes.

Preliminary calculations show that between $2 and $52 are returned for every $1 invested. The range reflects both variations in the nature of projects and their impacts and also the constraints of using pre-existing data. (Please refer to Boxes 2 and 3 of the study)

Results remain positive under **sensitivity analysis** – especially of wage rates applying to time-saved. The next steps in the research will be at regional level and include data specially collected for valuation work.

Some of the assumptions made in the case of **Tanzania** include: a) in the absence of real baseline data for the four project villages, the daily water consumption and time expended in water hauling at a neighboring village, Uhaaka, were used as a proxy, b) project lifetime is assumed here to be equal to the estimated design period of the pump, c) every hour saved is assumed to be worth as much as the wages rates.

Some issues include technology choices made for both source of development and pump technology for the differences in the return values.

In the case of **India assumptions** included: hour saved worth as much as the local hour wage rate. The wide variation in the returns is explained in the report by the fact that the CWD intervention was primarily a time-saving intervention which was not the case in the other two projects.

Issues for both countries have to do with the **reliability and availability of the data**.

8. SIPA-WaterAid Report. 2008. ***WaterAid Madagascar: Valuating Economic and Social Impacts of Improved Water and Sanitation Services.***
http://www.wateraid.org/documents/valuating_water_and_sanitation.pdf

The aim of this study was to develop a **preliminary** methodology for estimating the economic and social costs and benefits of safe water supply and improved sanitation in Madagascar. This study only evaluates the **benefits side only** since the costs to WaterAid are the project operation costs incurred by them which are easily quantified.

Various **data collection instruments** were used including a mixed method approach that combined direct quantitative studies with qualitative surveys.

Quantitative data was gathered from household surveys, census data, opinion polls, official files and records information. Qualitative analysis includes information gathering from historical records, legal codes, letters or written texts, media accounts, open ended responses to survey questions, observations, interviews or focus groups, and participatory approaches. Household survey questionnaires collected the majority of the necessary data.

The **methodology** applied included **survey questionnaires** in the region of Ambrosita (Madagascar) **in two villages**: Ampila and Fasimena. There have been substantial improvements in access to safe water and sanitation facilities in Ampila, and in Fasimena, the comparable village no improvements have been done. Twenty-one (21) households were analyzed in each village.

The data was collected for each household and aggregated to the community level using the appropriate formulas. The results from each commune were compared against each other.

The model isolates seven areas of impacts:

Incomes and Livelihoods

- Increased capital assets: the monetary value of the assets on a per household basis in the community
- Increased savings: the amount of savings in money and kind.

Health

- Decreased health care expenditure. Look particularly at cases of diarrhea and bilharzia in the last two weeks
- Improved hygiene practices: average number of bathing a week, percentage of survey respondent washing their hands after using the latrine, percentage of survey respondents having babies who wash their hands after changing babies, percentage of survey respondents washing hands before cooking.
- Diet improvement: the number of households of the community who meet the minimum weekly requirements in terms of proteins

Education

- Reduced absenteeism: number of school days missed in the last month' will be calculated
- Increased enrollment: net percentage of children of the appropriate age range enrolled in x-level of education, x representing middle school, high school or university respectively.
- Increased completion: net percentage of children in each appropriate age range with x-level of education being the highest completed school level, x being primary, middle school or high school
- Increased expected lifetime income: the expected lifetime income collectively earned in each community from different education completion levels

Gender

- Women participation in water collection
- **Time saved** from avoiding water collection activities: number of hours saved by the person who collects the water.
- **Potential additional income generation**: potential amount of income generated thanks to time saving.

Community Management

- Satisfaction with committees' performance to maintenance and repair: percentage of respondents that perceive the **water committees** complete their responsibilities.
- Satisfaction with problem resolution by water committees: percentage of respondents that are satisfied with problem solving process of the water committees.
- Satisfaction with member selection process of water committees: percentage of respondents that are satisfied with member selection process of the water committees.
- Satisfaction with decision-making process of water committees: percentage of respondents that are satisfied with the decision-making process of the water committees
- Participation in meetings organized by water committees: percentage of respondents that have participated in meetings organized by water committees.

- Water tax / Contribution: the willingness-to-pay based upon the monthly or annual taxes collected.
- Opinions about tax/contribution to water committees: percentage of respondents that think that they make a fair amount of economic contribution to the water committees.

Psychological Impacts. **No specific indicator designed.**

Environmental Sustainability. **No quantitative indicator designed.** However, increased awareness of individual behavior on ecosystem functioning, improved hygiene and personal welfare and village beautification through gardens and improving cleanliness are results in these two areas.

Some **weaknesses** of this report include:

- Small sampling size. Findings are not conclusive due to the limited size of households per village.
- Wages were taken from available data in 1995.
- Psychological impacts and environmental sustainability were not within the scope of this project. However these constitute interesting pieces for further analysis.

Given these weaknesses, the report suggests a) due to the small sampling size, it is recommended to develop the methodology and repeat this study with larger sample in the future to obtain more comprehensive and reliable data, b) In order to increase the validity of the findings, project evaluations should be based on inter-temporal comparisons within the same community, c) Another study should be conducted to further explore the preliminary findings on health care costs and d) plan for inconsistent and often contradicting answers from villagers were observed due to ambiguous wordings in the translations.

9. Christine Poulos, Subhrendu K. Pattanayak, Kelly Jones; "A Guide to Water and Sanitation Sector Impact Evaluations" World Bank, 2007.
http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&theSitePK=523679&entityID=000020953_20070220134649&searchMenuPK=64187283&theSitePK=523679

The purpose of this paper is to serve as a guide for conducting impact evaluations in the water and sanitation sector.

This paper attempts to provide rigorous scientific impact evaluations that show that water and sewerage policies are effective in delivering many important development goals. The **impacts of such policies and programs** range from greater efficiency in the utilities sector, improved access to higher quality services, health improvements, increased incomes and consumption, social and gender inclusion, and education improvements.

The paper describes in detail various definitions of evaluation and types of economic evaluations (cost-benefit, cost effectiveness analyses). It focuses on impact evaluations done in various WB projects (e.g., Armenia, Bolivia, Brazil, India) with the goal to measure the impacts of

programs on individuals or households and whether or not they are the result of the program. (For data sources please see box below[7])

Table 3: Possible Data Sources by Program Component

Evaluation Component	Possible Data Sources	Data used in Pattanayak et al. 2005a
Intermediate Indicators *Inputs* *Outputs*	Administrative data Expenditure data Payroll data Community surveys Program staff surveys	Government of Maharashtra data on Jalswarajya program (village applications, village action plans for program, expenditures, construction) Community Surveys (community planning processes, implementation of plans, funds received, maintenance activities)
Final Indicators *Outcomes* *Impacts*	Household surveys Existing panel data (LSMS, DHS, national census, PS/CWIQ) Consumer records (e.g., billing and metering data from utilities) Qualitative surveys Water quality samples	Household survey (access to WSH services, satisfaction with WSH services, coping costs, water sources used, knowledge and awareness of WSH, income/consumption, acute and chronic health, diarrhea rates, education, demographics,)
External Factors *Mediating Factors* *Intervening Factors*	Household surveys Qualitative surveys Direct measurement	Household survey (diarrhea rates, access to WSH services, knowledge and awareness of WSH services, income/consumption, acute and chronic health, education, demographics, satisfaction with WSH services) Community Surveys (other social programs, weather conditions, water sources)

The paper also considers **four reasons** to explain the importance of rigorously evaluating WSS programs and policies: 1) demonstrating that a particular WSS program yields health, socioeconomic, and poverty reduction benefits can be used to build support for program expansion or modification, 2) even though specific WSS programs show great promise, they might not work under all field conditions. Program outcomes can be highly variable, with some interventions and programs in some settings showing little impact. Good evaluations can identify why this might happen and what adjustments can be made to correct it; 3) if small-scale WSS projects are to make an important contribution to government policy, they need to be expanded or "scaled up". It is important to know what aspects of these projects lead to greater or less success. And finally, disseminating results of WSS outcomes will contribute to the economic development community's broader understanding of water and sanitation service delivery tools.

10. Turner, K., S., Georgiou, R., Clark, R., Brouwer, and J. Burke. 2004. Economic Valuation of Water Resources in Agriculture, FAO Water Report 27. Rome.
http://www.fao.org/docrep/007/y5582e/y5582e00.htm (taken from executive summary)

The purpose of this report was to produce a **review on water resource valuation issues and techniques** specifically for the appraisal and negotiation of raw (as opposed to bulk or retail) water resource allocation for agricultural development projects. The review considered raw water in naturally occurring watercourses, lakes, wetlands, soil and aquifers, taking an ecosystem function perspective at a catchment scale, and takes account of the demands from irrigated and rain fed agriculture. The review aimed to have particular application to developing countries where agreed methods for reconciling competing uses are often absent, but nevertheless takes account of valuation approaches that have been made in post industrial economies.

[7] Pattanayak, S.K., Yang, J. C., Patil, S., Poulos, C., Jones, K., Kleinau, E., Corey, C., and R.Kwok, 2005a. Environmental health Impacts of water Supply, Sanitation and Hygiene Interventions in Rural Maharashtra, India. Study Protocol, Submitted to the World Bank, January 2005a.

This review presents a framework and suite of techniques that can be employed to analyze these issues and make the rationale for agricultural use of water explicit and transparent. It is not a field manual in the sense of a practical 'cook book' but rather an **'advocacy' brief** which sets out to bring together economic and ecological evidence and argumentation in support of the need to challenge and change the fundamentals of the prevailing technocentric water resources exploitation worldview. A new and more suitable approach to water resources allocation in the new century is necessary if the world's population is to be adequately fed, without further degradation and destruction of the planet's critical ecosystem services. Water productivity needs to be greatly enhanced and **economic cost-benefit analysis and pricing regimes** can play a significant role in such a process. These economic measures will not, however, be sufficient on their own and will need to be buttressed by technological innovation and institutional changes to encourage a more equitable distribution of resources and to mitigate potential international conflicts across 'shared' water basins.

Executive Summary: http://www.fao.org/docrep/007/y5582e/y5582e03.htm#bm03

11. Whittington, D., Hannemann, W. M., Sadoff, C., Jeuland, M. Copenhagen Consensus 2008 Challenge Paper. " Sanitation and Water".
http://www.copenhagenconsensus.com/Files/Filer/CC08/Papers/0%20Challenge%20Papers/CP_Sanitation_and_Water_-_Whittington.pdf

There are two parts presented in this paper: **Part I** focuses on municipal water and sanitation network infrastructure. It provides observations to understand the economics of municipal water and sanitation network infrastructure. It also focuses on the costs of providing such infrastructure services, and then summarizes some empirical evidence on the economic benefits of municipal investments in them.

A discussion of the **economic costs and the benefits** involved and the limitations of the analytical approach used in such applications are also included in the paper. **Part II** considers the costs and benefits of **three specific low-cost, non-network water and sanitation interventions**, a rural water supply program providing rural communities in Africa with deep boreholes and public hand pumps, total sanitation campaigns to achieve open-defecation free communities in South Asia, biosand filters for point of use household water treatment; and one high-cost intervention—large multipurpose dams in Africa.

An important factor in why improving access has been so difficult to achieve has been a fundamental **misunderstanding of the economics of investment in the water and sanitation sector**. The core problem is to ensure that the benefits of improved water and sanitation access will be large enough to cover or possibly exceed the costs for those who will bear them: yet surprisingly often, this need is overlooked.

Reasons behind it include a) those who pay the costs are not necessarily those who will receive the benefits. Even considering water supply alone (for which externalities are less significant than for sanitation, as most of the benefits accrue directly to those who consume the water), the incremental benefits of improved access to water and sanitation network infrastructure may simply not be large enough to cover the costs of improved access.

The economic costs of providing a household with modern water and sanitation infrastructure services are the sum of **seven principal components**:

1. Opportunity costs of diverting raw water from alternative uses to the household (resource rents)
2. Storage and transmission of untreated water to the urban area
3. Treatment of raw water to drinking water standards
4. Distribution of treated water within the urban area to the household

5. Collection of wastewater from the household (sewerage collection)
6. Treatment of wastewater (sewage treatment)
7. Any remaining costs or damages imposed on others by the discharge of treated

Interesting findings include:

Table 7. Median Monthly Household Expenditures on Water (1998 US$).

	Households with in-house piped water connection	Households purchasing from water vendors
Côte d'Ivoire	US$12.40	US$13.90
Ghana	US$4.90	US$4.40
Nicaragua	US$4.60	US$6.00
Pakistan	US$1.00	US$7.50

Source: World Bank Living Standard Measurement Surveys, authors' calculations.

Table 8. Average Monthly Household Coping Costs of Acquiring Improved Water, Kathmandu, Nepal (US$ per month).

Type of Coping Cost	Households with piped connection	Households without piped connection
Collection (time spent)	US$1.57	US$1.60
Pumping	US$0.50	US$0.46
In-house treatment	US$0.78	US$0.83
In-house storage	US$1.22	US$1.29
Total	US$4.07	US$4.18

Source: Pattanayak et al., 2005. Averages are for 1500 households in 2001.

Table 11. Comparing Monthly Household Costs and Benefits of Improved Water and Sanitation Services: An Example from in Kathmandu, Nepal.

	Estimate
Costs (from Table 4)	US$20
Benefits	
Reduced water vending expenditures	Minimal
Coping costs avoided	US$ 4
COI avoided	< US$ 1
CV estimate of WTP	US$11–$14

Note: Benefit estimates are overlapping and cannot be summed to obtain total benefits.

Table 12 and 13 include equations for the cost benefit analysis and parameters used in the cost benefit analysis of water supply projects:

Table 12. Equations for Cost-Benefit Analysis of Water Supply Project.

Demand for water Q = f(T)	
Baseline demand	$Q_0 = 30 - (50/3) * T_0$
Additional demand	If $T_1 > T_0$, $dQ = 0$ $dQ = (50 / 3) * (T_0 - T_1)$ otherwise
Benefit type	
Time savings per trip (hours)	If $T_0 > T_1$, $T_s = (T_0 - T_1)$ $T_s = 0$ otherwise
Time savings per hh-month (hours)	$T_{s,m} = T_s * Q_0 * 30 * S / 20$
Value of time savings per hh-month ($)	$V_{ts} = T_{s,m} * (w / 8) * v_t$
Avoided morbidity per hh-month ($)	$m = (I / 12) * E * S * COI$
Avoided mortality per hh-month ($)	$M = (I / 12) * E * S * CFR * VSL$
Total health per hh-month ($)	$V_H = M + m$
Aesthetic (quantity) per hh-month ($)	If $(dQ * S * 30 / 20) * T_s * (w / 8) * v_t * a * (h) < V_H$, $V_A = (dQ * S * 30 / 20) * T_s * (w / 8) * v_t * a * (1 - h)$ $V_A = (dQ * S * 30 / 20) * T_s * (w / 8) * v_t * a - V_H$
Costs	
Capital recovery factor	$CR = r * (1 + r)^d / ((1 + r)^d - 1)$
Capital per hh-month ($)	$C_{c,m} = (C_c + C_p) * CR / (n * 12)$
Other - O&M + non-pecuniary mgmt per hh-month ($)	$C_{o,m} = (C_o + C_m) / (n * 12)$

Table 13. Parameters Used in Cost-Benefit Analysis of Water Supply Project.[a]

Symbol	Parameter	Base case	Lower limit	Upper limit	Correlated parameters
C_c	Capital cost ($) of borehole + hand pump	$6,500	$5,000	$8,000	O&M (0.5), Market wage (–0.5)
C_p	Program cost: capacity building and management ($/borehole)	$3,500	$2,000	$5,000	Market wage (–0.5)
C_o	O&M expenditures, repairs (annual)	$100	$50	$150	
C_m	Management costs (annual, non-pecuniary) - village + program	$500	$200	$800	
d	Water project duration (yrs)	15	10	20	Program costs (0.5)
r	Real (net of inflation) discount rate (%)	4.5%	3%	6%	
n	# Households served by borehole	60	30	90	New source collection time (0.5)
S	Household size	5	4	6	
T_0	Status quo collection time (hrs/20L): traditional source	1.0	0.1	1.9	
T_1	Collection time per liter (hrs/20L) - improved	0.3	0.1	0.5	
w	Market wage for unskilled labor ($/day)	$1.25	$0.50	$2.00	
v_t	Value of time savings / market wage for unskilled labor	30%	10%	50%	
a	Ratio of aesthetic and lifestyle benefits to time savings benefits	25%	0%	50%	
I	Diarrheal incidence (cases/person-yr) [b]	0.9	0.5	1.4	Capital cost (0.5), Program costs (0.5)
E	% Reduction in diarrhea incidence due to water project intervention	30%	10%	50%	
COI	Cost of illness ($/case)	$6	$2	$10	Market wage (0.5)
CFR	Diarrhea case fatality rate (%) [b]	0.08%	0.04%	0.12%	Capital cost (0.5), Program costs (0.5)
VSL	Value of a statistical life ($)	$30,000	$10,000	$50,000	Market wage (0.7)
h	Percentage of aesthetic benefits that are actually health-related	25%	0%	50%	

[a] Our uncertainty analysis does not purport to use the real probability distributions associated with these parameters but instead is aimed at assessing the range of possible situations in poor developing countries; therefore we use uniform distributions of parameters.

[b] Revised Global Burden of Disease (GBD) Estimates (WHO, 2002). Available at http://www.who.int/healthinfo/bodgbd2002revised/en/index.html. Diarrhea incidence in developing country subregions ranges 0.6–1.29 case per capita per yr (mean ~0.9) but may actually be higher or lower in some locations, CFR ranges 0.02–0.09, and is ~0.08% in Africa.

Table 31. Comparison of the Components of the Benefits and Costs of the Four Water and Sanitation Interventions (US$/hh-month).[a]

Benefit–Cost Category	Rural water	CLTS	Biosand Filter	Large dam
Benefits				
Time savings	3.28	0.20	0	
Quantity/aesthetic	0.54	0	0	
Morbidity	0.68	0.19	0.77	
Mortality	2.70	0.76	3.09	
Total Benefits	7.19	1.14	3.86	
Costs				
Capital, training and program	1.43	0.37	1.34	
Maintenance costs	0.83	0	0.05	
Household time costs	0	0.05	0.01	
Total Costs	2.26	0.43	1.40	
Net Benefits	4.93	0.74	2.45	
Benefit–Cost Ratio (BCR) [b]	3.2	2.7	2.7	1.8

[a] Assuming 6% discount rate.
[b] BCRs for the first three water and sanitation interventions do not pertain to any specific location in developing countries; instead they represent outcomes given the average, base case parameter values described in Part II of this paper. In contrast, the BCR for the large dam intervention does pertain to one specific, illustrative project location.

12. SIWI. 2005. "Making Water a Part of Economic Development: The Economic Benefits of Improved Water Management and Services"
http://www.siwi.org/documents/Resources/Reports/CSD_Making_water_part_of_economic_development_2005.pdf

This report was developed jointly by SIWI and the World Health Organization on behalf of the Governments of Norway and Sweden. It shows how investments in the water sector can generate economic benefits that considerably outweigh costs and contribute to human development. The report stresses, the cost of such investments are within reach of most countries.

Five major arguments are provided in support of increased investment in water and sanitation: a) Improved water supply and sanitation and water resources management boost countries' economic growth and contribute greatly to poverty reduction, b) The economic benefits of improved water supply and - in particular - sanitation far outweigh the investment costs, c) In countries where water storage capacity is improved national economies are more resilient to variability in rainfall and economic growth is boosted ; d) Investing in water is good business - improved water resources management and water supply and sanitation contribute significantly to increased productivity within economic sectors; and e) Meeting investment needs in the water and sanitation sector is within reach of most nations.

The report establishes a **poverty-focused investment priority list**: 1. Improve access to safe water supply and basic sanitation, and hygiene including household water management (these investments have the highest immediate economic returns); 2. Protect the integrity of aquatic and water-related terrestrial ecosystems; and 3. Invest in water-resource management including, where feasible, hydraulic infrastructures such as dams, irrigation schemes and flood control works.

Surveys and Methodologies

1. Demographic Health Survey (DHS) methodology link:
http://www.measuredhs.com/aboutsurveys/dhs/methodology.cfm#1

Demographic and Health Surveys (DHS) are nationally-representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition.

MEASURE DHS, and extension of the DHS program, is funded by the U.S. Agency for International Development (USAID), and implemented by ORC Macro in Calverton, Maryland, in partnership with the Johns Hopkins Bloomberg School of Public Health/Center for Communication Programs, the Program for Appropriate Technology in Health (PATH), Jorge Scientific Corporation (JSC), and Casals & Associates, Inc. (C&A).

The **main objectives** of the MEASURE DHS project are: 1) to provide decision-makers in survey countries with information useful for informed policy choices, 2) to expand the international population and health database, 3) to advance survey methodology, and 4) to develop in participating countries the skills and resources necessary to conduct high-quality demographic and health surveys.

There are **two main types of DHS Surveys**:

1) **Standard DHS Surveys** have large sample sizes (usually between 5,000 and 30,000 households) and typically are conducted every 5 years, to allow comparisons over time.

2) **Interim DHS Surveys** focus on the collection of information on key performance monitoring indicators but may not include data for all impact evaluation measures (such as mortality rates). These surveys are conducted between rounds of DHS surveys and have shorter questionnaires than DHS surveys. Although nationally representative, these surveys have smaller samples than DHS surveys (2,000–3,000 households).

DHS surveys collect primary data using three types of core questionnaires. A **Household questionnaire** is used to collect information on characteristics of the household's dwelling unit, and data related to the height and weight for women and children in the household. It is also used to identify members of the household who are eligible for an individual interview. Eligible respondents are then interviewed using an individual **Women's** or **Men's** questionnaire. For special information on topics that are not contained in the core questionnaires, optional **Questionnaire Modules** are available.

In particular, the Household Questionnaire contains information on the following topics:

Household listing: For every usual member of the household and visitor, information is collected about age, sex, relationship to the head of the household, education, and parental survivorship and residence.

Household characteristics: Questions ask about the source of drinking water, toilet facilities, cooking fuel, and assets of the household. In areas with a high prevalence of malaria, questions about the use of bed nets in the household are added.

Nutritional status and anemia: The height and weight of women age 15–49 and young children are measured to assess nutritional status. For the same individuals, the level of hemoglobin in the blood is measured to assess the level of anemia.

All DHS and AIS surveys contain the household and respondent characteristics modules. Household characteristics assessed include the household composition (how many

people per household and their ages), educational attainment of household members, and school attendance ratios. Data on housing characteristics are also collected, including availability of electricity, **water and sanitation facilities**, as well type of flooring material and cooking fuel. Surveys also assess ownership of various durable goods, such as radio, television, refrigerator, bicycle, car and telephone.

DHS sampling design is carried at the national level, residence level (urban-rural) and regional level (departments, states). The sample is usually based on a **stratified two-stage cluster design**. In the first stage Enumeration Areas (EA) are generally drawn from Census files and in the second stage in each EA selected, sample of households are drawn from an updated list of households.

A sample of the questions pertaining to water and sanitation can be obtained at: http://www.measuredhs.com/pubs/pdf/DHSQ4/DHS-IV-Model-A.pdf.pdf. (Please see pages 8-9, questions 21-24). Questions include, main source of drinking water used, time spent, facility used and if shared with other household, etc; they relate to the determinants of infant and child morbidity and mortality and are relevant for cross-national comparative analyzes).

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
21	What is the main source of drinking water for members of your household?[1]	PIPED WATER PIPED INTO DWELLING ..... 11 PIPED INTO YARD/PLOT ..... 12 PUBLIC TAP ..... 13 WATER FROM OPEN WELL OPEN WELL IN DWELLING ..... 21 OPEN WELL IN YARD/PLOT ..... 22 OPEN PUBLIC WELL ..... 23 WATER FROM COVERED WELL OR BOREHOLE PROTECTED WELL IN DWELLING ..... 31 PROTECTED WELL IN YARD/PLOT ..... 32 PROTECTED PUBLIC WELL ..... 33 SURFACE WATER SPRING ..... 41 RIVER/STREAM ..... 42 POND/LAKE ..... 43 DAM ..... 44 RAINWATER ..... 51 TANKER TRUCK ..... 61 BOTTLED WATER ..... 71 OTHER _____ 96 (SPECIFY)	→ 23 → 23 → 23 → 23 → 23 → 23 → 23 → 23
22	How long does it take you to go there, get water, and come back?	MINUTES ..... ☐☐☐ ON PREMISES 996	
23	What kind of toilet facilities does your household have?[1]	FLUSH TOILET ..... 11 PIT TOILET/LATRINE TRADITIONAL PIT TOILET ..... 21 VENTILATED IMPROVED PIT (VIP) LATRINE ..... 22 NO FACILITY/BUSH/FIELD ..... 31 OTHER _____ 96 (SPECIFY)	 → 25
24	Do you share these facilities with other households?	YES ..... 1 NO 2	

UNICEF World Fit for children Indicators include:
(http://www.measuredhs.com/pubs/pdf/DHSG2/DHS_Intl_Indicators.pdf)

Environment category (Indicator/Definition)

11. Use of improved drinking water sources / Percent of household members living in households using improved sources of drinking water

12. Use of improved sanitation facilities / Percent of household members using improved sanitation facilities

13. Water treatment / Percent of household members using drinking water that has been treated

14. Disposal of child's feces / Percent of youngest child less than 5 years of age whose last stool was disposed of safely.

To promote comparability of data collection, questionnaire design meetings have been

held with numerous agencies to harmonize the revised DHS questionnaire with the UNICEF Multiple Indicator Cluster Surveys, the CDC Reproductive Health Surveys, and other major household surveys programs.

For more details on **survey harmonization** please refer to section 3 of the following link http://www.unicef.org/ceecis/evidence_based_policy_making.pdf

2. Multiple Indicator Childhood Cluster (MICS) Methodology:
http://www.unicef.org/ceecis/resources_8586.html
http://www.childinfo.org/mics3_background.html
Country Reports, Data Sets, and Archives:
http://www.childinfo.org/mics3_surveys.html

The Multiple Indicator Cluster Survey (MICS) methodology was **developed by UNICEF** to support governments and other partners, in measuring progress for children and women at the end of the decade. At present, some 70 countries are planning to implement MICS surveys throughout the world. The MICS questionnaire has been designed, as a series of modules that allow countries to adapt the survey to suit their individual data needs. MICS modules can also be added onto other on-going household surveys.

The MICS was originally developed in response to the World Summit for Children to measure progress. The first round of MICS was conducted around 1995 in more than 60 countries. A second round of surveys was conducted in 2000 (around 65 surveys), and resulted in an increasing wealth of data to monitor the situation of children and women. For the first time it was possible to monitor trends in many indicators and set baselines for other indicators.

The current round of MICS, **MICS3**, is focused on providing a monitoring tool for the World Fit for Children, the Millennium Development Goals (MDGs), as well as for other major international commitments, such as the UNGASS on HIV/AIDS and the Abuja targets for malaria. Data on 21 of the 48 MDG indicators are collected in the third round of MICS, offering the largest single source of data for MDG monitoring.

The **survey consists of 3 questionnaire**s: a household questionnaire, a questionnaire for women aged 15-49, and a questionnaire for children under the age of 5 (addressed to the mother or primary caretaker of the child).

Household: Household characteristics, household listing, education, child labour, **water and sanitation**, salt iodization, insecticide-treated mosquito nets, and support to children orphaned and made vulnerable by HIV/AIDS, with optional modules for disability, child discipline, security of tenure and durability of housing, source and cost of supplies for ITNs, and maternal mortality.

Women: Women's characteristics, child mortality, tetanus toxoid, maternal and newborn health, marriage/union, contraceptive use, HIV/AIDS knowledge, malaria, polygyny, female genital mutilation, and sexual behavior, with optional modules for unmet need, security of tenure, and attitudes toward domestic violence.

Children: Children's characteristics, birth registration and early learning, vitamin A, breastfeeding, care of illness, malaria, immunization, and anthropometry, with optional modules for child development, and source and cost of supplies of ORS, antibiotics and antimalarials.

Data processing is done in coordination with the DHS survey and using the CSPro

System from the US Census Bureau. http://www.childinfo.org/mics3_dataprocessing.html and http://www.census.gov/ipc/www/cspro/download/cspro33.pdf

MICS3 has been carried out in more than 50 countries around the world. Surveys were conducted during the period of 2005-2006. Specific **country reports** can be found at http://www.childinfo.org/mics3_surveys.html. MICS vary within the country in terms of sample size and scope.

For example, in the case of **Malawi**, the National Statistical Office (NSO) carried out the MICS in a joint effort with UNICEF. The main objective was to provide up-to-date information at the district level, in addition to national and regional information, in order to assess the children and women situation in Malawi.

The Malawian MICS covered a **total of 31,200 households** (1,200 households per district in 1,040 clusters). The 2006 MICS results indicated evidence of a decline in infant and child mortality levels and increase in the use of family planning methods compared to the earlier household surveys. A total of 22,994 children under the age of five, 26,259 women aged 15–49, and 7,636 men aged 15–49 were interviewed in 26 districts of Malawi. MICS 2006 is one of the largest household surveys undertaken in the country.

The survey used a **two-stage sampling methodology** in which each of the 26 districts had 40 census enumeration areas or clusters and where a household listing was carried out within the cluster with a systematic sample of 30 households drawn to obtain the 1,200 households per district. For reporting results at the regional and national levels, sample weights were used.

The survey included **four questionnaires**: household, children under five, women and men aged 15–49. A water and sanitation module is included within the household questionnaire. The survey was designed to produce indicators for national, regional and district levels as well as by background characteristics of respondents. Twenty six teams carried out fieldwork between mid-July to mid–November 2006. Data entry started in August and completed by the end of December 2006. Data was entered on 20 microcomputers using the CSPro software.

Water and sanitation indicators include: use of improved drinking water source, use of adequate water treatment method, time to source of drinking water, person collecting drinking water, use of improved sanitation facilities (including pip latrines) use of improved sanitation facilities (excluding pit latrine), sanitary disposal of child's faeces, and households with soap/washing powder or liquid.

Water and sanitation results include:

• In Malawi, 75 percent of the population uses an improved source of drinking water such as piped water, a public tap, a borehole, protected wells and springs, and rainwater collection.

• Only 19 percent of households treat water using an appropriate treatment method. The most common way of treating water in Malawi is boiling, followed by the use of bleach or chlorine and straining water through a cloth.

• Only six percent of households have a source of water located on the premises. Nearly 46 percent of households take 30 minutes or more to get to a water source.

• Ninety-one percent of the population in Malawi stores drinking water in a covered container.

Overall, 88 percent of people in Malawi live in households that use improved sanitation facilities such as a piped sewer system, septic tanks, latrines and pit latrines.

• Seventy-nine percent of people have a hand-washing facility outside the toilet while 73 percent of households have soap or washing powder/liquid.

• Seventy-eight percent of young children's faeces (aged 0–2) are disposed of safely, either rinsed into a toilet or a latrine or disposed of by the children themselves when they go to the toilet.

• Use of soap by women aged 15–49 for all four key hygiene practices – after defecation, after cleaning a child, before feeding a child and before preparing food – is negligible.

Model of questions asked: http://www.childinfo.org/mics3_questionnaire.html

Cluster no. __ __ __ Household no. __ __ __

WATER AND SANITATION MODULE

This module is to be administered once for each household visited. Record only one response for each question. If more than one response is given, record the most usual source or facility.

1. **WHAT IS THE MAIN SOURCE OF DRINKING WATER FOR MEMBERS OF YOUR HOUSEHOLD?**
Piped into dwelling.....01
Piped into yard or plot.....02
Public tap.....03
Tubewell/borehole with pump.....04
Protected dug well.....05
Protected spring.....06
Rainwater collection.....07
Bottled water.....08
Unprotected dug well.....09
Unprotected spring.....10
Pond, river or stream.....11
Tanker-truck, vendor.....12
Other (*specify*) _____13
No answer or DK.....99

2. **HOW LONG DOES IT TAKE TO GO THERE, GET WATER, AND COME BACK?** No. of minutes.....__ __ __
Water on premises.....888
DK.....999

3. **WHAT KIND OF TOILET FACILITY DOES YOUR HOUSEHOLD USE?** Flush to sewage system or septic tank.....1Pour flush latrine (water seal type).....2
Improved pit latrine (e.g., VIP).....3
Traditional pit latrine.....4
Open pit.....5
Bucket.....6
Other (*specify*) _____ 7
No facilities or bush or field.....8

4. **IS THIS FACILITY LOCATED WITHIN YOUR DWELLING, OR YARD OR COMPOUND?****
Yes, in dwelling/yard/compound.....1
No, outside dwelling/yard/compound.....2

5. **WHAT HAPPENS WITH THE STOOLS OF YOUNG CHILDREN (0-3 YEARS) WHEN THEY DO NOT USE THE LATRINE OR TOILET FACILITY?**
Children always use toilet or latrine.....1
Thrown into toilet or latrine.....2
Thrown outside the yard.....3
Buried in the yard.....4
Not disposed of or left on the ground.....5
Other (*specify*) _____6
No young children in household.....8

Pictorials for Water and Sanitation Facilities:
http://www.childinfo.org/files/JMP_Pictorials_for_Water_and_Sanitation.pdf

3. Human Development Report 2006: Beyond Scarcity: Power, Poverty and the Global Water Crisis site**:**
http://hdr.undp.org/en/reports/global/hdr2006/chapters/

Indicators part:
http://hdr.undp.org/en/media/human_development_indicators.pdf

Human Poverty Index:

Calculating the HPI-1

1. Measuring deprivation in a decent standard of living
An unweighted average of two indicators is used to measure deprivation in a decent standard of living.

Unweighted average = 1/2 (population without sustainable access to an improved water source) + 1/2 (children under weight for age)

A sample calculation: Namibia
Percentage of population without sustainable access to an improved water source = 13%
Percentage of children under weight for age = 24%

Unweighted average = 1/2 (13) + 1/2 (24) = 18.5%

2. Calculating the HPI-1
The formula for calculating the HPI-1 is as follows:

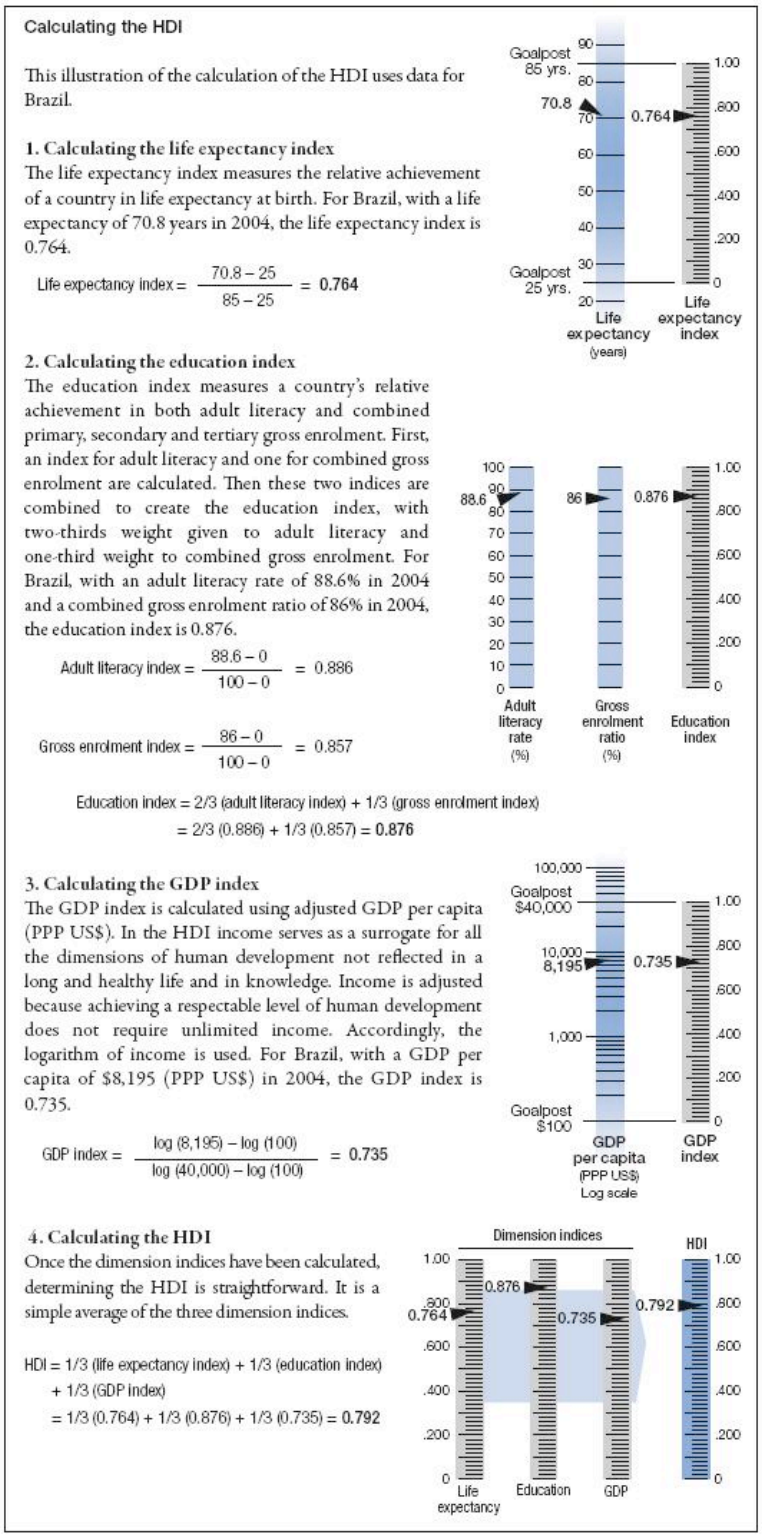
$$\text{HPI-1} = [1/3 (P_1^{\alpha} + P_2^{\alpha} + P_3^{\alpha})]^{1/\alpha}$$

Where:
P_1 = Probability at birth of not surviving to age 40 (times 100)
P_2 = Adult illiteracy rate
P_3 = Unweighted average of population without sustainable access to an improved water source and children under weight for age
$\alpha = 3$

A sample calculation: Namibia
$P_1 = 45.4\%$
$P_2 = 15.0\%$
$P_3 = 18.5\%$

$$\text{HPI-1} = [1/3 (45.4^3 + 15.0^3 + 18.5^3)]^{1/3} = 32.5$$

Human Development Index:



In terms of **tables** in the report:
http://hdr.undp.org/en/media/hdr_2006_tables.pdf

Table No. 3 Human and Income poverty: developing countries, uses as one of the indicators population without sustainable access to an improve water source.

Indicator **Table No. 9** specifically addresses the water, sanitation and nutritional status links.

4. World Bank Living Standards Measurement Study (LSMS) site:
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21610833~pagePK:64168427~piPK:64168435~theSitePK:3358997,00.html

The World Bank's Living Standards Measurement Study (LSMS) was created in 1980 as a tool to find ways of improving the **type and quality of household data** collected by statistical offices in developing countries. Its main objective has been to foster increased use of household data as a basis for policy decision-making. LSMS is working to develop new methods to monitor progress in raising levels of living standards, to assist governments with various policy interventions and to improve communications between survey statisticians, analysts, and policy makers. This site also provides guidance on how to create, design or search surveys.

For a list of **country survey**s please refer to:
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21485765~isCURL:Y~menuPK:4196952~pagePK:64168445~piPK:64168309~theSitePK:3358997,00.html

Survey and Analysis Tools:
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21555895~menuPK:4196884~pagePK:64168445~piPK:64168309~theSitePK:3358997,00.html

Designing survey guidelines:
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21555919~isCURL:Y~menuPK:4196884~pagePK:64168445~piPK:64168309~theSitePK:3358997,00.html

Questionnaires guidelines and samples:
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21556375~isCURL:Y~menuPK:4196884~pagePK:64168445~piPK:64168309~theSitePK:3358997,00.html

Relevant Sites on Water Supply and Sanitation

This part of the review provides a list of useful agency/joint programs sites in the field of water supply and sanitation.

1. International Year of Sanitation Site (IYS 2008):
http://esa.un.org/iys/

The United Nations General Assembly declared 2008 as the International Year of Sanitation (IYS 2008). The main purpose of this site is to continue to raise awareness on sanitation issues. To this extent, extensive information is provided in terms of economic costs and benefits of sanitation. Linkages with health, education, the environment and social development are discussed and statistical evidence is provided to encourage action at various levels.

This site is a very useful source for government, researchers, practitioners and media. It contains Kits with information included in English, Spanish and French. It also provides access to the flagship document " Tackling the Global Crisis: International Year of Sanitation". Various fact sheets and site sources are listed where the user can find further information if needed.

2. Joint Monitoring Programme (JMP) for Water Supply and Sanitation site:
http://www.wssinfo.org/en/welcome.html

The Joint Monitoring Programme (JPM) is an initiative created by UNICEF and WHO to collect and disseminate data pertaining to water supply and sanitation. Data can be found at the global, regional and country level depending on the specific needs or scope of analysis. The information is organized by subsets of indicators and corresponding maps in the field of WSS.

Water data: http://www.wssinfo.org/en/21_wat_intro.html

Sanitation data: http://www.wssinfo.org/en/31_san_intro.html

Water and Sanitation query tool: http://www.wssinfo.org/en/sanquery.html

3. UNICEF's Publications Site on Water, Sanitation and Hygiene:
http://www.unicef.org/wes/index_documents.html

This site provides a detailed list of various publications relevant to water, sanitation and hygiene. Publications are organized by technical, policy and advocacy pieces. It is also a useful tool for research as it provides links to other agencies working in the same area. Other useful UNICEF sites include:

Water, Environment and Sanitation Statistics:
http://www.unicef.org/wes/index_statistics.html

Water Supply and Sanitation Country Profiles Site:
http://www.unicef.org/28044.html

4. WHO Publications site on Water, sanitation and Hygiene:
http://www.who.int/water_sanitation_health/en/

Statistics Database: http://www.who.int/water_sanitation_health/database/en/index.html

Water, Health and Economics: http://www.who.int/water_sanitation_health/economic/en/

5. World Bank:
In addition to the LSMS links provided above the following links could also be of use:

WB Data and Statistics in Water Supply and Sanitation:
http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTWAT/0,,contentMDK:21733368~menuPK:4602430~pagePK:148956~piPK:216618~theSitePK:4602123,00.html

WB Data and Research site: (includes statistics on various sectors as well as access to Policy research reports, World Development Reports, etc)
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/0,,menuPK:476823~pagePK:64165236~piPK:64165141~theSitePK:469372,00.html

WB World Development Indicators Site 2008:
http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:21725423~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html

Data and Statistics: Environment site: (Indicators in all areas of environment)
http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20394745~isCURL:Y~menuPK:1390200~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html

Environment Department Water and Sanitation information:
http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTDATASTA/0,,contentMDK:21084598~pagePK:64168445~piPK:64168309~theSitePK:2875751,00.html

Access to Safe Water initiative:

This site is part of the WB's Development Education Program (DEP) web site. It is resource tool to help teachers and students think about various topics affecting their countries. In terms of water and sanitation these are the links that apply:

http://www.worldbank.org/depweb/english/modules/environm/water/
http://www.worldbank.org/depweb/english/modules/environm/water/index02.html
http://www.worldbank.org/depweb/english/modules/environm/water/index03.html