Research Report February 2008
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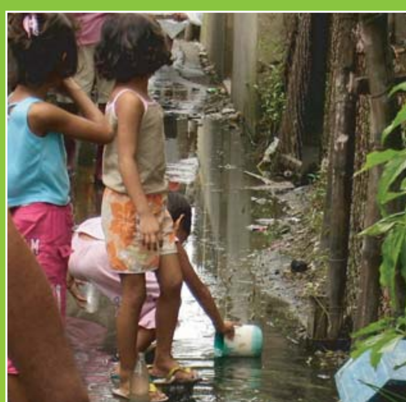
Economic Impacts of Sanitation in the Philippines

A five-country study conducted in Cambodia, Indonesia, Lao PDR, the Philippines and Vietnam under the Economics of Sanitation Initiative (ESI)



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30 years
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water and sanitation program

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Table S1. Background Information

Item	Value
Population (million, est. 2005)	84.2
Rural population (million, est. 2005)	55.1
Urban population (million, est. 2005)	29.1
Under 5 population (% of total population, 2005)	12.6
Female population (% of total population, 2000)	49.6
Currency	Peso (PhP)
Exchange rate (domestic currency per US$, 2005)	55.1
Year of cost data presented	2005
GDP per capita (US$, 2005)	1,281.9
Access to improved sanitation (2004)	
Rural (%)	59
Urban (%)	80
Urban households connected to treated sewers (%)	3.3

Executive Summary

Introduction

About 72% of the Philippine population had access to improved sanitation in 2004. Although this figure is a considerable improvement on the 57% in 1990, it still corresponds to about 20 million people who do not have access to improved sanitation. While it is clear that the lack of access to clean water and sanitation facilities has a wide variety of impacts, there are limited data and research to verify the significant burden imposed by poor sanitation on society. This, in turn, hampers the implementation of much needed investments in the sector. The urgency for such research, and not to mention investments, is only likely to grow over time. One of the reasons is that, with an average population growth of more than 2% per annum, an additional 2 million Filipinos will require adequate and clean sanitation facilities each year. Thus, the 'sanitation impact' study was initiated by the World Bank to generate evidence on the impacts of current sanitation conditions and the benefits of alternative sanitation and hygiene improvement options in the Philippines.

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Methodology

The study conducted a quantitative and qualitative assessment of the impacts of poor sanitation on health, water, tourism, and other welfare impacts. The inclusion of health was based on well-established links between sanitation and disease incidence. Water impacts were deemed important because poor sanitation is one of the causes of water pollution. This, in turn, leads to costly avertive behavior in response to less usable water resources. Moreover, pollution also affects the productivity of water resources by way of lower fisheries output. Other welfare impacts were included because the absence of sanitary facilities affects people in terms of the time spent accessing facilities and productivity in work and school. Finally, tourism was included in the study because poor sanitation facilities could influence the country's attractiveness as a tourist destination.

The analysis interpreted sanitation as activities that are related to human waste — particularly excreta. However, there were instances in which sanitation as it relates to gray water and solid waste were also included. In measuring the impacts, the study used standard peer-reviewed methodologies. An attempt was also made to distinguish between financial and economic costs. Where possible, the analysis was conducted at the regional level and aggregated to the national level.

Results

Overall, the study estimated that poor sanitation led to economic costs in the order of US$1.4 billion or PhP 77.8 billion per year. This was equivalent to about 1.5% of GDP in 2005 and translated to per capita losses of US$16.8 or PhP 923.69 per year. The health impacts represented the largest source of quantified economic costs. Estimated to be about US$1 billion, this item explained about 72% of total economic costs. The second most important economic impact was on water resources, which accounted for about 23% of the total costs. The remainder was divided between impacts on other welfare impacts and tourism.

Figure S1. Cost of poor sanitation (million US$)

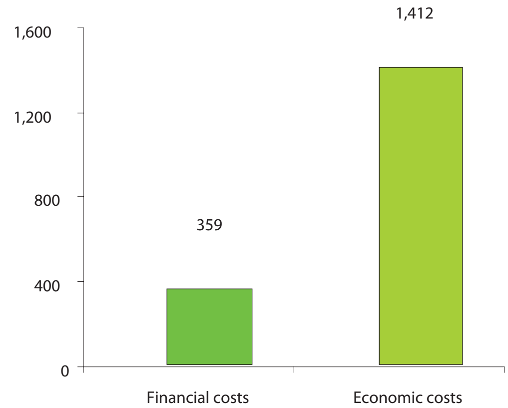
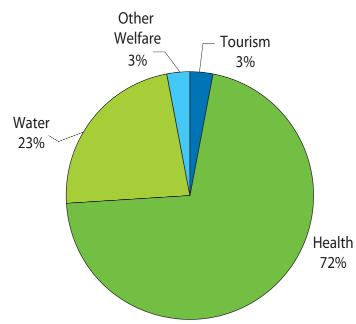


Figure S2. Distribution of economic costs (%)[1]



Note: [1] Values do not sum to 100 due to rounding.

Impacts on health

The cost of premature death was the biggest contributor to the health impacts. Estimated to be about US$923 billion per year, it accounted for about 91% of the health economic impact. It was explained mostly by the deaths of children, particularly from acute watery diarrhea and malnutrition-related diseases. While affixing a value on a person's life is a contentious issue from a methodological standpoint, the technique used in this study (human capital approach) may actually be viewed as generating conservative estimates. This is based on the finding that the values presented here are actually lower than those estimated using another technique (value of statistical life).

The other dimensions of health impacts are health care and productivity costs. Capturing the value of time lost as a result of sanitation-related illness, productivity costs accounted for slightly more than 5% of the total health impacts. The remainder was explained by health care costs.

Impacts on water

The water impacts of poor sanitation amounted to about US$323 million per year. Nearly six-tenths of this total was attributed to costs associated with domestic water uses (excluding water used for drinking). On the other hand, costs related to drinking water explained about 36% of total cost. The remainder, or about 3%, was explained by losses to fisheries.

Other welfare impacts

The total economic costs associated with other welfare impacts were estimated to be about US$38 million per year. About two-thirds of these costs were accounted for by productivity losses caused by time spent accessing toilets. The remainder was explained by productivity losses caused by the absences of women from work and school. While the effects were not quantified, the study also evaluated the impacts of poor sanitation on the intangible user preferences and on the surrounding environment. With respect to the first impact, it found indications that Filipinos prefer clean facilities and are forced to make adjustments in response to unsanitary conditions. Perhaps reflecting a weaker appreciation of the health impacts, it also found that Filipinos put a premium on the "lack of smell," privacy, and status that usually accompanies the presence/ownership of clean toilets. Given the lack of information, the impacts on the surrounding environment were evaluated in the context of solid waste management. In this regard, the study echoed the findings in the literature that a significant proportion of the country's garbage is not being disposed properly.

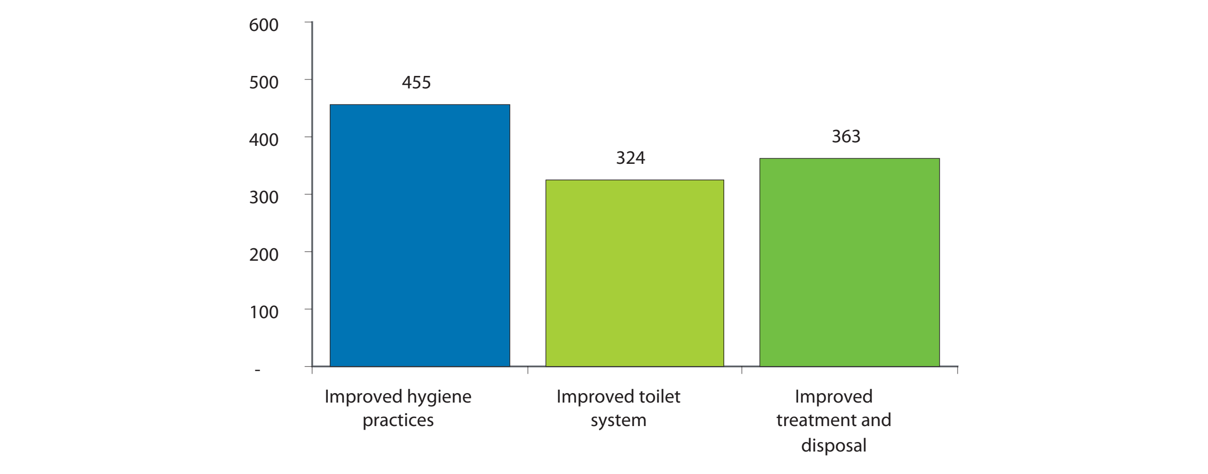
Impacts on tourism

Tourism impacts were computed on the assumption that visitors to the country are sensitive to sanitation conditions. Specifically, it assumed that improved sanitation, among other things, would allow the country to achieve the government target of 5 million tourists by 2010. The study estimated the costs to be about US$40 million.

Sanitation improvement options

Having estimated the impacts, the study also evaluated the benefits associated with improved sanitation and hygiene practices. Better hygiene practices and improvements in toilet systems were linked to a reduction in health costs, while improved physical access and treatment/disposal can reduce the other cost components. The results showed that improved hygiene practices — e.g., hand washing — can reduce health costs by approximately US$455 million. Improved physical access to sanitary toilets can reduce economic costs associated with time loss by about US$38 million, while improved toilet systems can reduce health costs by US$324 million. Improvements in the treatment or disposal of waste have a large impact on water resources and can reduce costs by US$363 million. While the benefits from pursuing all the improvements will not necessarily lead to gains which are equal to the sum of the values above, the results nonetheless suggested that the gains can be significant.

Figure S3. Economic benefits of sanitation improvement (million US$)



Sensitivity analysis

Since the study was based on secondary information and assumptions regarding the magnitude of the relationships between poor sanitation and its impacts, there will be uncertainty in the results. This is likely to exist in the (a) overall estimation of the impacts, (b) attribution of the overall impact to poor sanitation, and (c) the actual size of impact mitigation possible. To address these issues, the study implemented a sensitivity analysis on key parameters and assumptions. As a whole, the study found that the overall results were quite sensitive to assumptions regarding the health impacts and benefits to sanitation markets. This arises from the finding that these two aspects explained a very large proportion of the potential gains. To illustrate, improvements in hygiene practices were initially assumed to cause a 45% reduction in total health costs. Based on estimated economic health costs, this implies a gain of US$455 million. However, a high estimate, which assumes a 60% reduction in total health costs, represents a gain of US$607 billion.

Conclusions and recommendations

The findings of this study indicated that poor sanitation has significant economic costs. Consequently, it also showed that the gains could be substantial. On the basis of these findings, the study recommends the following. The first is to raise investments in the sanitation sector. While this is fairly obvious and well-known to stakeholders, it is nonetheless worth repeating, especially in the light of the findings above. Second, when financial resources are scarce, investments can be targeted to rural regions which have a disproportionately large population of children and to urban slum areas. The reason is that people in rural regions have relatively low access to improved sanitation. Moreover, children are more vulnerable to sanitation-related diseases such as diarrhea. On the other hand, the high population density and the potentially high exposure to poor sanitation in urban slums increase the risk of not only disease but of water pollution as well. Third, existing education and information campaigns should be intensified to promote personal hygiene. As shown in the study, the gains from such an initiative can be significant. Apart from the fact that the outlays may be lower than directly investing in sanitary facilities, there is also a large room for improvement in the light of surveys that indicate that less than half of Filipinos wash their hands after using the toilet. Fourth, there is also a need to evaluate the various options/technologies available to concerned agencies/institutions. Such an analysis is necessary in identifying suitable technologies and practices that will increase the potential for success of investment projects. The final recommendation is a call for more research in evaluating the impacts of poor sanitation. The study depended heavily on secondary information and only partially substantiated claims for the link between sanitation and the various impacts measured. Apart from introducing uncertainties in the results, the lack of reliable data also constrained its ability to quantitatively assess a number of impacts associated with poor sanitation.

The findings of this study are relevant for three reasons. First, the findings show that the economic impacts of poor sanitation are significant. Second, the findings illustrate that improvements in the sanitation sector will not only result in economic savings but will also lead to gains that go beyond the simple mitigation of costs for example, the value of human excreta used for fertilizer. Finally, the study methodology provides a starting point and framework for future studies on the economic impacts of sanitation.

Foreword

Countries in Southeast and East Asia, like those in other regions of the world, are on a development path that is lifting large numbers of people out of poverty. Economic indicators in the region are, generally, positive.

As well as economic growth, populations demand improved quality of life through improved health, housing, access to welfare services, and living environment. However, in a world of multiple government and donor priorities, some aspects of development remain neglected.

Sanitation is one such neglected aspect of development. Because of the many priorities of households and governments, it is often pushed down the agenda and left as an issue to be dealt with by someone else, or not at all. Indeed, without information on the link between sanitation and economic development, it is hardly surprising that sanitation is sidelined.

Strong evidence is needed to convince governments and households to spend more on improving sanitation. This includes generating information on the impacts of poor sanitation on the environment, health and welfare.

Based on this premise, the World Bank's Water and Sanitation Program (WSP) in East Asia and the Pacific (WSP-EAP) is leading the 'Economics of Sanitation Initiative' (ESI) to compile existing evidence and to generate new evidence on socioeconomic aspects of sanitation. The ultimate aim of the ESI is to assist decisionmakers at different levels to make informed choices on sanitation policies and resource allocations.

The first major activity of the ESI is 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. Once these questions are answered, national stakeholders can continue the discussions about policymaking and priority setting armed with a better evidence base for decisionmaking. They will be further supported in their policy debates following the completion of the second ESI study, a 'sanitation options' study, which 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 research under this program is initially being conducted in Cambodia, Indonesia, the Philippines, Vietnam, and Lao PDR.

While the WSP has supported the development of this study, it is an 'initiative' which includes the active contribution of many people and institutions (see 'Acknowledgements' and Annex E for details).

Abbreviations and Acronyms

ABD	acute bloody diarrhea
ADB	Asian Development Bank
ARMM	Autonomous Region of Muslim Mindanao
ALRI	acute lower respiratory infection
AWD	acute watery diarrhea
BFAR	Bureau of Fisheries and Aquatic Resources
BOD	biological oxygen demand
BSNOH	Baseline Surveys on the National Objectives for Health
cap	capita
CAR	Cordillera Administrative Region
CBA	cost-benefit analysis
COD	chemical oxygen demand
d	day
DA	Department of Agriculture
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DOLE	Department of Labor and Employment
DOVB	Department of Vaccines and Biologicals
DHS	Demographic and Health Survey
DO	dissolved oxygen
DOT	Department of Tourism
EAP	East Asia and the Pacific
EASAN	East Asia Sanitation Conference
ECO-Asia	Ecological Sanitation - Asia
EcoSan	ecological sanitation
EMB	Environmental Management Bureau
ESI	Economics of Sanitation Initiative
FAO	Food and Agriculture Organization
FDI	foreign direct investment
FHSIS	Field Health Service Information System
FSSI	Foundation for Sustainable Society, Inc.
g	grams
GDP	gross domestic product
GNP	gross national product
HRQL	health-related quality of life
HCA	human capital approach
IPD	inpatient day
JMP	Joint Monitoring Programme
kg	kilogram(s)
L	liter(s)
LWUA	Local Water Utilities Administration
mg	milligrams
MDG	Millennium Development Goal
mt	metric tons
NCR	National Capital Region
NDHS	National Demographic and Health Survey
NEC	National Epidemiology Center
NEDA	National Economic and Development Authority

NGO	nongovernmental organization
NSCB	National Statistical Coordination Board
NSO	National Statistics Office
NTU	nephelometric turbidity unit
OECD	Organization of Economic Cooperation and Development
OPV	outpatient visit
ORS	oral rehydration solution
PADCO	Planning and Development Collaborative International
PEM	Philippine Environment Monitor
ppm	parts per million
PCWS	Philippine Center for Water and Sanitation
PhilHealth	Philippine Health Insurance Corporation
PhP	Philippine peso
PSY	Philippine Statistical Yearbook
SEAR-B	WHO Southeast Asia Region epidemiological strata B
SCOTIA	Sustainable Coastal Tourism in Asia
SEI	Stockholm Environment Institute
STC	short-term consultant
SWAPP	Solid Waste Management Association of the Philippines
TSS	total suspended solids
TCU	true color unit
UN	United Nations
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
UNITAR	United Nations Institute for Training and Research
UPLB	University of the Philippines Los Baños
US$	United States dollar
USAID	United States Agency for International Development
VIP	ventilated improved pit latrine
VOSL	value of statistical life
WB	World Bank
WHO	World Health Organization
W&S	water supply and sanitation
WPR-B	WHO Western-Pacific Region epidemiological strata B
WSH	Water, Sanitation and Hygiene
WSP	Water and Sanitation Program
WTP	willingness to pay

Acknowledgements

The Sanitation Impact Study was conducted in four countries: Cambodia, Indonesia, the Philippines, and Vietnam. A study is ongoing in Lao PDR. The study was led by the East Asia and Pacific Office of the World Bank's Water and Sanitation Program (WSP), with the contribution of WSP teams in each of the participating countries. The study took 1 year to complete and has undergone two major peer review processes.

Guy Hutton (WSP-EAP regional senior water and sanitation economist) led the development of the concept and methodology for the Economics of Sanitation Initiative (ESI) and the management and coordination of the country team. The study benefited from the continuous support of other WSP-EAP staff. Isabel Blackett was the task team leader; Jema Sy, Brian Smith, Almud Weitz, and Richard Pollard provided inputs to concept development and study execution. Bjorn Larsen (WSP consultant) contributed to the study methodology and provided the figures for malnutrition-related health effects of poor sanitation.

The country team in Philippines consisted of U-Primo E. Rodriguez (USAID consultant and country lead) and Nelissa Jamora (USAID consultant). Edkarl Galing and Leila Elvas (WSP Philippines) also contributed significantly to the study.

The ESI has been financed by the regional component of the Sustainable Sanitation in East Asia (SUSEA) Program, which is funded by the Swedish International Development Agency (SIDA). The Philippine study received co-funding from the USAID Environmental Cooperation-Asia (ECO-Asia) Program. WSP and the report authors are grateful to the funding agencies for supporting this study.

Elena Strukova, Caroline van den Berg, Anjali Archarya, and Tracey Hart reviewed the methodology study before its implementation. Peer reviewers of the **Philippine** country draft report were Jema Sy and Andy Robinson (consultant). The Philippine study benefited from peer review conducted simultaneously on other country reports as well as the synthesis report. Peer reviewers of the **synthesis** draft report were (World Bank staff unless otherwise stated) Eddy Perez, Anjali Acharya, Pete Kolsky, Elena Strukova (consultant), Bjorn Larsen (consultant), and Peter Feldman (Plan International). Peer reviewers of the **Cambodia** country draft report were Hilda Winarta (UNICEF), Jan Lam (SNV), Chea Samnang (Ministry of Rural Development), Ruud Corsel (Niras-Scanagri, Vietnam), and Oun Syvibola (Plan International). Peer reviewers of the **Vietnam** country draft report were: Samuel Leibermann, Doan Hong Quang, Pham Khanh Toan (Ministry of Construction), Nguyen Viet Anh (University of Civil Engineering), Nguyen Kim Thai (University of Civil Engineering), Nguyen Van Thuan (Australian Agency for International Development), and John Collett (Plan International).

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Reference

Economic impacts of sanitation in the Philippines. Rodriguez UE, Jamora N, Hutton G. World Bank, Water and Sanitation Program. 2008.

A short version of this technical report is available from WSP offices and http://www.wsp.org/pubs/index.asp.

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1 Introduction

One of the targets of the United Nations Millennium Development Goals (MDG) is to halve the proportion of people without access to sanitation by 2015 [1].[1] As of 2004, 59% of the world's population had access to improved sanitation. This appears to be below the target at that point, given the 49% coverage that existed in 1990. Moreover, population growth also meant that the unserved global population has decreased only marginally from 2.7 to 2.6 billion over a 14-year period [1].

Table 1 shows official sanitation coverage data from the WHO/UNICEF Joint Monitoring Programme (JMP) for Southeast Asian countries and other regions in the world.[2] It indicates that about 72% of the Philippine population had access to improved sanitation in 2004. This is about 15 percentage points higher than the value in 1990 and slightly above the average for Southeast Asia. The rate of increase of coverage is in line, though barely, with the MDG target. In spite of this, the values in Table 1 raise two key areas of concern. First, with a population of about 85 million, the values suggest that at least 20 million people have no access to improved sanitation facilities.[3] Second, there continues to be a wide gap between rural and urban areas. In 1990, only 48% of the rural population had access to improved sanitation. This was about 18 percentage points lower than estimates for urban areas. By 2004, the gap between urban and rural areas actually widened to 21 percentage points.

Apart from access to improved sanitation, another area of concern is hygiene practices. A nationwide survey in 2000 found that less than half of the respondents wash their hands after using the toilet (Figure 1). It also showed that only about a quarter of the respondents wash their hands before handling or preparing food.

The positive side is that the government recognizes the importance of the problem. For example, Chapter 3 of the Medium-term Development Plan 2004-10 states the following target: "Ensure that all barangays/municipalities that will be provided with water supply services have corresponding sanitation facilities for proper disposal of wastewater and septage…" [2]. However, achieving this objective can be a formidable task in the light of fiscal constraints and the apparently higher demand for investments in water supply. To illustrate, average investments in water supply and sanitation accounted for 1.5% of gross domestic product (GDP) in 1999. Of this amount, only about 3% was allocated to sanitation [3].

Despite the importance of water and sanitation in the development process, policymakers have not been presented with comprehensive evidence on the impacts of poor sanitation. To make informed policy decisions, policymakers need to understand the long-term economic benefits of improved regulatory measures and increased resource allocations for sanitation. Likewise, claims for increased spending on sanitation need to be supported by reliable evidence showing that economic and social returns on sanitation investments are at least as high as returns in other sectors [4]. Therefore, policymakers and sanitation advocates require evidence not only of the negative impacts of poor sanitation, but also how these impacts can be mitigated with different sanitation options, and the comparative costs of these options.

1 The base period for the target is 1990.
2 Table 2 provides JMP definitions of improved and unimproved water and sanitation.
3 A regional breakdown of the Philippine population is presented in Annex A.

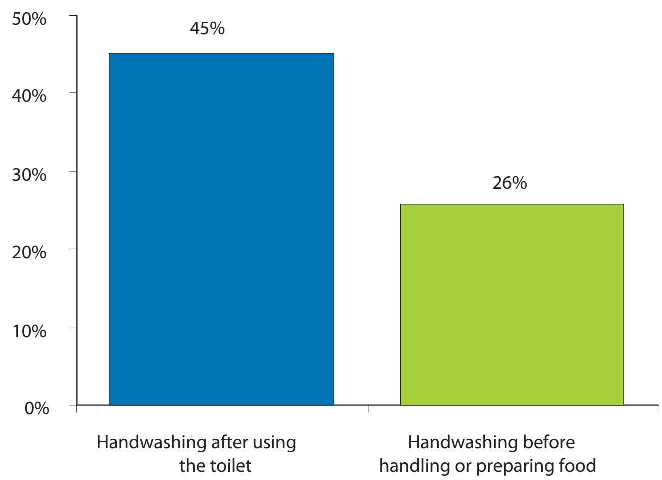
Table 1. Improved sanitation coverage statistics for Southeast Asian countries versus other developing world regions (%)[1]

Country	Rural		Urban		Total	
	1990	2004	1990	2004	1990	2004
Cambodia	-	8	-	53	-	17
Indonesia	37	40	65	73	46	55
Laos	-	20	-	67	-	30
Malaysia	-	93	95	95	-	94
Myanmar	16	72	48	88	24	77
Philippines	48	59	66	80	57	72
Singapore	-	-	100	100	100	100
Thailand	74	99	95	98	80	99
Timor-Leste	-	30	-	66	-	33
Vietnam	30	50	58	92	36	61
SOUTHEAST ASIA	**40**	**56**	**70**	**81**	**49**	**67**
OTHER REGIONS						
East Asia	7	28	64	69	24	45
South Asia	8	27	54	63	20	38
West Asia	55	59	97	96	81	84
Oceania	46	43	80	81	54	53
Latin America and the Caribbean	36	49	81	86	68	77
North Africa	47	62	84	91	65	77
Sub-Saharan Africa	24	28	52	53	32	37
Commonwealth of Independent States	63	67	92	92	82	83

Source: WHO/UNICEF/JMP after [5]

Note: [1]Annex A1.2 presents alternative measures of sanitation coverage in the Philippines. Annex A1.3 provides a regional breakdown.

Figure 1. Selected hygiene practices in the Philippines (%), 2000



Source: Festin et al. after [6]

Evidence takes many forms. Given the multiplicity of funding sources, channels, and regulations for sanitation, relevant evidence of the sanitation impact would need to be provided for different decision-making levels: national, regional, provincial, district, city, village, community, and household. However, the global economic evidence base is extremely limited [4, 7-11], and published local evidence is even weaker. The majority of the studies conducted to date focus on the health impacts of poor sanitation (see Box 1). Given that the health arguments for improved sanitation have only had a limited (if any) effect on resource allocation, it is clear that health arguments need to be evaluated and presented together with other negative impacts of poor sanitation.

Box 1. Studies on sanitation in the Philippines

In the Philippines, the focus on sanitation and sewerage was heightened in the 1990s with the provision of World Bank funding for the Manila Sewerage Project and for the local government units' Urban Water and Sanitation Project. In line with this, the *Philippine Environment Monitor* (*PEM*) series was launched to help disseminate information about environmental indicators and to engage and inform stakeholders on key environmental trends at the local level. The *2000 Monitor* was the first attempt at benchmarking general environmental indicators and cited early studies on economic valuation of pollution on the Philippine environment. The *PEM 2003 on Water Quality* estimated the annual economic losses caused by water pollution at PhP 67 billion, including PhP 3.3 billion for health, PhP 16.7 billion for fisheries production, and PhP 47 billion for tourism. The *PEM 2006 on Environmental Health* estimates that water pollution and poor sanitation conditions are costing the economy PhP 6.7 billion per year, including PhP 2.8 billion for illness cost and PhP 3.9 billion in lost income due to premature death from diseases.

Therefore, the specific **goal** of the present 'sanitation impact' study is to provide decisionmakers at the national and regional levels 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 policymakers who can influence the overall allocation of resources to sanitation. The list includes central ministries (budgeting, economics, finance), line agencies (infrastructure, sanitation, water, rural development, urban planning), and external funding and technical partners (multilateral, bilateral, and nongovernment agencies). The study also targets subnational decision-making levels where the results and conclusions of this study are also relevant. The study disaggregates selected impacts by regions, as well as provides a rural-urban breakdown. However, to inform decisionmakers at the local level, additional studies are needed to further disaggregate the results.

This study is a situation analysis. To provide timely evidence, it uses a methodology' that draws largely on existing data sources available from governments, donors, nongovernment agencies, and the scientific literature. The data gaps and weaknesses identified in this study enable the crafting of recommendations to further strengthen routine information systems and identify priority areas for scientific research to allow a better estimation of sanitation impact in the future.

The results of this study will contribute to the design and execution of a second study under the Economics of Sanitation Initiative. The second study is based on the rationale that decisionmakers need to know which sanitation improvements provide the best value for money, what the overall costs and benefits are, and who are willing or able to finance the improvements. These studies, taken together, will provide an improved evidence base for the efficient planning and implementation of sustainable sanitation options in the Philippines.

A focus of this study on sanitation and not on water *per se* is justified on the following grounds:

1. Water has historically received greater emphasis than sanitation in terms of research, policy development, program support, and resource allocation. The WHO /UNICEF JMP estimates that, in the 1990s, water received US$12.6 billion annually, while sanitation received US$3.1 billion, a factor difference of four times [12]. In Asia,

the factor difference between spending on water and spending on sanitation in the same period is 5.5 times. As a result of this skewed spending, sanitation is lagging behind other global development goals: 59% of the world's population had access to improved sanitation in 2004, compared with 83% for access to improved water supply [1]. In the Philippines, the proportion allocated to sanitation (3% of the total for water and sanitation) is even lower.

2. Poor sanitation practice is the starting point for many of the observed negative impacts of poor water *and* sanitation. For example, water quality is affected by poor sanitation. This means that better sanitation leads to improvements in the quality of water for human consumption and productive purposes. Also, a major share of water-, sanitation-, and hygiene-related diseases are fecal-oral in nature, which means that they are transmitted because the sanitation practice fails to isolate the pathogens from contact with humans.

Hence, this study is a first attempt to comprehensively evaluate the impacts of poor sanitation at the national level in the Philippines.[4] Many of these impacts are quantifiable in economic terms. Other impacts, which are less tangible or difficult to evaluate, are also potentially important for economic development, quality of life, and political decisionmaking. This study is the first application of a comprehensive sanitation impact evaluation methodology developed by the World Bank Water and Sanitation Program [13]. Based on the experiences of this present study, the methodology will be revised for application in other countries and regions of the world.

4 Similar studies are also being implemented in Cambodia, Indonesia, Laos, and Vietnam.


HE
NO ENTRY

2 Overview Of Study Methodology

This sanitation impact study followed a standardized peer-reviewed methodology [13]. It used the approach adopted in four other countries (Cambodia, Indonesia, Laos, and Vietnam) with a view toward generating comparable outputs in the Southeast Asian region [14].

This section describes the following:

1. The levels and units of analysis used (2.1)
2. The aspects of 'sanitation' that were included (2.2)
3. How impacts were classified and which were included (2.3)
4. An overview of how the different economic impacts of unimproved sanitation were measured (2.4)
5. The methods used for predicting the economic benefits associated with improved sanitation ('impact mitigation') (2.5)

Annex A describes the detailed methods for estimating the economic impacts of unimproved sanitation. It also discusses how methodological weaknesses and uncertainty in input variables are evaluated in sensitivity analysis.

2.1 Levels and units of analysis

The primary aim of this study was to describe and quantify sanitation impacts at the national level. It was designed to inform policymakers about the overall negative impacts of poor sanitation and the potential benefits of implementing different types of sanitation improvement. The ultimate usefulness of this exercise is to serve as a basis for estimating the impacts that can be mitigated from improving sanitation. It is important to note that the gains from improving sanitation will be less than the losses from unimproved sanitation. The reasons are that (a) sanitation interventions do not have 100% effectiveness to reduce adverse health outcomes associated with poor sanitation, and (b) poor sanitation is one of many causes of water and environmental pollution.

The aim of the study was to present impacts to aid interpretation and eventually set policy recommendations. Where possible, a regional analysis of the results was conducted. In cases where it was feasible, a rural/urban disaggregation of the impacts was also presented. Furthermore, health impacts were disaggregated by age groups for selected diseases and descriptive gender analyses were conducted for selected impacts.

The study used a modeling approach and drew almost exclusively on secondary sources of data. It presented impacts in physical units and converted these into monetary equivalents using conventional economic valuation techniques. Results on economic impact were presented for a single year–2005. Results were also presented in US dollars to enable cross-country comparisons of the *relative* impact of poor sanitation. For those impacts where quantification in economic terms was not feasible using secondary data sources, the impacts were examined and reported descriptively.

2.2 Scope of sanitation

Sanitation is used to describe many different aspects of hygiene and disposal or recycling of waste. This requires the study to clearly specify the aspects of sanitation that will be assessed. Furthermore, what actually constitutes *improved* sanitation–as opposed to *unimproved*–will vary across countries and cultural contexts. In the international arena, the sanitation target adopted as part of the MDG focuses on the disposal of human excreta. Hence, for human excreta, there are significantly better national data available on population numbers with access to improved coverage. Table 2 presents definitions used by the WHO/UNICEF JMP for improved and unimproved water supply and sanitation.

Table 2. Definition of 'improved' and 'unimproved' sanitation and water supply[1]

Intervention	Improved	Unimproved[2]

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

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

Notes: [1]This table reflects the updated definition of improved and unimproved sanitation and water supply presented in the 2006 JMP report [1].
[2] An unimproved facility is defined as being unsafe or costly.

Despite the focus of the sanitation MDG target on human excreta, this study recognizes that other areas of sanitation are relevant to the economic impacts. The management of human and animal excreta, solid waste, other agricultural waste, toxic waste, wastewater, food safety, and associated hygiene practices were also included in the broader definition of sanitation. However, not all of these could be included in the present study. Table 3 provides an overview of the aspects of sanitation which were included in this study. While the primary focus is on human excreta disposal, selected components of domestic sanitation–gray water and solid waste–were also evaluated. The health implications of poor hygiene as they relate to human excreta were also assessed.

While sanitation is often more broadly defined than the components included, it was not possible to apply a broader definition in this present study due to time and resource constraints. Hence, the issues of drainage, flood control, hospital waste, agricultural waste and run-off, industrial waste, and broader environmental health such as food hygiene, air pollution, and vector control were not included in this study.

Table 3. Aspects of sanitation included in the present 'sanitation impact' study

Included	Excluded

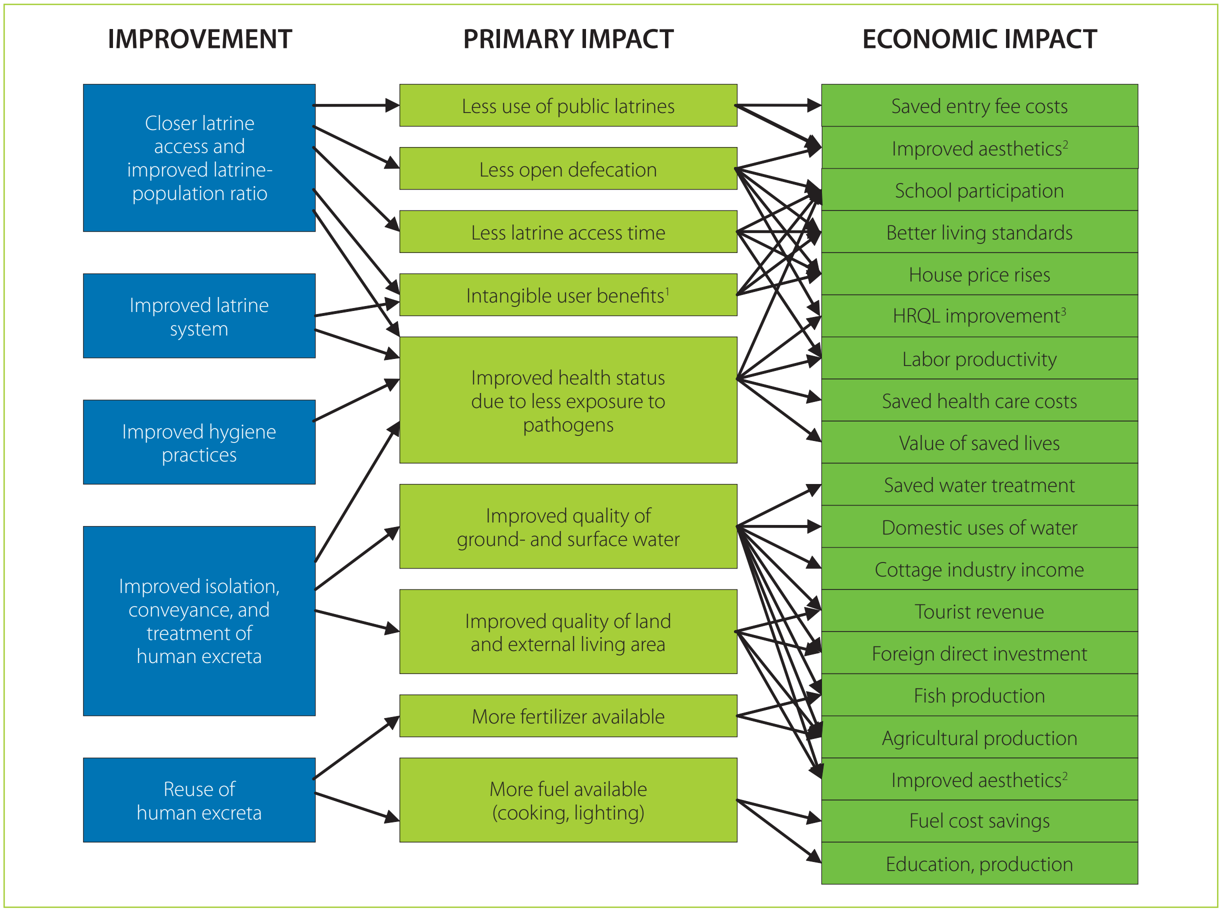
• Practices related to human excreta:
  • Quality, safety, and proximity of latrine system
  • Disposal or treatment of waste and impact on the (inhabited) outdoor environment
  • Hygiene practices
• Practices related to disposal or treatment of gray water
• Practices related to disposal or treatment of household solid waste
	• Drainage and general flood control measures
	• Industrial effluents, toxic waste, and medical waste
	• Broader environmental sanitation
	• Air pollution unrelated to human excreta
	• Vector control
	• Broader food safety
	• Practices related to use or disposal of animal excreta
	• Other agricultural wastes

2.3 Impact identification and classification

Poor sanitation has many actual or potential adverse impacts. Conversely, different measures for improving sanitation can go some way in mitigating these negative impacts. Figure 2 presents the full range of possible impacts of sanitation, as they relate to five different aspects of sanitation — access, latrine system, hygiene practices, waste disposal, and waste reuse. The major links are shown with arrows: sanitation option and the primary impact (between left and central boxes); and primary impact and the resulting economic impact (between central and right-hand boxes). To illustrate, one of the primary impacts of having closer access to and improved latrines is the improved health of the population. This is likely to be manifested in lower incidence rates of diseases such as diarrhea. Among the top 10 diseases in the Philippines in terms of incidence [15], fewer cases of diarrhea in particular and improved health in general lead to economic benefits. In Figure 2, these gains are increased school participation, health-related quality of life (HRQL) improvement, enhanced labor productivity, saved health costs, and the value of saved lives.

Based on the exhaustive set of impacts shown in Figure 2, Table 4 presents a shortened list of negative impacts of poor sanitation that were included in this study. These impacts were classified under five main categories: health impacts, water resource impacts, environmental impacts, other welfare impacts, and tourism impacts. It also provides further justification for inclusion of these impacts in the study, showing the presumptions based on preliminary evidence of importance [16] and discussion with country partners. Annex A provides further background on these impact categories.

Figure 2. Primary and economic impacts associated with improved sanitation options (human waste)



Notes: [1]For example, comfort, convenience, security, and privacy. [2] Examples are visual effects and smells. [3]HRQL=health-related quality of life.

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

Impact	Link with sanitation	Justification for inclusion in the present study
Health	- Poor sanitation and hygiene cause diseases which lead to 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 treating the disease
Water	- Released human and animal excreta pollute water resources, affecting usability or productivity and leading to costly averse behavior and/or production impact	- Unregulated sewage release into water bodies is a proven significant contributor to inland (and marine) water resource pollution - Water is treated or purchased by households; it undergoes costly treatment by piped water providers for domestic and commercial purposes - Household members hauling water themselves travel farther to access cleaner and safer water supply - Fish are unable to reproduce and survive in heavily polluted water. - 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	- 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 affect life choices or lead to absenteeism in school or the workplace	- Household members have to spend time accessing toilet in the open (nature) or queuing to use shared or public facilities - Privacy and convenience are underestimated 'intangible' aspects in sanitation choices - There exists an income gradient in latrine ownership - 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 thus tourist arrivals; 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 have clean environments and good toilet facilities; there is lower risk of tourists getting sick

The major anticipated impacts of poor sanitation were on health and water resources, and therefore greater focus was given on data collection for these impacts in all participating countries. Hypothesized economic impacts such as saving entry fee, which is related to public toilet users, house price rises due to improved sanitation, and foreign direct investment were not examined in the present study, either due to anticipated low importance or data limitations.

Table 5 details the specific impacts examined under health, water resources, external environment, other welfare, and tourism. The columns indicate the relevance of each component of sanitation for each impact. Human waste is relevant for all impact areas. Poor hygiene mainly affects health. Gray water and animal waste mainly affect water resources. Solid waste affects mainly the external environment and tourism. Also, potential impacts of improved sanitation–stimulation of local markets for sanitation inputs (labor, materials) and reuse of waste for productive purposes–were also included in the table. Of the items in the list, it is expected that health is going to be the most significant for the Philippines. Poor sanitation is expected to have a substantial impact on the incidence of water-borne and malnutrition-related diseases. The reason is that diseases such as diarrhea and acute lower respiratory infection (ALRI), a disease associated with malnutrition, are among the top five diseases in the country. Moreover, deaths arising from these diseases can be substantial.

Table 5. Categorization of impacts measured in the present study[1]

Impact	Sub-impacts	Human excreta	Hygiene practices	Gray water	Animal excreta	Solid waste
Health	Health status	√	√			
	Disease treatment costs	√	√			
	Productive time loss	√	√			
	Premature death	√	√			
Water resources	Water quality	√		√	√	
	Drinking water	√		√	√	
	Domestic uses of water	√		√	√	
	Fish production	√		√	√	
External environment	Aesthetics	√		√		√
	Land use and quality	√		√		√
Other welfare	Intangible aspects	√				
	Time used for toilet access	√				
	Life choices	√				
Tourism	Tourist numbers	√	√	√		√
	Tourist sickness	√	√	√		
Sanitation markets	Sanitation 'inputs'	√				
	Sanitation 'outputs'	√			√	

Note: [1]A tick shows which impacts were measured in this study. The absence of a tick does not indicate the absence of an empirical relationship. It only means that the relationship was not evaluated in the study.

The impacts on water are expected to be large, given the importance of this resource in the lives of people as well as the extent to which poor sanitation contributes to water pollution. Apart from the impacts, gains associated with improving sanitation may also have a big effect on sanitation markets. This is especially true during the phase in which investments in sanitation facilities are taking place.

2.4 Estimation methods for financial and economic costs of poor sanitation

Policymakers are interested in understanding the nature of the economic impacts being measured. For example, do the impacts have immediate implications for expenditure and incomes by households or governments, or are the effects nonpecuniary or longer term in nature? The answer will naturally affect how results are interpreted and what level of support there will be for impact mitigation measures. Hence, while recognizing the difficulties in making a distinction between the different types of economic impacts, this study attempts to distinguish broadly between two different types of impact–financial and economic:

- **Financial** costs capture impacts that are most likely to affect economic activity in the short term. These include changes in household and government spending as well as impacts likely to have real income losses for households (e.g., health-related time loss with impact on household income) or enterprises (e.g., fishery loss). It should be noted that, while these 'financial' costs affect economic indicators in the short term, these impacts are not expected to have a one-for-one effect on gross domestic product because of substitution effects, transfer payments, and so on.

- **Economic** costs approximate the overall welfare impact of poor sanitation. These include the longer term financial impacts (e.g., less educated children, loss of working people due to premature death, loss of usable land, long-term tourist losses), as well as nonfinancial implications (value of loss of life, time use of adults and children, intangible impacts).

Table 6 defines financial and economic costs for each sub-impact. Attribution factors, which vary by impact, were used to calculate the costs associated with poor sanitation.

Table 6. Financial and economic costs due to poor sanitation

Impact category	Sub-impacts evaluated	Financial costs attributable to poor sanitation	Economic costs attributable to poor sanitation
Health	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 associated with 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 yr)	Discounted lifetime income losses for adult and child death
Water resources	Drinking water costs	Financial costs of water treatment and distribution	*Financial* + time spent hauling water from safe water sources
	Domestic water uses	Additional expenditure in sourcing water from non-polluted sources	*Financial* + time spent hauling water from less polluted sources
	Fish losses	Value of lost sales due to reduction in fish catch	Value of lost sales due to reduction in fish catch
External environment	Land quality	-	Economic value of land made unusable by poor sanitation
Other welfare	Time loss	-	Welfare loss due to adult and child latrine travel/waiting time
	Work/school absence	-	Temporary absence of women from work and of girls from school
Tourism	Tourism costs	-	Revenue loss from low occupancy rates and failure to exploit long-term potential tourist capacity

2.5 Impact mitigation associated with improved sanitation and hygiene

Having estimated the financial and economic impacts, it is important to know, from a policy perspective, how much of these costs can be reduced by implementing improved sanitation options. Indeed, while this study initially presents total costs attributed to poor sanitation, it is unlikely that this total value can be averted by improving sanitation.

While there are many types and configurations of sanitation improvement available, this study aimed to estimate potential benefits obtainable for a small number of *features* of sanitation improvements. It therefore gave an initial and tentative estimate of the likely gains possible from improving sanitation.

Table 7 shows the five main categories of sanitation improvement (in columns) assessed in this study. It also identifies the relevance of these categories for each sub-impact category (in rows). The features are described in the table footnotes. The impact mitigation estimation methods are described in Annex A7. Table C9 also contains a more detailed description of the options.

Table 7. Potential benefits of different sanitation improvement options

Impact	A Latrine physical access[1]	B Improved toilet system[2]	C Hygiene practices[3]	D Treatment or disposal[4]	E Reuse[5]
Health		Yes	Yes	Yes	
Water resources					
Water treatment				Yes	
Fish production				Yes	
Domestic uses of water				Yes	
Environmental quality		Yes		Yes	
Other welfare					
Intangibles	Yes	Yes	Yes		
Access time	Yes				
Life choices	Yes	Yes	Yes		
Tourism	Yes	Yes	Yes	Yes	
Sanitation markets					
Sanitation input market		Yes	Yes	Yes	Yes
Sanitation output market					Yes

Notes: [1] Closer and improved latrine for those using open defecation; improved population to toilet ratios through increased coverage of latrines (less queuing time). [2]Improved position or type of toilet seat or pan; safe, private, and secure structure: walls/door/roof; improved and safe collection system (tank vault, pit); improved ventilation; improved waste evacuation. [3]Availability of water for anal cleansing; safe disposal of materials used for anal cleansing; hand washing with soap; toilet cleaning. [4]Improved septic tank functioning and emptying; sealed top of pit latrine to withstand flooding; household connection (sewerage) with treatment; sewers with non-leaking pipes and a drainage system that can handle heavy rains; wetlands or wastewater ponds. [5]Urine separation, composting of feces, hygienization; use of human excreta products in commercial aquaculture, composting (fertilizer); biogas production (anaerobic digestion).

2.6 Uncertainty analysis

This study faced several challenges in attempting to meet scientific criteria and present evidence that is useful for policymakers. To provide timely evidence on sanitation impact, this study was entirely based on secondary information collected from a variety of sources, combined with assumptions where necessary input data were missing. Therefore, to fill the gaps in evidence, several innovative and untested methodologies were developed for the present study.

Three major types of uncertainty surround the quantitative figures presented in this study. These are as follows.

(1) Uncertainty in the input values for the estimation of overall economic impacts. The sources of uncertainty include epidemiological variables (for health) and economic variables such as market prices and economic values. This arises from the severe lack of data available from routine information systems or research studies that can feed into the quantitative model. Hence, in the absence of these data, relationships were modeled and assumptions made.

(2) Uncertainty in the attribution of the overall impact to poor sanitation. For example, when there are multiple sources of pollution, only a portion of the overall economic impact estimated must be apportioned to the component of pollution being examined (e.g., domestic waste contribution to overall water pollution). A second example is the importance of poor sanitation in keeping away tourists from a country.

(3) Uncertainty in the actual size of impact mitigation achievable.

The variables with greatest importance for the quantitative results were evaluated further in a one-way sensitivity analysis. This was implemented by changing one input value over a reasonable range and assessing the impact on overall findings. The alternative values that were used in the sensitivity analysis are provided in Annex A8.

3 Economic Impact Results

3.1 Summary of economic impacts of poor sanitation

Table 8 summarizes the quantified economic impacts of poor sanitation. It shows that the estimated overall economic losses from poor sanitation amounted to about US$1.4 billion or PhP 77.8 billion per year. Equivalent to about 1.5 % of GDP for 2005, this translated into approximately US$16.8 per person per year. More than two-thirds (72%) of these costs were accounted for by the health impacts. This was followed by water impacts, which explained close to a quarter (23%) of the total. The remainder was accounted for by other welfare impacts and tourism.

Among the sub-impacts, premature death was the most significant source of economic costs. It was expected to cost US$922.7 million or about 65% of the total losses. The second most important economic loss was the impact on the (other) domestic uses of water (14%).

Table 8 also provides a glimpse of the extent to which confining the analysis to financial losses underestimates the impacts. Accounting for about US$359.0 million per year, financial costs were only about a quarter of the economic costs.

Table 8. Financial and economic losses due to poor sanitation, by impact type

Impact	Financial losses				Economic losses			
	Value (million)		Per capita (US$)	%	Value (million)		Per capita (US$)	%
	US$	PhP			US$	PhP		
Health								
Health care costs	6.2	342.2	0.1	1.7	33.1	1,826.0	0.4	2.3
Productivity costs	29.7	1,636.3	0.4	8.3	55.3	3,045.6	0.7	3.9
Premature death costs	1.1	58.0	0.0	0.3	922.7	50,833.7	11.0	65.3
Water								
Drinking water	116.5	6,417.0	1.4	32.4	117.0	6,445.9	1.4	8.3
Fish production	9.6	531.6	0.1	2.7	9.6	531.6	0.1	0.7
Domestic water uses	195.9	10,793.2	2.3	54.6	196.7	10,836.4	2.3	13.9
Other welfare								
Time use	-	-	-	-	24.6	1,352.7	0.3	1.7
Life choices	-	-	-	-	13.0	713.7	0.2	0.9
Tourism								
Tourist loss	-	-	-	-	40.1	2,208.7	0.5	3.3
Total	**359.0**	**19,778.28**	**4.3**	**100.0**	**1,412.1**	**77,794.3**	**16.8**	**100.0**

Table 9 provides a rural-urban breakdown, where available, of the impacts. It shows that rural regions were likely to lose the most from poor sanitation. With estimated losses of about US$663.6 million, rural households accounted for slightly more than 47% of total economic losses. This is also an underestimate because nearly 27% of the total economic losses were not apportioned between rural and urban areas. The observed pattern can be explained mostly by the weight of the health costs. Accounting for the bulk of the total economic losses, slightly more than 64% of the total health costs were incurred in rural areas. This was explained by the higher disease incidence and mortality in these areas. Per capita economic losses painted a slightly different picture. Total economic losses in the rural regions were estimated to be US$12.0 per person, which was slightly lower than the corresponding values for urban areas. This was explained largely by the higher incomes and cost of living in urban areas. However, the previous observation must be handled with care. It is possible that the pattern could be reversed if the non-assigned impacts could be apportioned between rural and urban areas.

Table 9. Losses due to poor sanitation, by impact type and rural-urban setting

Impact	Financial losses			Economic losses		
	Value (million US$)	Per capita (US$)[1]	%	Value (million US$)	Per capita (US$)[1]	%
Health						
Rural	18.4	0.3	49.7	650.6	11.8	64.3
Urban	18.6	0.6	50.3	360.5	12.4	35.7
Water	322.0	3.8	nc	323.4	3.8	nc
Other welfare						
Rural	-	-	-	13.0	0.2	34.6
Urban	-	-	-	11.6	0.4	30.8
Non-assigned	-	-	-	13.0	0.2	34.5
Tourism	-	-	nc	40.1	**0.5**	nc
Total						
Rural	**18.4**	**0.3**	**5.1**	**663.6**	**12.0**	**47.0**
Urban	**18.6**	**0.6**	**5.2**	**372.1**	**12.8**	**26.4**
Non-assigned	**322.0**	**3.8**	**89.7**	**376.4**	**4.5**	**26.7**

Note: [1]Per capita losses for rural and urban households were calculated using the populations of these areas. Per capita losses for non-assigned impacts were calculated using the entire population of the Philippines.

It is important to note that the results presented above do not include impacts that cannot be properly quantified in this study. Table 10 presents a listing and a few remarks on these impacts.

Table 10. Impacts that were not quantified

Impact category	Costs attributable to poor sanitation	Remarks
Health	Quality of life impact	This is difficult to quantify because of the lack of reliable information. For all diseases, a major constraint is valuing the discomfort that the victims and their carers experience for the duration of the disease. This is perhaps more serious in the case of malaria because the affected persons have the potential to suffer from recurrent attacks for the rest of their lives.
	Other S&H-related diseases	The inclusion of diseases like schistosomiasis and viral hepatitis in the study will definitely raise the health costs. However, using disease incidence as a barometer, the exclusion of these diseases is unlikely to have a significant impact on the results. The reason is that the incidence of these diseases in 2005 was only about 2% of diarrheal diseases as a whole.
Water resources	Household time spent treating drinking water	While the time spent treating drinking water is expected to raise the costs, the impact is not expected to be significant. The reason is that treating water does not really prevent household members from performing other duties/responsibilities.
	Unrecorded marketed freshwater fish and subsistence fishing losses	This is not likely to be significant in the aggregate but it may be so for subsistence fishers who probably consume a substantial proportion of their catch.
	Marine fish	This impact is likely to be felt more by fishing groups that live near the coastline. Its impact on the aggregate fishery losses is hard to determine.

Table 10. continued

Impact category	Costs attributable to poor sanitation	Remarks
External environment	Economic value of land made unusable by poor sanitation	This is difficult to quantify because of the lack of reliable estimates on how much land is made unusable as a result of poor sanitation.
Other welfare	Welfare loss from lack of comfort, privacy, security, convenience, status, prestige	This is difficult to quantify in the absence of reliable data on how people value the attributes mentioned.
Tourism	Expenditure by tourists becoming sick and welfare loss of sick tourists (not all countries)	While the absence of data makes this difficult to quantify, it is possible to obtain a fairly general idea of the costs by imposing a few assumptions. In 2004, there were roughly 2.2 million foreign visitors to the Philippines, about 2.6% of the Philippine population. Assuming that incidence rates and the treatment behavior of foreigners and local residents are the same, then the expenditures of tourists on health would also be about 2.6% of the total health costs of domestic residents (US$33.1 million). This amounts to losses of about US$0.9 million.
Others	Foreign direct investment	The potential impact is difficult to quantify because of the absence of information on the sensitivity of foreign direct investment to sanitation conditions in a country. However, the potential losses could be large. In 2005, foreign direct investments in the Philippines amounted to US$1.9 billion [17]. This is very close to the estimated total costs of poor sanitation, which were presented earlier.

3.2 Health impacts

Table 11 reports the estimated annual cases and deaths that were attributed to poor sanitation. It shows that diarrheal diseases had the most number of cases at about 38 million, 36.8 million of which were considered mild or nonsevere cases. Of the diseases explicitly included in this study, acute watery diarrhea was dominant with 1.2 million cases. Diarrheal and malnutrition-related diseases included in this study also caused 20,344 deaths. This was dominated by acute watery diarrhea, with 11,338 fatalities or about 58% of the total.

Table 11. Total cases and deaths attributable to poor sanitation and hygiene, by disease

Disease	Total cases		Estimated deaths
	Seeking formal treatment	All cases	
Diarrheal			
Acute watery diarrhea	516,928	1,181,183	11,338
Acute bloody diarrhea	6,552	16,905	135
Cholera	136	289	46
Typhoid	10,939	26,128	1,909
Other	-	36,793,536	-
Malnutrition-related			
ALRI, measles, malaria	608,234	608,234	6,917

Table 12 presents the health care costs of diseases related to sanitation and hygiene. It indicates that malnutrition-related diseases as a whole accounted for about US$21.1 million or 64% of the total. A far second was "other" diarrheal diseases, at slightly less than US$9 million. While malnutrition-related diseases accounted for a tiny proportion of total cases, these had higher treatment costs per patient than diarrheal diseases.[5]

Table 13 presents the productivity costs related to days-off daily activities because of diseases related to sanitation and hygiene. It shows that financial costs from these diseases were about US$29.7 million. However, these were only about 54% of total economic costs (US$55.3 million) because the financial impacts ignored the time value of sick children and nonworking adults. The impact of ignoring the time value of sick children, about US$17.3 million, was very significant. It explained about two-thirds of the difference between economic and financial costs. The remainder was explained by the time value of nonworking adults.

Table 12. Total health care costs, by disease (000 US$)

Disease	Financial costs				Economic costs				
	Hospitals	Self-treatment	Transport	Total	Hospitals	Informal care	Self-treatment	Transport	Total
Diarrheal									
Acute watery diarrhea	356.8	33.4	168.0	558.2	2,741.6	122.0	33.4	168.0	2,897.0
Acute bloody diarrhea	6.9	0.5	2.2	9.6	66.6	1.8	0.5	2.2	68.9
Cholera	0.3	0.0	0.0	0.3	1.5	0.0	0.0	0.0	1.6
Typhoid	28.7	0.2	3.6	32.5	138.1	2.5	0.2	3.6	140.8
Other	-	1,925.3	2,026.2	3,951.6	-	7,036.9	1,925.3	2,026.2	8,962.2
Malnutrition-related									
ALRI, measles, malaria	1,505.7	nc	154.6	1,660.2	21,074.6	nc	nc	154.6	21,074.6
Total	**1,898.4**	**1,959.4**	**2,354.6**		**24,022.5**	**7,163.2**	**1,959.4**	**2,354.6**	

Source: Appendix Table D1.
Note: nc = not calculated.

Table 13. Total productivity costs (000 US$)[1]

Disease	Financial costs (age 15+)[2]	Economic costs,[3] by age group			
		0-4	5-14	15+	Total
Diarrheal					
Acute watery diarrhea	604.4	422.5	102.6	705.9	1,231.0
Acute bloody diarrhea	45.3	21.9	5.8	46.8	74.5
Cholera	1.6	0.2	0.1	1.7	1.9
Typhoid	128.2	7.4	0.1	133.2	140.7
Other	28,922.9	15,300.3	4,827.6	32,123.5	52,251.4
Malnutrition-related					
ALRI, measles, malaria	nc	1,584.6	nc	nc	1,584.6
Total	29,702.4	17,336.9	4,936.2	33,011.1	55,284.2

Notes: [1]Value of time is average wage approximated by average compensation of employees. [2]Financial cost = income loss of working adults. [3]Economic cost = value of time loss of children and adults.

Table 14 presents the total costs of premature death from diseases related to sanitation and hygiene based on the human capital approach (HCA). It shows that the economic losses from premature death were about US$922.7

5 Table D1 shows the unit costs of health care for the different diseases.

million. The results also revealed three important points. First, a very large proportion of the losses were from the deaths of children less than 5 years old. With an estimated cost of US$796.2 million, this age group accounted for a little more than 86% of the total costs of premature death. Second, among the diseases, the biggest contribution came from acute watery diarrhea. This disease accounted for US$512.7 million or about 56% of the total. Third, there was a very large difference between financial and economic costs. This captured, for the most part, the omission of the under-15 population in the computation of financial costs. It also illustrated the impact of using the present discounted value of the future stream of incomes in the calculation of economic costs.

Table 14. Total costs of premature deaths (000 US$)

Disease	Financial costs	Economic costs, by age group			
	Age 15+	0-4	5-14	15+	Total
Diarrheal					
Acute watery diarrhea	703.8	432,020.4	54,079.2	25,881.0	512,684.4
Acute bloody diarrhea	7.4	5,191.0	640.6	270.7	6,109.7
Cholera	10.2	1,073.8	492.2	374.3	1,950.5
Typhoid	331.5	41,191.0	31,574.6	12,191.9	85,289.0
Malnutrition-related					
ALRI, measles, malaria	-	316,705.2	nc	nc	316,705.2
Total	**1,052.8**	**796,181.5**	**86,786.6**	**38,717.9**	**922,738.8**

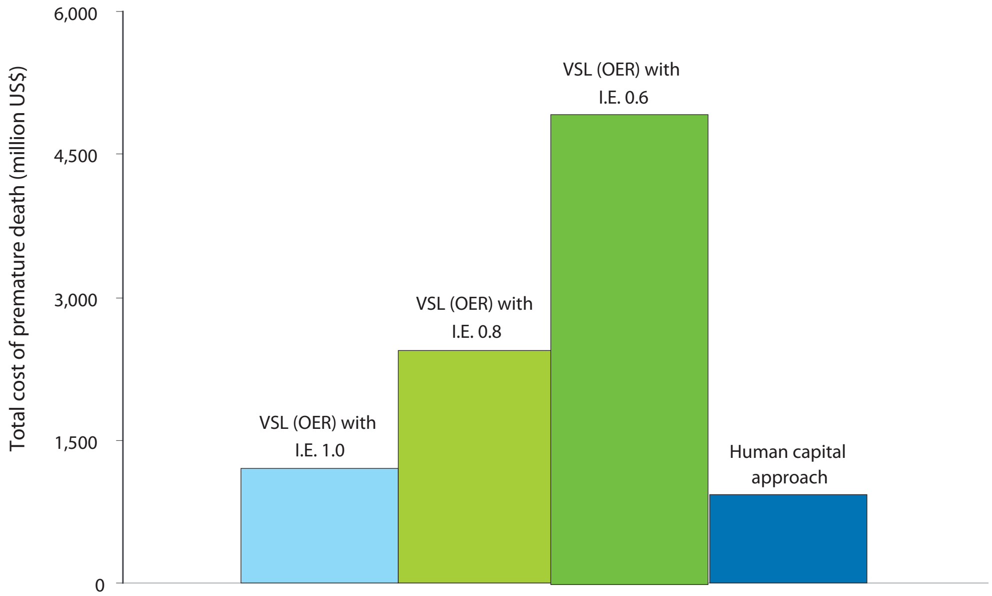
Note: nc = not calculated.

Figure 3 shows the variation in cost of premature death by using different values for premature death. It shows that the value of statistical life approach (VOSL), with a 0.6 income elasticity, generated the highest losses at about US$4.9 billion. This was closely followed by the VOSL approach with an income elasticity of 0.8. What is clear from the use of alternative valuation techniques is that the HCA generated the most conservative estimates of losses. This conclusion may, of course, change if a higher income elasticity is used to estimate the value of saved lives.

Table 15 shows the estimated financial and economic costs of the negative health impacts of poor sanitation and hygiene in the Philippines. It shows that economic cost associated with health was about US$1.0 billion per year. While a big portion of the costs was due to acute watery diarrhea, 91% of the total costs (US$922.7 million) were due to premature death. These two results are not totally unrelated. In fact, it only highlights the finding that acute watery diarrhea was the largest source of costs associated with premature death.

Figure 4 shows the contribution of different costs to overall cost, by disease. It indicates that health care costs only accounted for a small fraction of the total costs for each disease. Premature death was the dominant factor for almost all diseases. In the case of "other" diarrheal diseases, which were not assumed to be fatal, the majority of the costs were attributed to lost productivity.

Figure 3. Economic cost of premature death at different unit values for premature death (million US$)[1]



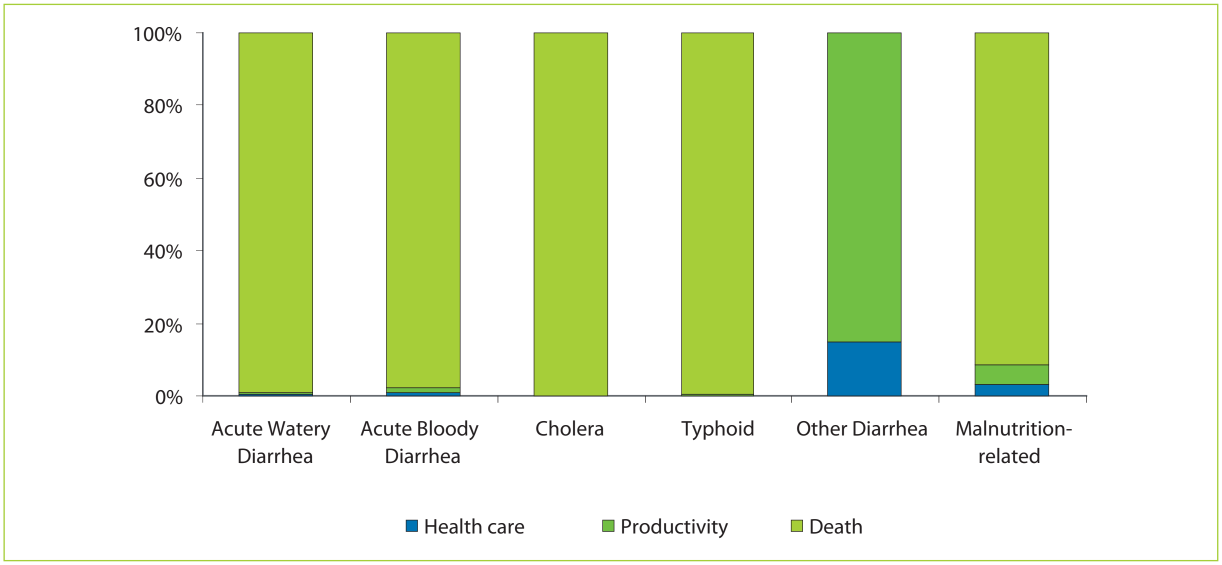
Note: [1]Table A24 indicates the unit values used in the calculations. I.E. = income elasticity, VOSL = value-of-life-saved, OER = official exchange rate.

Table 15. Total health-related costs (000 US$)

Disease	Total financial costs				Total economic costs			
	HC	PROD	DEATH	Total	HC	PROD	DEATH	Total
Diarrheal								
Acute watery diarrhea	558.2	604.4	703.8	1,866.4	2,897.0	1,231.0	512,684	516,812
Acute bloody diarrhea	9.6	45.3	7.4	62.2	68.9	74.5	6,110	6,253
Cholera	0.3	1.6	10.2	12.1	1.6	1.9	1,951	1,954
Typhoid	32.5	128.2	331.5	492.2	140.8	140.7	85,289	85,571
Other	3,951.6	28,922.9	-	32,874.5	8,962.2	52,251.4	-	61,214
Malnutrition-related[1]	1,660.2	-	-	1,660.2	21,074.6	1,584.6	316,705	339,364
Total	**6,212.4**	**29,702.4**	**1,052.8**	**36,967.6**	**33,145.1**	**55,284.2**	**922,739**	**1,011,168**

Note: [1]The malnutrition-related diseases considered in the study were ALRI, malaria, and measles. Financial costs associated with productivity loss and premature death were zero because only children under 5 were included in the study. HC = health costs, PROD = productivity costs and DEATH = premature death costs.

Figure 4. Contribution (%) of different costs to total cost, by disease



3.3 Water resource impacts

The Philippines is well-endowed with water resources. According to the Bureau of Fisheries and Aquatic Resources (BFAR), the country has 200,000 hectares of lakes, 31,000 hectares of rivers, 19,000 hectares of reservoirs, and 246,063 hectares of swamplands [18]. It also has an extensive coastline that stretches over a distance of 32,289 kilometers.

Table 16 presents an inventory of 495 classified water bodies in the Philippines. It indicates that five of these bodies have been classified as Class AA and 185 as Class A (i.e., potential drinking water sources following partial or full treatment). Eighty-seven water bodies have been classified as Class B for contact recreation (bathing, swimming, etc.); 161 as Class C for contact recreation (boating, etc.) and fishing; and 15 as Class D for agriculture, irrigation, and livestock watering.

Table 17 shows the estimated release of polluting substances attributable to sanitary waste. The estimates accounted for toilet facilities and their assumed efficiency in treating human waste. It indicates that Filipinos annually released 4.2 billion kilograms of feces and 33.9 million cubic meters of equivalent black water (feces and urine) into the environment. The largest contributor to such wastes was the NCR, accounting for about 12% of the national release of feces and urine. This was slightly lower than the share of the region in the national population (13%) because of the existence of sewers and septic tanks, which reduced the release of human waste into the environment. Table 17 also indicates that the total wastewater from households (gray and black water) was 1.96 billion cubic meters. Based on assumptions described in Annex A3.2, about 762.6 million cubic meters or about 38% of household wastewater was attributed to sanitation. In other words, 33.9 million cubic meters of black water mixes with flushed water to give 762.6 million cubic meters of brown water. In both cases, the NCR, Region 3, and Region 4a had the largest contributions to the total. Accounting for about 42% of the total, this was due to the relatively high population and/or per capita consumption of water in these regions. For similar reasons, these regions also had the largest contribution of BOD and coliform.

Table 16. Inventory of classified water bodies, 2004

Region	Freshwater surface waters					Coastal and marine waters				Total
	AA	A	B	C	D	SA	SB	SC	SD	
NCR		1		4						5
CAR	2	9	19	6						36
1		10	4	10			1			25
2		3	8	19	4					34
3		17	6	22	1		2	2		50
4		15	6	40	1	2	1	2		67
5		23	11	12	2					48
6		16	6	11			6	2		41
7	1	22	4	2	1	1	5	3		39
8				13				3	3	19
9		19	8							27
10		33						1		34
11	2	4	8	7	3		3			27
12		3	6	9	3			4		25
13		10	1	6		1				18
ARMM										-
Total	**5**	**185**	**87**	**161**	**15**	**4**	**18**	**17**	**3**	**495**

Source: National Statistical Coordination Board [19].
Notes: *For freshwater surface waters (rivers, lakes, reservoirs, etc.)*: AA = public water supply - waters that require disinfection to meet the national standards for drinking water (NSDW); A = public water supply - waters that require full treatment to meet the NSDW; B = recreational water - waters for primary contact recreation (e.g., bathing, swimming, skin diving, etc.); C = water for fishery production; recreational water class II (boating, etc.); industrial water supply class I; D = for agriculture, irrigation, livestock watering; industrial water class II; other inland waters. *For coastal and marine waters (as amended by DAO 97-23):* SA = water suitable for fishery production; national marine parks and marine reserves; coral reefs, parks, and reserves; SB = tourist zones and marine reserves; recreational water class I; fishery water class 1 for milkfish; SC = recreational water class II (e.g., boating); fishery water class II (commercial); marshy and/or mangrove areas declared as fish and wildlife sanctuaries; SD = industrial water supply class II; other coastal and marine.

While the information in Table 17 indicates the release of urine and feces into the environment, adjusted for treatment associated with the type of facilities available to the households in the regions, it does not show which aspect of the environment it affects. Theoretically, these wastes can pollute the groundwater and water bodies such as rivers, canals, and lakes. However, there is very little evidence on the magnitude of such effects in the Philippines. For example, the Environmental Management Bureau (EMB) states that local governments have been approving plans for buildings and housing with open bottom septic tanks [20]. It adds that such structures allow human waste to contaminate groundwater. The same source also states that 61% and 8% of septic tanks in Manila discharge directly into drains and drains/canals/creeks, respectively. Outside Metro Manila, a survey of informal settlers in Barangay Look of Dumaguete City showed that 63% of households dispose of their sewage in a canal [21]. The rest of the sewage in turn goes to the ground (30%) and a nearby creek (6%). The information above seems to indicate that about 70% of human waste makes it way to water bodies. Using this value as a working assumption, the estimates in Table 17 imply that about 2,966 million kilograms of feces and 23.7 million cubic meters of urine are released to water bodies each year. However, until more precise regional and national estimates are made available, such values should be viewed with extreme care.

Table 17. Total release of polluting substances from sanitation

Region	Total release (volume)[1]				Polluting substances	
	Feces (million kg)	Urine (million m^3)	Wastewater from households (million m^3)	Wastewater attributable to sanitation (million m^3)	BOD (million kg)	Coliform (trillion count)
NCR	516.9	4.1	323.0	124.1	120.6	10,424,903.7
CAR	80.0	0.6	38.1	14.6	13.0	1,368,508.9
1	224.9	1.8	110.0	42.3	36.6	3,865,696.4
2	155.4	1.2	65.3	25.1	25.3	2,306,206.3
3	431.1	3.4	236.9	91.0	70.2	8,311,771.2
4a	514.0	4.1	261.1	100.3	119.9	9,244,964.1
4b	125.2	1.0	63.6	24.4	20.4	2,251,085.0
5	265.1	2.1	108.0	41.5	43.2	3,893,228.2
6	356.3	2.9	134.5	51.7	58.0	4,877,434.2
7	311.5	2.5	124.5	47.8	50.7	4,478,040.6
8	212.5	1.7	83.4	32.1	34.6	3,007,025.0
9	168.5	1.3	62.5	24.0	27.5	2,269,322.9
10	202.4	1.6	88.6	34.0	32.9	3,176,004.8
11	207.8	1.7	89.7	34.5	33.8	3,196,337.4
12	193.2	1.5	78.3	30.1	31.5	2,829,925.9
13	124.3	1.0	50.7	19.5	20.2	1,808,025.1
ARMM	148.3	1.2	43.3	16.6	24.1	1,622,929.6
Total	**4,237.2**	**33.9**	**1,961.5**	**753.7**	**762.6**	**68,931,409.5**

Note: [1]These are emissions attributable to sanitation and adjusted for type of toilet facilities.

Table 18 presents selected quality measurements for priority rivers in the Philippines. It shows that selected rivers in Regions 4b, 7, and 10 have low BOD levels, indicating relatively low levels of pollution. In contrast, rivers in the NCR, CAR, Region 3, and Region 4a have high levels of BOD. The BOD concentration in Meycauayan River (Region 3) at 119.8 mg/L is quite alarming because it is more than 3.5 times higher than the second most "polluted" river in the sample–San Juan River. Table 18 also shows that 11 of the 18 priority rivers have a dissolved oxygen (DO) concentration below 5 mg/L, the EMB standard on DO concentration necessary to support fish [20]. Measured against this standard, rivers in the NCR, CAR, and Region 3 appear to be the most polluted.

Table 18. Selected water quality measurements for priority rivers in the Philippines, annual average for 2005

Region	Water body	BOD (mg/L)	DO (mg/L)
NCR	Marikina River	12.1	3.4
	San Juan River	33.5	2.4
	Parañaque River	29.5	1.5
	Pasig River	24.2	2.4
CAR	Balili River[1]	31.8	4.9
3	Meycauayan River	119.8	1.2
	Marilao River	41.5	1.0
	Bocaue River	6.4	2.0
4A	Imus River	9.0	5.3
	Ylang Ylang River	8.4	4.6
4B	Calapan River	2.9	2.9
5	Anayan River	2.3	6.3
	Malaguit River	5.8	5.6
	Panique River	5.6	5.7
6	Iloilo River	4.9	4.9
7	Luyang River	2.0	7.6
	Sapangdaku River	0.9	7.1
10	Cagayan de Oro River	1.3	8.1

Source: Environmental Management Bureau [20].
Note: [1]See Table D2 for more detailed water quality measurements for Regions 3, 6, and 12.

Table 19 presents the access costs of drinking water that can be attributed to poor sanitation. It indicates that the total economic costs were estimated to be US$117 million. About 56% of this total was explained by the household treatment of drinking water and 40% for the purchase of nonpiped water. There was also substantial variation in drinking water access costs across regions. Table D3 shows that the NCR accounted for US$34.9 million (about 30%) of the total economic costs. A far second was Region 4a with an estimated cost of US$15.6 million.

Table 19. Drinking water access costs (000 US$)

Water source	Financial costs'		Economic costs	
	Value (000 US$)	%	Value (000 US$)	%
Purchased piped water	4,029.6	3.5	4,029.6	3.4
Purchased nonpiped water	46,793.6	40.2	46,793.6	40.1
Household water treatment	65,658.5	56.4	65,658.5	56.1
Hauled water	-	-	525.5	0.4
Total	**116,481.7**	**100.0**	**117,007.2**	**100.0**

Source: Table D3.

There is information on DO and fish production for 10 out of the 16 regions in the country. These regions produced 102.1 thousand tons of fish in 2005 or about 71% of the total production (143.8 thousand tons) for the period. Using the method described in Annex 3.5, these regions could have produced 137.1 thousand metric tons of fish. Therefore, current production in these regions was estimated to be about 35 thousand metric tons lower than production at the optimum, about 34% of the current production (102.1 thousand tons). For regions in which information of DO was not available, it was also assumed that current production was lower than the optimum by an amount equal to 34% of current production. It was asserted in Annex A3.2 that poor sanitation explained 33% of water pollution. Ignoring all the issues that could arise from applying this value, poor sanitation is estimated to cause a loss to fish production in the order of about 11% of current production.

Assuming that the proportion above applies to all of the country's regions and ignoring the potential impacts on prices, Table 20 shows the estimated losses to inland municipal fisheries. With an estimated total production value of US$85.1 million in 2005, an 11% loss translated to about US$9.7 million.

Table 20. Fish catch value and estimated annual loss in inland fisheries, 2005[1]

Region[2]	Production (mt)	Value (000 US$)	Loss due to sanitation (000 US$)
NCR	na	na	na
CAR	899.0	532.2	60.3
1	2,278.0	1,348.6	152.8
2	6,801.0	4,026.1	456.3
3	9,843.0	5,826.9	660.4
4a	72,011.0	42,629.7	4,831.7
4b	761.0	450.5	51.1
5	2,825.0	1,672.4	189.5
6	5,740.0	3,398.0	385.1
7	170.0	100.6	11.4
8	2,761.0	1,634.5	185.3
9	584.0	345.7	39.2
10	1,993.0	1,179.8	133.7
11	175.0	103.6	11.7
12	15,811.0	9,359.9	1,060.9
13	3,681.0	2,179.1	247.0
ARMM	17,475.0	10,345.0	1,172.5
Total	**143,808.0**	**85,132.8**	**9,649.0**

Sources**:** Bureau of Agricultural Statistics [22, 23].
Note: [1]Since there is no regional disaggregation of the value of production for inland municipal fisheries, an implicit price based on national data was used in the calculations. [2]Information on dissolved oxygen is available for Regions 1, 3, 4a, 5, 6, 8, 9, 10, 11, and 13 (see Table A31). The regions accounted for 102.1 out of the 143.8 thousand metric tons of fish produced in 2005.
na = not applicable

Table 21 shows the costs attributed to poor sanitation of accessing non-drinking water from improved water sources. Although water requirements are not as strict, household members may still walk farther for improved water or pay companies to deliver or purchase piped water for nondrinking domestic uses. The estimated economic impact amounted to US$196.7 million. Nearly 90% of these costs were accounted for by households with purchased piped water.

Table 21. Water access costs for domestic uses (drinking water excluded), 000 US$[1]

Water source	Financial costs		Economic costs	
	Value (000 US$)	%	Value (000 US$)	%
Purchased piped water	176,906.0	90.3	176,906.0	89.9
Purchased nonpiped water	19,013.3	9.7	19,013.3	9.7
Household water treatment	-	-	-	-
Hauled water	-	-	785.1	0.4
Total	**195,919.3**	**100.0**	**196,704.4**	**100.0**

Source: Table D4.
Note: [1]The estimates assume that only adults haul water for the households. Hence, there is no adjustment for the time value of children.

It is important to note that domestic costs might be lower in reality. The reason is, compared with drinking water, the demand for high-quality water is less important for tasks such as bathing and washing. However, people pay for the water, perhaps, because they can afford it or because it is more convenient to have piped water, but not necessarily because it is essential to have treated water for all domestic uses.

3.4 Environmental impacts

The key environmental aspect of poor sanitation identified in this study was that of solid waste. Due to lack of information on the impacts of human waste on aesthetics and land use, this aspect was not assessed, and household solid waste was the focus of this study. Moreover, industrial and commercial wastes were not included in the study.

Filipinos in rural and urban areas were estimated to generate 0.3 to 0.5 kg/capita of garbage per day, respectively [24]. Using the population estimates for these regions, this implies that the country produced about 11.35 million metric tons of garbage per year. Nearly 18% or 2.05 million tons were from the NCR alone. About 42% of the waste was due to kitchen waste, and the remainder was accounted for by paper (19%), plastic (17%), metal (6%), garden waste (7%), and others (9%) [25].

The collection and treatment of solid waste is an important issue in the Philippines. The World Bank in 2001 reported that collection efficiency in the country was only about 40%, with rates reaching 70% in key cities [25]. This suggests that a substantial proportion of the solid waste was not collected. In Metro Manila, for example, it is not uncommon to find garbage accumulating in canals, sewers, empty lots, and sidewalks. Despite being prohibited by the Clean Air Act, households in some communities continue to burn their waste. The collection of solid waste was brought to the forefront as a national issue with the garbage crisis in Metro Manila during the early 2000s [25-27]. This event was triggered by the closure of three disposal sites for the region.

Of the waste collected, the World Bank also reported that only 2% were put in sanitary landfills and 10% were composted [25]. This left about 88% being disposed of in open dumps or other facilities.

The poor performance with respect to collection and disposal of garbage creates a wide variety of problems. The list includes heath risks, flooding arising from clogged sewers and waterways, pollution of groundwater from leachates, foul odor due to rotting garbage, and lower real estate values [28]. This is, of course, a bigger issue for people who live in areas where the garbage accumulates. However, the greatest threat is to the health of people who live in dump sites and make a living out of the garbage, as they are in regular and direct contact with the waste and its various contaminants.

While national estimates are not available, there are some indications that the Filipino people take issue with poor garbage disposal and collection. For example, a survey of households in Tuba rated solid waste as the number one environmental problem in the area [29]. The World Bank has also noted the growing public awareness of the problem [25]. However, the latter report was also quick to add that there is still a lack of maturity with respect to "appropriate and suitable management practices" in the Philippines.

3.5 Other welfare impacts

Apart from being difficult to quantify, there are no studies at the national level that provide information on what is classified in the present study as "intangible" aspects of sanitation. However, there are some site-specific surveys that can provide clues on the importance of these benefits to Filipinos.

A survey with 312 respondents in San Fernando, La Union, reported that almost all households disinfected their toilet bowls once a week [30]. Moreover, more than half of the respondents said that they did so at least three to seven times a week. The same study also showed that while Filipinos may be conscious about the cleanliness of their toilets, they were probably not as diligent when it comes to desludging septic tanks. This is based on the finding that 71% of households never desludged their septic tanks or, if they did, this was done more than 5 years prior to the survey. The study argued that this may be due to the fact that septic tanks are not water-tight and, hence, wastewater seeps directly into the ground from their tanks.

To say the least, many public toilets in the Philippines are not as clean as those found in households. Moreover, many of these toilets do not have the basic necessities like running water, toilet paper, soap, etc. As a result, people are forced to make adjustments in order to cope with the situation. For example, one study reports that the absence of water for flushing and hand washing in public restrooms in the Philippines has made it habitual for women to bring their own toilet paper [31].

The importance of these intangible benefits can also be seen from consultations with rural households in the Philippines that have received latrines. Cairncross [32] showed that the number one "reason for satisfaction" with latrines was the "lack of smell." This was followed by "cleaner surroundings," "privacy," "less embarrassment when friends visit" and "less gastrointestinal diseases." A demand assessment of sanitary latrines from Cambodia found that improved latrine provides–in order of importance–better hygiene and clean environment; comfort; health improvement; safety; convenience and time savings; privacy; and prestige/status [33]. The various consultations suggest that different households value different benefits of improved sanitation differently, and that many give relatively low importance to the perceived health benefits. Of course, this could reflect a failure of the respondents to appreciate the links between access to clean toilets and health.

Table 22 shows the impacts on time use of suboptimal toilet access. It indicates that, as a whole, people who practiced open defecation in the Philippines spent a total of 11.47 million days a year in accessing a "suitable" location. On the other hand, people who shared toilets spent about 19.1 million days a year in accessing facilities. This essentially represents the amount of time spent waiting for a facility to be available and/or traveling to the toilet. All this was estimated to cost about US$24.6 million a year. While the difference in total costs between rural and urban households did not appear to be very large, the underlying explanation was not the same. In the case of rural households, the costs were associated mainly with open defecation. In contrast, it was the cost of using a shared facility that explained the value of access time for urban households.

Table 22. Value of time used in accessing sub-optimal latrines

Location	Population size (000)		Total time spent accessing (000 days)		Value (000 US$)		
	Open defecation	Shared facility	Open defecation	Shared facility	Open defecation	Shared facility	Total
Rural	7,538.6	9,144.9	9,554.1	11,589.9	7,041.4	5,948.1	12,989.5
Urban	1,508.2	5,938.6	1,911.4	7,526.4	2,288.9	9,276.1	11,565.0
Total	**9,046.8**	**15,083.5**	**11,465.5**	**19,116.3**	**9,330.3**	**15,224.2**	**24,554.5**

Source: Table D5.

Table 23 presents the estimated impacts of poor sanitation on school and work attendance of females. The table indicates estimated economic impacts of about US$13 million. Almost all of these losses (97%) were explained by absenteeism of working women. The reasons behind this finding are as follows. First, the estimation procedure used the population of 12-16-year-olds for school-aged girls as a base, while those aged 17-44 years old were used for working-age women. This alone skews the analysis in favor of working age women. Second, as described in Annex A5.3, the proportion of unsanitary toilets in workplaces was higher than that in schools. Along with the differences in population, this means that absences for working women will be larger than those for girls in secondary schools. Third, the productive time loss (per day) for girls who are in school were assumed to be half that of working women.

Table 23. Impacts of poor sanitation on school attendance of girls[1] and work attendance of women[2]

Establishment	Absences (000 days/year)	Economic cost	
		Value (000 US$)	%
Secondary school[1]	995.8	448.4	3.5
Workplace[2]	13,889.6	12,507.2	96.5
Total	**14,885.5**	**12,955.6**	**100.0**

Notes: [1]Only refers to girls in secondary school. [2]Only refers to working women under the age of 44.

3.6 Tourism impacts

While the absence of data and the isolation of the specific cause-and-effect relationships make a quantitative analysis difficult, there are some indications that poor sanitation and its effects can influence the attractiveness of a country as a tourist destination. For example, the World Bank cited the "drastic drop in tourism" following a water quality monitoring report that showed high levels of coliform in the waters of Boracay Island [3].[6] While the study did not mention the sources of contamination, Annex A3.2 of this paper shows that poor sanitation contributes importantly to water pollution in general and to coliform levels in particular.

The economic losses to tourism are reported in Table 24. Based on the procedure discussed in Annex A6, economic losses were estimated to be about US$40.1 million.

Table 24. Economic losses to tourism as a result of poor sanitation

Item	Value
Number of tourists (million)	4.2
Government target, number of tourists (million)[1]	5.0
Potential tourism revenues per year (million US$)	2,589
Potential revenues less actual revenues (million US$)	802
Attribution to sanitation (%)	5
Losses due to poor sanitation (million US$)	40.1

Note: [1]The target is for the year 2010.

3.7 Economic gains from improved sanitation and hygiene

Table 25 shows predicted economic gains from improved sanitation. The values were derived by multiplying the values in Table A41 (Alternatives for Impact Mitigation) with the corresponding cost values in Table 8. Briefly, it assumed that basic improvements in sanitation and hygiene practices reduced the costs of sanitation and hygiene by 42% and 32%, respectively. For all other aspects of improved sanitation, this study assumed that all of the estimated costs of poor sanitation can be averted.

The results indicate that improvements in hygiene practices alone, particularly hand washing, can reduce health costs by up to US$455 million a year. Notwithstanding errors and omissions committed in the estimation process, this result is very important from a policy perspective because, unlike improvements in toilet facilities, such improvements do not have to rely heavily on investments in physical infrastructure.

6 The same study also cites government findings that the sewage system may have contributed to the spread of the severe acute respiratory syndrome (SARS) in the Amoy Gardens housing estate in Hong Kong. It also noted the severe impacts of the SARS outbreak on the tourism sector.

There was also a large one-time benefit arising from the construction of toilets for people who currently practice open defecation or have unimproved pit latrines. This was shown by the US$1.5 billion gain from sanitation input markets (Table 25).

It is important to note that the estimated financial and economic benefits associated with health impacts in columns A and C of Table 25 are not additive. It is unlikely that improving both hygiene and sanitation leads to full benefits of US$28.5 million (financial) and US$778.6 (economic), but instead only a partially additive effect. This conclusion was based on the evidence available so far on the health efficacy of multiple water, sanitation, and hygiene interventions whose relative risk was not lower than those of interventions implemented independently.

Table 25. Estimated financial and economic gains from improved sanitation (million US$), 2005 [1]

	A		B		C		D		E	
	Hygiene practices		Latrine physical access		Improved toilet system		Treatment or disposal		Reuse	
	Financial	Economic	Financial	Economic	Financial	Economic	Financial	Economic	Financial	Economic
Health										
Health care	2.80	14.92	-	-	1.99	10.61	-	-	-	-
Productivity	13.37	24.88	-	-	9.50	17.69	-	-	-	-
Premature death	0.47	415.23	-	-	0.34	295.28	-	-	-	-
Water										
Drinking water	-	-	-	-	-	-	116.48	117.01	-	-
Fish production	-	-	-	-	-	-	9.65	9.65	-	-
Domestic uses	-	-	-	-	-	-	195.92	196.70	-	-
Environment										
Aesthetics	-	-	-	-	-	-	nc	nc	-	-
Land use	-	-	-	-	-	-	nc	nc	-	-
Other welfare[2]										
Time use	-	-	-	24.55	-	-	-	-	-	-
Life choices	-	-	-	12.96	-	-	-	-	-	-
Tourism[3]										
Tourist number	-	-	-	-	-	-	-	40.09	-	-
Sanitation markets										
Input markets	-	-	-	-	-	-	-	-	nc	1,499.97
Output markets	-	-	-	-	-	-	-	-	nc	0.18
TOTAL	**16.64**	**455.03**	**-**	**37.51**	**11.83**	**323.58**	**322.05**	**363.45**	**-**	**1,500.15**

Notes: [1]Improved sanitation generally means improved physical access, improved toilet system and treatment or disposal, all of which have implications on health status (see annex table for definitions). For the purposes of reporting, the sanitation benefits are included only under improved toilet system to avoid confusion over double counting. [2]Other welfare impacts discussed and presented in Chapter 3.5 are all presented here under 'latrine physical access,' but some of these are also likely due to improved toilet system.[3] Tourist number and sickness will also be related to hygiene practices and toilet systems used, but the benefits are reported here under treatment and disposal, as this has the major environmental implications.

Table 26 shows the potential market size for sanitation inputs. There were about 3 million households (or 18% of the total) that only had access to unimproved pit latrines or practice open defecation (no toilets). Using the procedure discussed in Annex A7.3, these households were assumed to receive either VIP, EcoSan type 1, EcoSan type 2, or septic tanks. The result was a potential gain to sanitation providers of about US$1.5 billion. Most of these gains came from the provision of facilities to rural areas.

Table 26. Sanitation input market values

Item	VIP	EcoSan1	EcoSan2	Septic tanks	Total
Number of households receiving facility (000)	602	202	202	2,030	3,038
Rural	571	126	126	1,704	2,528
Urban	31	76	76	326	510
Percentage of total households in the country	4%	1%	1%	12%	18%
Value (000 US$)	54,643	73,645	153,715	1,217,962	1,499,966

At this point, it is worth noting that the benefits to input markets should be interpreted with extreme care. On the one hand, the estimates may be too optimistic because it assumed that all the affected households will benefit from the improvements, and that quite a high number (more than 400,000) of high-cost EcoSan toilets were assumed to be demanded by households. In contrast, the benefits might also be lower than it should be because of the omission of maintenance costs.

As mentioned in Annex A7.4, the approach for estimating the benefits from sanitation outputs was confined only to human waste that could be used as fertilizer. Moreover, the analysis was limited to assuming that it can raise the output of organic fertilizer by an arbitrarily determined factor. In 2006, sales of organic fertilizer were about 4,683 metric tons. Assuming that the use of human waste can raise this output by 50% (2,276 metric tons) and noting that the price of organic fertilizer is US$78.1 per metric ton (or PhP 4,300.50), then the potential increase in sales will be about US$0.18 million.

3.8 Evaluation of uncertainty

The present study was based on secondary information, which was combined in a model to estimate the impacts of poor sanitation and the potential benefits of improving sanitation. Two major types of uncertainty surround the figures presented above:

- Uncertainty in the values and assumptions used for the included variables (data uncertainty)
- Uncertainty due to the fact that some hypothesized impacts were not included (parameter omission)

Table 27 presents the results from a sensitivity analysis with the economic variables. Using GDP per capita (high) was likely to raise the estimated economic losses to health from US$1.0 billion to about US$1.1 billion. Valuing the time of children at the same rate as adults also has a similar, albeit smaller, impact as it was likely to increase health losses by US$22.3 million. Using the value of statistical life approach, the total health costs were expected to be more than four times higher at US$5.0 billion. What is clear from this analysis is that the health impacts are more sensitive to the values chosen for estimating premature death. This is explained by the earlier finding that health impacts accounted for a substantial proportion (91%) of total costs.

Table 27. One-way sensitivity analysis–economic variables (million US$)

Variable	Financial			Economic		
	Low	Base case	High	Low	Base case	High
Health						
Hourly value of productive time	29.5	37.0	99.9	997.3	1,011.2	1,128.2
Hourly value of productive time for children[1]	37.0	37.0	37.0	985.6	1,011.2	1,033.5
Premature death	Not tested	37.0	Not tested	745.7	1,011.2	5,023.6
Water						
Fish production impact	314.4	322.0	588.7	315.7	323.4	590.0
Other welfare						
Time access	-	-	-	31.4	37.5	43.6
Hourly value of productive time	-	-	-	31.4	37.5	65.2

Note: [1]Time was valued using the compensation of employees.

The water impacts appeared to be sensitive to changes in the fishery impacts at first glance. The water impacts were about 80% higher, from US$323.4 million to US$590 million, when a pessimistic scenario was adopted for the fishery impact. However, the impact was small in relative terms. The base scenario assumed that fishery losses were about 11% of current production value. In the pessimistic scenario, the fishery losses were about 325% of the current production value. This means that the experiment involved a shock in which fishery losses were almost 30 times larger (= 325%/11%) than the base. The finding that it "only" generates an 80% increase in total water impacts suggests the relatively small share of fisheries in the total impacts.

Raising the amount of time it takes to access toilet facilities by 25%, from 5 minutes per trip to 6.25 minutes, increased time access costs from US$37.5 million to US$43.6 million. This 16% increase is explained by the finding that time access accounted for about two-thirds of other welfare impacts.

Table 28 shows the results from a sensitivity analysis of sanitation links. Since the procedure for analyzing the results were similar to the previous analysis, the emphasis is on the key findings only. Using WHO, instead of DHS, incidence rates for diarrheal diseases raised health costs from US$1.0 billion to about US$1.2 billion. This appears quite small, given the fact that WHO incidence rates are substantially higher than DHS data.

Table 28. One-way sensitivity analysis–sanitation links (million US$)

Variable	Financial costs			Economic costs		
	Low	Base case	High	Low	Base case	High
Health						
Disease incidence attributed to poor sanitation and hygiene (diarrhea only)[1]	30.89	36.97	43.00	873.75	1,011.17	1,176.30
Water						
Water pollution attributed to poor sanitation	241.5	322.1	402.6	242.5	323.7	404.2
Other welfare						
Life choices attributed to poor sanitation	-	-	-	34.3	37.5	40.8
Tourism						
Proportion of tourist revenues affected	-	-	-	16.0	40.1	80.2
Total	**272.43**	**359.02**	**445.57**	**1,166.58**	**1,412.13**	**1,701.44**

Note: [1]Only the attribution factors for diarrhea were revised in this sensitivity analysis.

The changes, which had relatively large impacts, were the assumptions regarding the proportion of tourism that was affected by poor sanitation and the proportion of water pollution that was attributed to poor sanitation. In both cases, a 25% change in the critical parameters affected the impacts by a similar proportion. For example, the table shows the increase in the estimated costs of water pollution from US$323.4 million to US$404.2 million.

The sum of the base case values (at economic costs) for the four items in the table was equal to US$1.4 billion. Adding the same items for "low" and "high" scenarios suggests that, at extremes, the losses from poor sanitation can range from slightly less than US$1.2 billion to US$1.7 billion.

Table 29 shows the results from a one-way sensitivity analysis of impact mitigation. With the exception of fish production and sanitation-related life choices, the impacts of the changes were one-for-one (in percentage terms). An examination of the estimated values, however, indicated that the assumptions for impact mitigation on health and sanitation markets can have significant effects on the results. Assuming that improved hygiene mitigates 60% (high) rather than 45% (base case) of the health costs raised economic benefits from US$455.0 million to US$606.7 million. This US$151.7 million increase was actually larger than the combined benefits from other welfare impacts and tourism in the base case. Another important result pertains to the benefits to sanitation markets. In the base case, the benefits to sanitation markets were estimated to be US$1.5 billion. A low estimate, which assumed that only half of the benefits were obtained, indicated economic gains of US$750 million.

Table 29. One-way sensitivity analysis–impact mitigation (million US$)

Variable	Financial costs			Economic costs		
	Low	Base case	High	Low	Base case	High
Health						
Sanitation-related diseases mitigated	4.8	11.8	17.4	131.5	323.6	475.2
Hygiene-related diseases mitigated	9.2	16.6	22.2	252.8	455.0	606.7
Water						
Sanitation-related drinking water pollution costs mitigated	165.8	322.0	Not tested	166.5	323.4	Not tested
Sanitation-related fish production costs mitigated	317.2	322.0	Not Tested	318.5	323.4	Not tested
Other welfare						
Sanitation-related life choices affected	-	-	-	31.0	37.5	Not tested
Tourism						
Sanitation-related tourist losses mitigated	-	-	-	20.0	40.1	Not tested
Sanitation markets						
Sanitation output coverage (% households without improved sanitation adopting EcoSan)	-	-	-	750.2	1,500.1	Not tested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4 Discussion, Conclusions, and Recommendations

4.1 Discussion

4.1.1 Overview and interpretation of main results

The objective of this study is to estimate the economic impacts of poor sanitation in the Philippines. It focused on the effects on health, water, other welfare impacts, and tourism. Where possible, the strategy began with a calculation of the physical impacts followed by the assignment of monetary values. After the estimation process, an attempt was also made to quantify the potential economic gains from improving sanitation.

As a whole, the total economic costs to health of poor sanitation were estimated to be US$1 billion. About 91% of these costs were accounted for by premature death. The remainder was explained by health care costs (3%) and productivity losses (5%). The distribution of the health impacts is also worth noting. The results showed that the largest impacts of poor sanitation were on children under the age of five. This age group explained around 86% of the costs of premature death. Arising mainly from its relatively low access to improved sanitation and high population, rural regions also accounted for 64% of all health-related costs.

The water impacts were related to poor sanitation through the latter's impacts on water quality. Accounting for about US$323 million annually, nearly two-thirds of these costs were explained by domestic water uses (not counting drinking water). With fish losses contributing a relatively small proportion of the total, the remainder of the cost was due to water used for drinking.

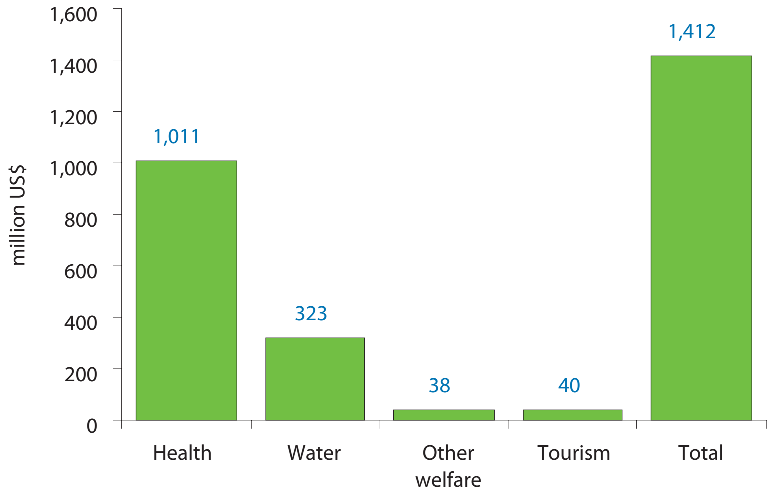
The total economic costs associated with other welfare impacts were estimated to be about US$38 million per year. Nearly two-thirds of these costs were accounted for by productivity losses caused by time spent accessing toilets. The remainder was explained by productivity losses caused by the absences of women from work and school.

Tourism impacts were computed on the assumption that potential visitors to the country are sensitive to sanitation conditions. The study estimated the economic costs to be about US$40 million.

Summing the losses accross all the impacts, this study found that poor sanitation led to economic costs amounting to US$1.4 billion or PhP 77.8 billion per year (Figure 5). This was about 1.5% of 2005 GDP at current prices. It was also slightly more than six times larger than the programmed health budget of the national government (PhP 12.9 billion) for the same period [19]. With a population of nearly 84 million people, this translates into per capita losses of US$16.8 or PhP 923.7. The amount is roughly equivalent to 3 days work for the average Filipino, based on the GDP per capita in 2005 of PhP 271.6 per working day.

Overall financial costs (US$359 million) were found to be substantially lower than economic costs. This was because financial costs did not include (a) the productive losses associated with sick children and adults who are not employed; (b) the value of children in terms of the value of premature death from avoidable diseases; (c) the opportunity cost of hauling water; (d) the value of girls being absent from school; and (e) the expansion of tourism to meet government targets. From the list above, the most serious omission was found to be for the second – the value of children in terms of the value of premature death from avoidable diseases. The economic cost from premature death was estimated to be about US$798 million. Since children were found to be most vulnerable to such diseases, omitting the value of premature death for this group, along with the use of compensation of employees, resulted in a negligible estimate of financial costs.

Figure 5. Economic costs of poor sanitation in the Philippines (million US$)



4.1.2 Study weaknesses

Having discussed the omitted impacts in Section 3.1 (Table 10), the focus here is on the weaknesses of the techniques and values used in the study. The first was the lack of well-established relationships to estimate economic impacts. This covers both theoretical and empirical grounds from which reasonably good estimates can be generated. The second was the unavailability of accurate data on many of the key parameters. In many instances, data specific to the Philippines were not available. This motivated the use of proxy variables or data assumptions. With this in mind, the following paragraphs describe some of the weaknesses that are specific to the impacts studied.

The health impacts rely heavily on incidence rates and case fatality rates. The values used in this study were derived from sources that were either not specific to the country or the time frame being studied. Incidence and case fatalities for diarrhea relied heavily on compiled evidence from the WHO. This resulted in case incidence and fatalities that were significantly larger than those reported in official statistics but considered to be more realistic due to underreporting of official statistics.

Not finding reliable studies on unit costs of informal care and self-treatment, this study simply imposed assumptions. In the case of informal care, the assumption was that it is one-third of doctor's fees. In the case of self-treatment, medical professionals were consulted in order to identify the common practices of people afflicted with diseases.

In estimating the water impacts, assumptions were based on available evidence on access time, cost of treatment, and quantity of water used per day. However, these assumptions all contain uncertainty and, in reality, will vary from region to region.

In fisheries, the reliance on existing production data to base predictions of fish production under conditions of good water quality introduces uncertainties into the analysis. The use of a derived relationship between dissolved oxygen and fish production does not take into account other determinants of fish production, and in reality will vary between fish species and different water bodies. Future studies would need to collect further information on the carrying capacity of different water bodies in order to derive an improved estimate of fish losses due to water pollution.

Measuring the impacts on other welfare indicators also suffered from the same problems discussed previously. In terms of access time, the issue is the absence of a reliable estimate on how much time is needed to access a suitable "facility." In the case of life choices, there is no available information on the absences of female pupils from school and women from work. Household surveys on time use have so far not included a time element related to toilet-going or on absences from school and work and their sanitation-related causes.

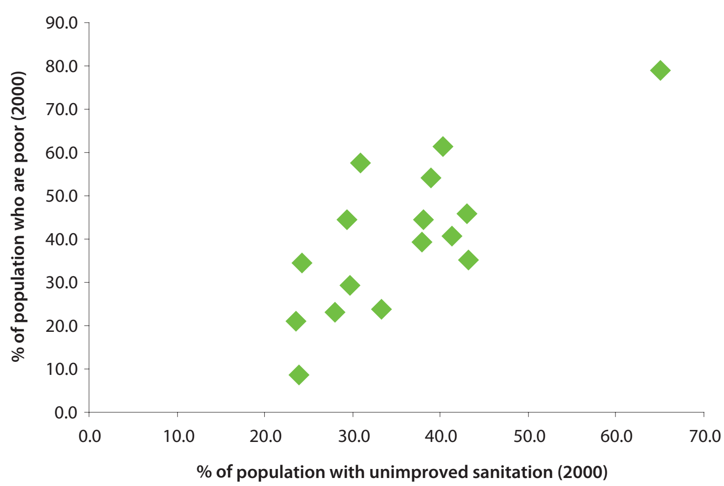
Finally, the estimation of the economic impact of poor sanitation on tourism suffered from the absence of a well-established empirical link between sanitation and tourist arrivals. Hence the estimates provided in this study were approximations.

4.1.3 Livelihoods and poverty reduction

Sanitation and poverty are two concerns that are closely related. It should not come as a surprise that poor families are likely to lack access to toilet facilities. Improved sanitation also has impacts on the livelihoods of the poor. What follows is a brief attempt to elaborate on the points raised above in the context of the Philippines.

Figure 5 plots the proportion of the population with access to unimproved sanitation versus the proportion of poor people for the different regions of the Philippines. It very crudely indicates that regions with relatively high levels of poverty tend to have fewer people served with improved sanitation. The association between unimproved sanitation and the poor can also be viewed in terms of the impacts. For example, it is expected that poor households are less likely to receive adequate medical attention for diseases caused by poor sanitation. Consequently, deaths from such diseases are likely to be a more serious concern for the poor.

Figure 6. Access to unimproved sanitation and poverty rates in the Philippines (%)



Source of basic data: National Statistics Coordination Board [34-36]. See Table A3.

A more concrete example is associated with the impacts of poor sanitation and municipal fisheries. It has been asserted that communities engaged in fishing are considered the "poorest of the poor" in the Philippines [37]. Ignoring imports and other potential substitutes, declining fish production can also have important implications on food security. The WorldFish Center reports that fish accounts for about 14% of the household expenditures on food in the country [38]. This item is second only to cereals (31%) and slightly higher than (other) meat products (13%). Fish is, therefore, an important source of animal protein for Filipinos. The lower availability of fish is likely to affect poor people more, as measured by households belonging to the lowest income group, because they allocate a larger proportion of their food expenditure (16%) to this product.

This brief discussion implies that improving access to sanitation facilities can contribute to the livelihood of the poor. The effects may be direct, as is the case with municipal fishers. It may also be indirect, taking the form of productivity gains due to less exposure to diseases and better nutrition.

4.1.4 Sanitation and gender

Gender is an important issue in sanitation. It has been argued that the success of sanitation (and water) projects depend on the involvement of the targeted beneficiaries, which means both men and women, in the management and decision-making process [39, 40]. The participation of women is essential because the frequency with which they use the systems "puts them in a good position to provide accurate, up-to-date reporting on the functioning of a given system" [39].

At the risk of oversimplifying the arguments, the importance of the participation of women in sanitation projects may be classified into two broad factors. The first may be classified as their heightened need for privacy, security, and dignity associated with access to toilets (also see Section 3.5). The second factor is related to the role of women. In some societies, women have the task of cleaning latrines and training children on the use of latrines [41]. The latter of course can easily be broadened to cover the role of mothers in educating children on, among other things, personal hygiene. In as much as water is essential for personal hygiene, its collection becomes an important issue. In this regard, gender issues become important, especially in societies where women are tasked with collecting water [39, 42]. Another aspect that deserves attention is the role of women in caring for sick children. In societies where this is commonly practiced, caring for sick children means that women have less time for productive activities.

4.1.5 Sanitation and sustainable development

The World Commission on Environment and Development [43] defined "sustainable development" as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." It has long been recognized that local efforts and attention given to water and sanitation sectors in the Philippines are patchy and inadequate. While there has been significant progress since 1990, providing access to improved water and sanitation over the coming years to at least 20 million Filipinos is a formidable task. Further, with a population growth rate of 2.3% [44], close to 2 million additional Filipinos will require water supply and sanitation services every year.

The importance of maintaining the quality of water for the use of future generations is a great challenge. Poor sanitation pollutes water resources which, in turn, affect their present and future usability or productivity. Annually, about 4 billion kilograms of feces and 1 billion cubic meters of household wastewater are being flushed into water bodies in the Philippines. As a result, many water sources are increasingly rendered unusable and water bodies are becoming less productive for crop and fish production and for domestic use. An important element in stopping this trend is reducing the wasteload from households, which has been established as a major source of organic pollution of water resources.

4.2 Conclusions

The primary objective of this study is to generate evidence on the negative effects of poor sanitation in the Philippines. In particular, it attempted to quantify the impacts on health, water, other welfare indicators, and tourism. The analysis was implemented using information from government and donor statistics and reports and from the literature.

The study found that losses from poor sanitation in the Philippines are substantial. Annual economic costs amount to US$1.4 billion (PhP 77.8 billion) or about 1.5% of GDP. Translating to about US$16.8 per year, per capita losses are equivalent to slightly more than 3 working days for the average Filipino.

About 72% of the costs are due to health impacts. These are estimated to be driven mostly by costs of premature death. Accounting for about 23% of the total, the impacts on the uses of water are the second most important source of economic losses. The remainder is explained by other welfare impacts and tourism.

Consequently, improving access to better sanitation facilities can generate considerable gains by way of mitigating the costs mentioned above. The benefits are also expected to be significant if one accounts for the gains to markets related to the sanitation sector. Apart from mitigating costs, the study also showed that simply investing on better hygiene practices can go a long way in reducing health costs.

4.3 Recommendations

4.3.1 Policy recommendations

Recommendation 1. Provide greater priority for investments in sanitation
With more than a quarter of the Philippine population exposed to unimproved sanitation, it is clear that more investments are needed in the sector. While the specific types of investment projects were not explored in the study, these may include the provision of simple pit latrines and moderately sophisticated latrines in rural and urban areas, respectively. This may also include increasing the coverage of piped sewers in urban areas. In areas where space is a major constraint and when financial resources are limited, projects may involve constructing easy-to-maintain communal facilities. This recommendation is of course fairly well known, and there are ongoing projects to address the problem. Nonetheless, it bears repeating in view of the estimated costs associated with unimproved sanitation.

Recommendation 2. Target investments to rural regions with high concentrations of children and to urban slum dwellers
The World Bank estimates that a 10-year program, which treats domestic wastewater in rural regions and introduces a piped system in urban areas, would require a capital outlay of PhP 211 billion [3].[7] Inflated to 2005 prices and converting to US dollars using the current exchange rate, this roughly amounts to US$5.3 billion. On the other hand, the relatively simple improvements explored in this study potentially generate an initial investment of US$1.5 billion (see Table 25). Regardless of the scheme selected, what is clear is that such investments are large. Accounting for maintenance costs only means that the values will be larger.

Since the people who require better access to sanitation are likely to be poor, the burden of financing such investments will fall partially on the government, donor agencies, and cause-oriented groups. Moreover, initiatives to improve sanitation facilities are likely to compete with other projects for whatever funds are available, and, therefore, it is imperative that specific target beneficiaries are identified. In light of the above, the study recommends prioritizing projects in poor areas with relatively high concentrations of children.

The priority for rural regions arises from the finding that access to improved sanitation is lower in rural areas. This means that relatively simple and inexpensive facilities can go a long way in terms of addressing the problem. On the other hand, the emphasis on regions with high concentrations of children arises from the finding that children, especially those under the age of five, are very vulnerable to health impacts of unimproved sanitation.

Another priority would be the slum areas in urban areas. Such areas have high population densities, which are more likely to be exposed to poor sanitation. Apart from relatively high risks of contracting diseases, poor sanitation in these areas is likely to contribute to water pollution.

Recommendation 3. Strengthen education and information campaigns to promote personal hygiene
The paper showed that hand washing can lead to substantial benefits in the form of lower health costs, particularly reduced diarrheal incidence. This means that intensifying existing campaigns for hand washing and other hygiene

7 This is measured at 2002 prices.

practices can be an effective and cheaper means to directly reduce disease incidence and the impacts of poor sanitation indirectly. Another reason is that, despite existing campaigns, there is still sufficient room for improvement in hygiene practices. A nationwide survey in 2000 showed that only 45% of respondents wash their hands after using the toilet [6]. It also showed that, while 97% of the respondents wash their hands before eating, only 26% of them do so before handling or preparing food.

4.3.2 Research recommendations

Recommendation 4. Collect relevant and direct information on key variables related to sanitation
The present study relied on secondary data and the existing literature to analyze the economic impacts of sanitation. In many instances, it did not find information which is directly relevant to the analysis. This not only limited the scope of the study but also introduced considerable uncertainty in the results. Listed in full in Sections 3.8 and 4.1.2, important omitted variables include (a) other diseases related to poor sanitation and hygiene; (b) tourist sickness due to poor sanitation; (c) intangible aspects of sanitation; and (d) environmental impacts (e.g., devaluation and loss of land). Future studies should consider inclusion of these omitted impacts.

Recommendation 5. Conduct empirical analysis on the relationships between sanitation and its impacts
As with the lack of directly relevant and reliable data, the absence of well-defined and established relationships between sanitation and its impacts also constrained the analysis. Examples include the links of sanitation to (a) fisheries, (b) tourism, and (c) foreign direct investment. Studies aimed at verifying and quantifying these relationships through well-founded statistical techniques will go a long way in strengthening the conclusions from similar studies in the future.

Recommendation 6. Evaluate the available options/technologies for improving sanitation in the country
Having estimated the economic costs of unimproved sanitation, the next step is to evaluate available interventions to improve sanitation. This involves analyzing the options that are available to concerned agencies/institutions. Such studies should carefully weigh the costs of each option relative to the benefits calculated in the present study. To increase the likelihood of success, it should also address the acceptability of the options to beneficiaries and management approaches for implementing sanitation programs. All these will serve as inputs in designing proposals for investment projects in the sanitation sector.

Annexes

Annex A. Study Methods and Basic Inputs

This annex describes the various methods and basic inputs used in the calculation of the impacts. Annex B contains a complete listing of the equations used here, whereas Annex C provides more detailed information on some of the inputs used.

A1. Background

A1.1 Population of the Philippines

Table A1 shows that the Philippine population reached 84.2 million in 2005. Slightly over a quarter of the total is located in the National Capital Region (NCR) and CALABARZON (Region 4a). Almost two-thirds (65%) of Filipinos reside in rural areas.

Table A1. Estimated population size and provincial makeup of regions in the Philippines (million people), 2005

Region		Population			Provinces
Region	Name	Rural	Urban	Total	
NCR	National Capital Region	-	11.2	11.2	
CAR	Cordillera Administrative Region	1.2	0.3	1.6	Abra, Apayao, Benguet, Ifugao, Kalinga, Mt. Province
1	Ilocos Region	3.7	0.8	4.5	Ilocos Norte, Ilocos Sur, La Union, Pangasinan
2	Cagayan Valley	2.7	0.4	3.1	Batanes, Cagayan, Isabela, Nueva Vizcaya, Quirino
3	Central Luzon	6.5	2.1	8.6	Aurora, Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, Zambales
4a	CALABARZON	7.7	2.5	10.2	Batangas, Cavite, Laguna, Quezon, Rizal
4b	MIMAROPA	2.2	0.3	2.5	Marinduque, Mindoro Occidental, Mindoro Oriental, Palawan, Romblon,
5	Bicol	4.7	0.4	5.2	Albay, Camarines Norte, Camarines Sur, Catanduanes, Masbate, Sorsogon
6	Western Visayas	4.3	2.6	6.9	Aklan, Antique, Capiz, Guimaras, Iloilo, Negros Occidental
7	Central Visayas	3.9	2.2	6.1	Bohol, Cebu, Negros Oriental, Siquijor
8	Eastern Visayas	3.5	0.7	4.1	Biliran, Eastern Samar, Northern Leyte, Northern Samar, Southern Leyte
9	Zamboanga Peninsula	2.1	1.1	3.3	Zamboanga Norte, Zamboanga Sur, Zamboanga Sibugay
10	Northern Mindanao	2.4	1.6	4.0	Bukidnon, Camiguin, Lanao del Norte, Misamis Occidental, Misamis Oriental
11	Davao Region	2.8	1.3	4.1	Compostella Valley, Davao del Norte, Davao Oriental, Davao del Sur
12	SOCCSKSARGEN	2.9	0.8	3.7	North Cotabato, Sarangani, South Cotabato, Sultan Kudarat
13	CARAGA	1.9	0.6	2.4	Agusan del Norte, Agusan del Sur, Surigao del Norte, Surigao del Sur
ARMM	Autonomous Region of Muslim Mindanao	2.6	0.1	2.8	Basilan, Lanao del Sur, Maguindanao, Sulu, Tawi-tawi
Total		**55.1**	**29.1**	**84.2**	

Source: National Epidemiology Center [15].

A1.2 Alternative measures of sanitation coverage

It is important to note that there could be slight differences in the presentation and interpretation of the data between the internationally cited JMP numbers (Table 1 of the text) and national sources of statistics in the Philippines. The JMP defines improved sanitation as the proportion of the population that has access to house connections (sewers), septic tanks, and improved pit latrines. According to JMP, unimproved sanitation includes public toilets, pit latrines, open defecation, and other facilities. The National Demographic and Health Survey (NDHS) of the Philippines classifies toilet facilities as (a) flush toilet: own, (b) flush toilet: shared, (c) closed pit, (d) open pit, (e) drop/overhang, (f) no toilet, and (g) other [45, 46]. The values can be reconciled with JMP data by taking the sum of own flush toilets and half of closed pit latrines to derive the households with access to improved sanitation [45]. An example for 2003 is provided in Table A2.

Table A2. Comparison of sanitation types and coverage values (%) measured in different national surveys in the Philippines[1]

Survey	Level	Improved sanitation (%)			Unimproved sanitation (%)				
		Sewer connections and septic tanks[3]	Pit latrine	Total	Public toilet	Pit latrine	Open	Other	Total
PSY 2006 [2]		42.0	25.4	67.4	14.6 [5]	7.6	8.7	1.8	32.6
FHSIS 2005		Na	na	73.9	na	na	na	na	26.1
NDHS 2003	Total	65.7	3.0	68.7	13.4	3.7	9.3	0.1	31.4
	Rural	53.6	5.4 [4]	59.0	10.7	25.6	15.4	0.1	41.1
	Urban	76.7	0.8	77.5	15.9	0.8	3.9	0.1	22.6

Sources: Philippine Statistical Yearbook (PSY) [19], National Demographic and Health Survey [46], Field Health Service Information Systems [15].
Notes: [1]A regional breakdown of the data is available in Table A3. [2]The data are for year 2000. [3]The national statistics do not clearly make a distinction between "house connections" and "septic tanks." [4]50% of closed pit latrine; see text for details. [5]Includes all shared toilets with or without access to septic tanks/sewers. na = not available.

Notwithstanding the differences in definition, the information here and in Table 1 suggest that a sizeable proportion, from a third to a quarter of the Philippine population, do not have access to improved sanitation facilities.

A1.3 Sanitation coverage, by region

Table A3 shows sanitation coverage for the different regions in the Philippines.

Table A3. Sanitation coverage (%), by region

Region	Improved sanitation			Unimproved sanitation			
	HC and septic tanks	Pit latrine[1]	Total	Public	Pit latrine[2]	Open	Total
NCR	67.84	8.33	76.16	21.01	0.64	2.19	23.84
CAR	36.60	25.57	62.17	13.38	20.23	4.22	37.83
1	34.95	40.77	75.72	17.90	4.33	2.05	24.28
2	26.55	43.73	70.27	18.65	8.48	2.59	29.73
3	48.68	27.80	76.48	16.45	2.11	4.97	23.52
4	50.41	21.65	72.06	13.40	4.78	9.77	27.94
5	33.74	27.31	61.05	11.76	9.02	18.17	38.95
6	28.84	33.11	61.95	8.66	13.29	16.11	38.05
7	35.53	21.28	56.81	14.00	6.42	22.77	43.19
8	36.60	20.44	57.05	10.53	6.32	26.10	42.95
9	25.58	33.10	58.68	10.85	14.02	16.45	41.32

Table A3 (Continued)

10	40.59	28.45	69.04	12.36	11.33	7.27	30.96
11	38.02	28.71	66.73	16.65	9.97	6.64	33.27
12	27.00	32.70	59.70	14.10	16.54	9.65	40.30
13	39.05	31.61	70.66	11.56	6.41	11.37	29.34
ARMM	10.03	24.87	34.90	7.64	34.03	23.44	65.10
Total	**41.99**	**25.40**	**67.39**	**14.58**	**7.55**	**10.49**	**32.61**

Notes: [1]Improved pit latrine = VIP, simple, double-vault. [2]Unimproved pit latrine = open, traditional.

A2. Health impacts

Health impacts are considered to be among of the most significant costs associated with poor sanitation and hygiene, and both national surveys and context-specific scientific studies testify to the population burden of sanitation and hygiene-related diseases. Many diseases are associated with poor sanitation and hygiene practices, among them, diarrhea, dysentery, cholera, salmonellosis, shigellosis, typhoid fever, hepatitis A, trachoma, and some parasitic diseases (ascariasis, trichuriasis, hookworm, and schistosomiasis). These not only have direct implications on population welfare through their impact on the quality of life; they also have financial and economic consequences [47-49]. The impacts assessed in this study include spending on health care, loss of income or production associated with disease, and the value associated with premature loss of life.

This section describes the methodology and basic inputs that were used in calculating the health impacts of poor sanitation. A summary of the formulas used for the calculations is presented in Equations 2 and 6–11 of Annex B.

A2.1 Selection of diseases

There are many diseases associated with exposure to human waste due to poor sanitation and hygiene practices (see Table A4). These can be viral, bacterial, parasitic, protozoal, helminth, and fungal in nature and can have many pathways: fecal-oral, urine-oral, and fecal-eye, the main one being fecal-oral [50, 51]. According to the F-diagram, pathogens can be passed from the feces through fluids, fields, flies, and fingers [52]. In addition, food can act as an intermediary for all of these direct transmission pathways. The principle of 'poor practices,' which supports heightened transmission of disease from human waste, includes an unsanitary toilet area, poor personal hygiene practices following toilet-going, open defecation in the fields or water sources, lack of protection or treatment of drinking water, poor food preparation practices, and lack of latrine and water-source protection in flood-prone areas. Furthermore, exposure to household solid waste and to agricultural and industrial wastes can also lead to disease and premature death.

Given the large number of diseases and health effects due to poor sanitation, this study selected key health impacts based on their epidemiological and economic importance. The availability of health data from national statistics, local research studies, and international sources also played an important role in determining which diseases to include. Table A5 presents data available in the Philippines on the number of cases and deaths from key sanitation and hygiene-related diseases. While the data are likely to underestimate the actual burden of the diseases at the national level, these are relevant for selecting the diseases that will be included in the study.

Table A5 shows that diarrheal diseases accounted for 636 thousand cases in 2005. Of this, nearly 615 thousand cases or 95% are for acute watery diarrhea. At the national level, this disease ranks second only to ALRI and pneumonia in terms of incidence in 2005 [15]. The table also shows that at least 3 million children under the age of five are suffering from malnutrition either through stunting or wasting, or both. Among the diseases associated with malnutrition, about 417,000 children suffer from ALRI and pneumonia.

Table A4. Diseases linked to poor sanitation and hygiene, and primary transmission routes and vehicles

Disease	Pathogen	Primary transmission route	Vehicle
Diarrheal diseases (gastrointestinal tract infections)			
Rotavirus diarrhea	Virus	Fecal-oral	Water, person-to-person
Typhoid/ Paratyphoid	Bacterium	Fecal-oral and urine-oral	Food, water + person-to-person
Vibrio cholera	Bacterium	Fecal-oral	Water, food
Escherichia coli	Bacterium	Fecal-oral	Food, water + person-to-person
Amoebiasis (amoebic dysentery)	Protozoa[1]	Fecal-oral	Person-to-person, food, water, animal feces
Giardiasis	Protozoa[1]	Fecal-oral	Person-to-person, water (animals)
Salmonellosis	Bacterium	Fecal-oral	Food
Shigellosis	Bacterium	Fecal-oral	Person-to-person + food, water
Campylobacter enteritis	Bacterium	Fecal-oral	Food, animal feces
Helicobacter pylori	Bacterium	Fecal-oral	Person-to-person + food, water
Protozoa			
Other viruses[2]	Virus	Fecal-oral	Person-to-person, food, water
Malnutrition	Caused by diarrheal disease and helminthes		
Helminthes (worms)			
Intestinal nematodes[2]	Roundworm	Fecal-oral	Person-to-person + soil, raw fish
Digenetic trematodes (e.g., *Schistosomiasis japonicum*)	Flukes (parasite)	Fecal/urine-oral; fecal-skin	Water and soil (snails)
Cestodes	Tapeworm	Fecal-oral	Person-to-person. + raw fish
Eye diseases			
Trachoma	Bacterium	Fecal-eye	Person-to-person, via flies, fomites, coughing
Adenoviruses (conjunctivitis)	Protozoa[1]	Fecal-eye	Person-to-person
Skin diseases			
Ringworm (*Tinea*)	Fungus (E-ectoparasite)	Touch	Person-to-person
Scabies	Fungus (ectoparasite)	Touch	Person-to-person, sharing bed and clothing
Other diseases			
Hepatitis A	Virus	Fecal-oral	Person-to-person, food (especially shellfish), water
Hepatitis E	Virus	Fecal-oral	Water
Poliomyelitis	Virus	Fecal-oral, oral-oral	Person-to-person
Leptospirosis	Bacterium	Animal urine-oral	Water and soil – swamps, rice fields, mud

Sources: World Health Organization [53], Dorfman et al. [54] and Strickland [55].

Notes: [1]There are several other protozoa-based causes of GIT, including *Balantidium coli* (dysentery, intestinal ulcers), *Cryptosporidium parvum* (gastrointestinal infections), *Cyclospora cayetanensis* (gastrointestinal infections), *Dientamoeba fragilis* (mild diarrhea) and *Isospora belli/hominus* (intestinal parasites, gastrointestinal infections). [2]Other viruses include adenovirus (respiratory and gastrointestinal infections), astrovirus (gastrointestinal infections), and calicivirus (gastrointestinal infections). [3]Intestinal nematodes include *Ascariasis* (roundworm - soil), *Trichuriasis trichiura* (whipworm), *Ancylostoma duodenale/Necator americanus* (hookworm), intestinal capillariasis (raw freshwater fish in Philippines), Norwalk viruses (gastrointestinal infections), and reovirus (respiratory and gastrointestinal infections).

Table A5. Importance of sanitation and hygiene-related diseases, total cases and total deaths

Disease[1]	Morbidity		Annual reported deaths (year)
	Cases in 2005	Cases per population [4]	
Diarrheal diseases (total)	636,084	0.007553	4,015 (2000)
Acute watery diarrhea	614,884	0.007301	no data
Acute bloody diarrhea	7,509	0.000089	no data
Typhoid/paratyphoid	13,528	0.000161	892 (1999)
Cholera	163	0.000002	85 (1998)
Schistosomiasis	9,383	0.000111	no data
Viral hepatitis	3,907	0.000046	950 (2000)
Leptospirosis	209	0.000002	no data
Malnutrition (<5) - stunted[2]	3,036,224	0.036050	no data
Malnutrition (<5) - wasting[3]	2,958,868	0.035132	no data
Diseases associated with malnutrition (under five)	425,659	0.005054	no data
ALRI	417,038	0.004952	no data
Measles	2,894	0.000034	no data
Malaria	5,727	0.000068	no data

Sources: National Epidemiology Center [15] and Cendeña et al. [56].
Notes: [1]Cases of ameobic dysentery, *E coli*, helminthes, trachoma, ringworm, scabies, and poliomyelitis were not reported due to lack of data. [2]Prevalence of "under-height" (short height for age) children was used as a proxy for stunted children; equal to 31.4% of 9,669,502 population of children under the age of 5. [3] Prevalence of "under-weight" (low weight for age) children used as a proxy for wasting, equal to 30.6% of the population of children under the age of 5. [4]Case per population was computed by taking the ratio of the cases of each disease and the population for 2005.

Table A6 shows the distribution of the cases, by age group. It indicates that, at least 60% of the incidence of acute watery diarrhea, acute bloody diarrhea, and ALRI occur in children under the age of five. Along with malaria, at least three quarters of all the cases of these diseases affect school-age children.

Table A6. Distribution of cases (%), by age group

Disease	Morbidity cases (%)		
	0-4 years old	5-14 years old	15+ years old
Diarrheal diseases (overall)	61.6	15.3	23.0
Acute watery diarrhea	62.7	15.0	22.4
Acute bloody diarrhea	60.5	15.3	24.2
Typhoid/paratyphoid	15.0	31.9	53.1
Cholera	19.4	18.1	62.6
Schistosomiasis	0.9	31.5	67.6
Viral hepatitis	12.7	29.7	57.6
Leptospirosis	4.3	4.8	90.9
Malnutrition-related			
ALRI	60.2	13.4	26.3
Measles	36.3	28.3	35.4
Malaria	29.9	58.8	11.4

Source of basic data: National Epidemiology Center [15].

In evaluating the health impacts, the study focused on the four diarrheal diseases and three diseases associated with malnutrition. The choice reflects the importance of these diseases in the Philippines as they are all among the top 10 leading causes of morbidity in the country [15]. For other water and sanitation diseases not included in the study (amoebic dysentery, E. Coli, helminthes, trachoma, ringworm, scabies, and poliomyelitis), lack of data on reported cases nationwide and/or complementary information constrained any quantitative analysis.

A2.2 Mortality and morbidity from diseases associated with poor sanitation

A2.2.1 Disease burden from diseases directly related to poor sanitation

DHS data were used for estimating diarrheal disease incidence for children under the age of five. Given that the DHS does not normally report diarrheal disease incidence for the other age groups, WHO data were also used.

Table A7 shows the values used in the calculations. It indicates that children under the age of five have an incidence rate of 2.1 to 2.7 episodes per year. Considerably lower than WHO regional estimates, DHS incidence rates were chosen in order to generate conservative estimates. Table A7 also shows that the incidence rates used for the 5–14 age group were 0.33 and 0.52. The values represent the incidence rates for populations who are exposed to improved and unimproved sanitation conditions, respectively. In calculating the total number of episodes, a weighted average of these values was used. The weights used in the calculation were the proportions of the regional populations who are exposed to improved and unimproved sanitation. The same procedure was adopted for the other age groups.

Table A7. Diarrheal disease incidence assumptions

Source	Age grouping				
	0 to 1	1 to 4	5 to 14	15 to 59	60+
WHO WPR-B (Western Pacific Region B)	6.555	2.458	0.33-0.52	0.16-0.26	0.16-0.26
DHS [1]	2.72	2.08	-	-	-

Note: [1] Calculated using information from National Statistics Office and ORC Macro [46].

It is important to note that not all diarrheal cases are due to poor sanitation. Hence, the values in Table A7 were adjusted by the proportion of total diarrheal cases related to poor sanitation, which was estimated at roughly 88% [50].

Data on the number of premature deaths from health information systems are not up to date and perhaps unreliable due to underreporting of cases and misdiagnosis.

The following steps were taken in calculating the number of deaths arising from diarrhea in 2005. For children under the age of five, an aggregate value of the number of deaths was estimated.[8] This was later allocated among the different subtypes of diarrhea by exploiting the implied case fatality rates from official statistics (see Table A8). For the remaining age groups, the number of deaths was calculated using case fatality rates from the WHO (Figure A1). As with children under the age of five, the totals were also apportioned using the case fatality rates from official statistics.

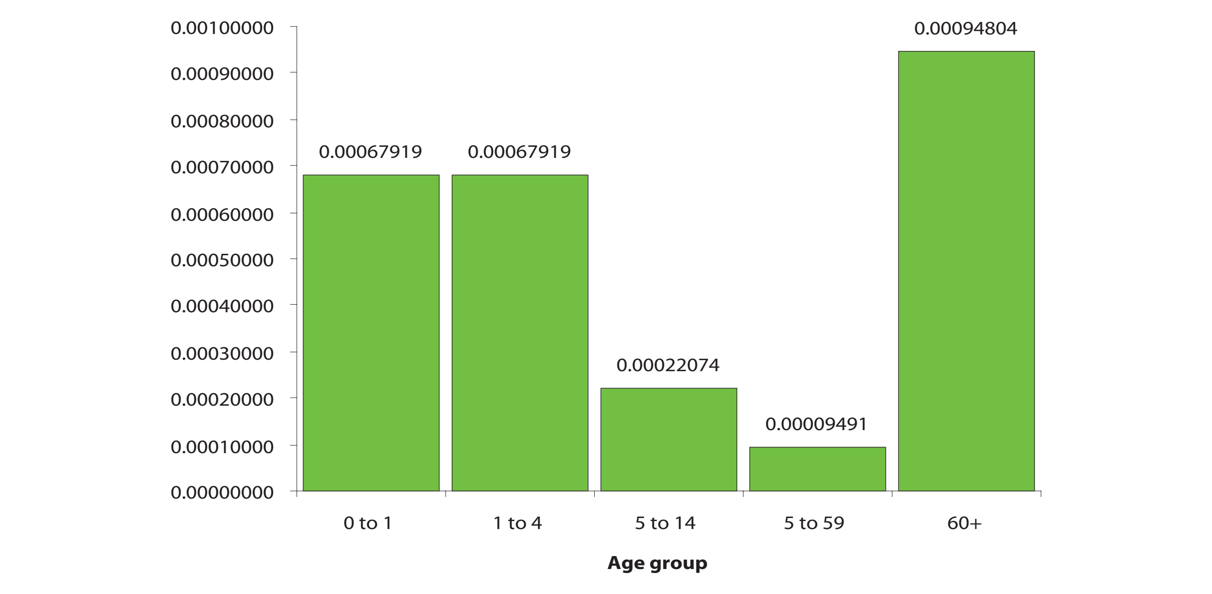
Table A8. Implied case fatality rates from official statistics

Disease	Case fatality rate	Years
All diarrheal diseases	0.00448	1995-2000
Cholera	0.13400	1995-1998
Typhoid	0.08500	1995-1999

Source of data: National Statistics Coordination Board [57].

8 Given the complexities involved in the estimation process, this is discussed in the next section.

Figure A1. Case fatality rates for diarrhea, deaths per case



Note: The values in the figure reflect case fatality rates for the Western Pacific Region [58].

A2.2.2 Disease burden from diseases indirectly related to poor sanitation[9]

Three steps were taken in estimating the indirect health effects (via malnutrition) of sanitation on children. These were:

(a) the effect of diarrheal infections on children's nutritional status was determined from a review of the research literature;

(b) counterfactual nutritional status was then estimated (i.e., the nutritional status that would have prevailed in the absence of diarrheal infections); and

(c) health effects of currently observed nutritional status and health effects of counterfactual nutritional status were estimated.

The difference in the health effects of observed and counterfactual nutritional status was then treated as the indirect health effects of diarrheal infections, caused largely by poor sanitation. Commonly used indicators of poor nutritional status are underweight, stunting, and wasting.[10] Underweight is measured as weight-for-age (WA) relative to an international reference population.[11] Stunting is measured as height-for-age (HA), and wasting is measured as weight-for-height (WH). Underweight is an indicator of chronic or acute malnutrition or a combination of both. Stunting is an indicator of chronic malnutrition, and wasting is an indicator of acute malnutrition. Underweight status is most commonly used in assessing the risk of mortality and morbidity from poor nutritional status.

A child is defined as mildly underweight if his or her weight is in the range of one to two standard deviations (SD) below the weight of the median child in the international reference population, moderately underweight if the weight is in the range of two to three SD, and severely underweight if the child's weight is below three SD. The standard deviations are also called z scores and noted as WAZ (weight-for-age z score).

9 This section is largely based on Larsen [59].

10 Micronutrient deficiencies were not explicitly evaluated here but were found in other studies to have a significant cost [60-62]. Also, Alderman and Behrman [63] found a significant cost associated with low birth weight, which in part is caused by low maternal pre-pregnancy body mass index [64].

11 The international reference population is defined by the National Center for Health Statistics (NCHS standard), United States, or by the World Health Organization's international reference population.

Repeated infections, especially from diarrhea, have been found to significantly impair weight gains in young children. Studies documenting and quantifying this effect have been conducted in communities with a wide range of infection loads in a diverse group of countries such as Bangladesh [65-67], Gambia [68, 69], Guatemala [70], Guinea-Bissau [71], Indonesia [72], Mexico [73], Peru [74], Philippines [75], Sudan [76], and Tanzania [77].

These studies typically find that diarrheal infections impair weight gains in the range of 20–50%. A mid-point–i.e., 35% of the child's weight deficit is attributed here to diarrheal infections to estimate the indirect disease burden from sanitation.[12] So in the absence of weight-retarding infections, the WAZ of an underweight child would be approximately 40% greater than the observed z score (i.e., observed WAZ*(1-0.4)).[13] For instance, if a child has a WAZ=-3, then, in the absence of weight-retarding infections, the child's WAZ would be -1.8.

The prevalence of underweight malnutrition rates is presented in Table A9. The Philippines does not officially report the prevalence of mild underweight children. However, this is important in relation to increased risk of child mortality [64]. To address this issue, the value that was used for mild underweight children was borrowed from the Indonesian component of the ESI study. This strategy was adopted because the Philippines and Indonesia have the same rates for moderate to severe underweight children.

Counterfactual prevalence rates of underweight children (i.e., prevalence rates in the absence of weight-retarding infections) were calculated for Cambodia using the original household data in the Cambodia DHS 2005. The first step was to estimate the counterfactual WAZ for each underweight child in the survey using the formula discussed above (i.e., WAZ reported for each child in the survey multiplied by (1-0.4)). Counterfactual underweight prevalence rates were then tabulated using the counterfactual WAZ. The original survey data in Indonesia, the Philippines, and Vietnam were not readily available for this purpose. Counterfactual prevalence rates were therefore estimated using counterfactual rates calculated for Ghana and Pakistan [59]. These countries, along with Cambodia, reflect a sufficient range of counterfactual prevalence rates to estimate such rates for the Philippines.[14] The results for the Philippines are presented in Table A9.

Table A9. Current and estimated counterfactual underweight prevalence rates in children under the age of 5 in the Philippines

Prevalence	Percentage
Current	
Severe underweight (<-3 SD)	8.8[1]
Moderate underweight (-2 to -3 SD)	19.2[1]
Mild underweight (-1 to -2 SD)	29.3[1]
Non-underweight (>-1 SD)	42.7
Counterfactual	
Severe underweight (<-3 SD)	0.10
Moderate underweight (-2 to -3 SD)	2.0
Mild underweight (-1 to -2 SD)	32.0
Non-underweight (>-1 SD)	65.9

Source: Food and Nutrition Research Institute [78].

Note: [1]Moderate and severe underweight prevalence combined was 28% in the Philippines and was not reported separately. The country does not report the prevalence of mild underweight. The combined rate of moderate and severe underweight is the same as that in Indonesia. Mild, moderate, and severe underweight prevalence in the Philippines was therefore assumed to be the same as that in Indonesia.

12 A child's weight deficit is the difference in weight between the child's observed weight and the weight of the median child in the international reference population.

13 This is calculated using the WHO Anthro 2005 software.

14 Current underweight prevalence rates in Vietnam are very similar to rates in Ghana. Current rates in Indonesia and the Philippines are between the rates in Ghana and Pakistan.

In the absence of diarrheal infections, it is estimated that practically no children would be severely underweight and the prevalence of moderate underweight would be as low as 2-3%. The prevalence of mild underweight would increase significantly in the Philippines.

Various health and debilitating effects from malnutrition are documented in the research literature. This includes long-term chronic illnesses from low birth weight; effects of iodine, vitamin, and iron deficiencies; and impaired cognitive development [60, 79]. The focus here is on mortality and morbidity in children under 5 years (u5), which are associated with being underweight.

Fishman et al. [64] present estimates of increased risk of cause-specific mortality and all-cause mortality in children u5 with mild, moderate, and severe underweight. Severely underweight children (WA <-3 SD) are five times more likely to die from measles, eight times more likely to die from ALRI, nearly 10 times more likely to die from malaria, and 12 times more likely to die from diarrhea than non-underweight children (WA >-1 SD). Even mild underweight doubles the risk of death from major diseases in early childhood (Table A10).

Child underweight also increases the risk of illness. Fishman et al. [64] present estimates of increased risk in children u5 with moderate and severe underweight (WA <-2 SD). The largest increased risk of illness is for pneumonia/ALRI. No increased risk of measles is confirmed (Table A11).

Table A10. Relative risk of mortality from mild, moderate, and severe underweight in children under the age of 5

Weight-for-age (WA)	<-3 SD	-2 to -3 SD	-1 to -2 SD	>-1 SD
Pneumonia/ALRI	8.1	4.0	2.0	1.0
Diarrhea	12.5	5.4	2.3	1.0
Measles	5.2	3.0	1.7	1.0
Malaria	9.5	4.5	2.1	1.0
Other causes of mortality[1]	8.7	4.2	2.1	1.0

Source: Fishman et al. [64].
Note: [1]Not including mortality from perinatal conditions.

Table A11. Relative risk of illness from moderate and severe underweight in children under the age of 5

Weight-for-age (WA)	<-2 SD	>-2 SD
Pneumonia/ALRI	1.86	1.0
Diarrhea	1.23	1.0
Measles	1.00	1.0
Malaria	1.31	1.0

Source: Fishman et al. [64].

These relative risk ratios can be applied to the underweight prevalence rates in Table A9 to estimate attributable fractions (AF) of mortality and morbidity from diarrheal infections through their effect on nutritional status (underweight status).[15] The following formula was used to calculate attributable fractions of ALRI, measles, malaria, and "other causes" of mortality, and attributable fractions of ALRI and malaria morbidity incidence from diarrheal infections:

15 The attributable fraction of mortality or morbidity from malnutrition is the percent of deaths or percent of cases of illness (e.g., percent of ALRI deaths or cases of ALRI) caused by malnutrition.

$$AF = \frac{\sum_{i=1}^{n} P_i RR_i - \sum_{i=1}^{n} P_i^C RR_i}{\sum_{i=1}^{n} P_i RR_i} \quad (1)$$

where RR_i is relative risk of mortality or morbidity for each of the WA categories in Tables A10 and A11; P_i is the current underweight prevalence rate in each of the WA categories; and P_i^c is the counterfactual underweight prevalence rate in each of the WA categories. This formula is also called the "potential impact fraction" because it estimates the mortality or morbidity that would have been avoided for a different counterfactual population distribution (e.g., less children being underweight) exposed to those levels of risk of mortality or morbidity. For a further discussion of this formula, see Ezzati et al. [80].

For diarrheal mortality and morbidity, the estimation of AF would be different because there are two risk factors–i.e., the direct effect of sanitation and the indirect effect through malnutrition. As 88% of diarrheal infections and mortality was estimated to originate from sanitation (or mediated from sanitation through water), the additional effect of malnutrition was minimal and therefore ignored in the study.[16]

Annual cases of mortality and morbidity from diarrheal infections caused by poor sanitation, through the effect of infections on nutritional status, were estimated using the formula below:

$$M = c \sum_{j=1}^{j=m} AF_j M_j^0 \quad (2)$$

where AF_j is the AF in Equation 1 for each cause of mortality or type of disease j, M_j^0 is the current total number of annual cases of mortality or disease incidence in each of the categories in Tables A10 and A11, and c is the fraction of diarrheal infections caused by poor sanitation (88%).

The most recent available estimates of annual cases of mortality (M_j^0) in u5 children are presented in Table A12. These reflect u5 child mortality rates in 2005, and the structure of cause-specific deaths was estimated from WHO country estimates of cause-specific mortality in 2002 [81].

Table A12. Estimated cause-specific annual deaths in children under the age of 5 in the Philippines, 2005[1]

Disease	Deaths
Diarrheal disease	**9,800**
ALRI	11,600
Measles	5,500
Malaria	400
Protein energy malnutrition	1,000
Low birth weight	7,800
Other perinatal conditions	14,900
Other causes	16,200
Total	**67,200**

Note: [1]The World Health Organization provides country estimates, by cause, for 2002 [81]. Child mortality rates were used to calculate comparable information for 2005.

16 See Larsen [59] for the methodology and estimation of environmental health effects from multiple environmental risk factors in Ghana and Pakistan.

Complete records or statistics on annual cases of ALRI and malaria in children u5 are not available in the Philippines. This may be due to incomplete reporting and record systems, cases never treated at health care providers, and incomplete or potentially incorrect case identification and diagnosis. Annual cases therefore need to be estimated. WHO provides regional estimates of ALRI for the year 2002 [82]. These data suggest that the incidence of ALRI in children u5 in Asia is in the order of 0.35 to 0.70 cases per child per year. A conservative annual incidence of 0.35 cases of ALRI was applied to the Philippines. Annual incidence in all children u5 is the incidence per child multiplied by the number of children (Table A13).

Table A13. Demographic and mortality data in the Philippines, 2005

Item	Value
Mortality rate, under 5 (deaths per 1,000)[1]	33
Population, total[2]	84,221,578
Number of children under 5[2]	10,650,271
Estimated annual births[3]	2,202,745

Sources: [1]World Bank [83] ; [2]Country population statistics; [3]Estimated from the number of children u5.

The incidence of malaria is likely to be more uncertain than the incidence of ALRI. The regional WHO data for 2002 suggest that the incidence of malaria in SEARO B is 0.07 cases per child per year. Indonesia holds a large share of the population in this region. The incidence of malaria in WPRO B is only 0.001 per child per year; China constitutes more than 80% of the population in this region and it has a very low incidence of malaria.

A recent paper by WHO [84] estimates that the global incidence of malaria in 2004 was six times higher than what was recorded in national health information systems and around 17 times higher than that in non-African countries. The estimated country population incidence in Korenromp [84] indicates that the incidence in children u5 could range from 0.16 case per child per year in the Philippines, 0.27 case in Vietnam, 0.39 case in Indonesia, and 0.8 case per child in Cambodia.[17] These estimates are, however, very uncertain. A much more conservative estimate would be to assume that the incidence in children u5 in Indonesia is 0.07 case per child per year (as reported for SEAR B for 2002) and that the incidence in the other countries is in the same proportion relative to the estimated incidence in Korenromp [84]. This approach gives an estimated incidence of 0.03 in the Philippines. Using the incidence rates, annual cases of malaria in children u5 are presented in Table A14.

Table A14. Estimated annual cases of illness in children under the age of 5

Disease	Cases (000)
ALRI	3,728
Malaria	298

Sources: Estimated from regional WHO incidence data (WHO [82] and Korenromp [84]).

Applying Equation 2 to the cases of mortality and illness in Tables A10 and A11 provides an estimate of mortality and morbidity from poor sanitation (Tables A12 and A14). Mortality in children from protein-energy malnutrition is estimated separately using the methodology in Fishman et al. [64] and attributing a fraction of this mortality to sanitation in proportion to the effect of diarrheal infections on malnutrition. Diarrheal mortality from poor sanitation is 88% of total diarrheal mortality.

About 95% of estimated annual mortality is in children u5. In children u5, mortality directly attributable to poor sanitation (i.e., diarrheal mortality) constitutes 13% of total u5 child mortality. Mortality attributable to sanitation from malnutrition (i.e., the indirect effect of infections through malnutrition) constitutes 20% of total u5 child mortality. Total attributable mortality to sanitation is 33% of total u5 child mortality (Table A15).

17 Korenromp [84] presents population incidence. The WHO regional data indicate that the incidence in children u5 in SEARO B is 4.5 times higher than population incidence. This ratio is applied to the estimated population incidence in Korenromp to estimate incidence in children u5.

For morbidity in children u5, ALRI attributable to sanitation from malnutrition constitutes 16% of annual cases, and malaria attributable to sanitation constitutes 7% of annual cases (Table A16).

Table A15. Percent of total under-5 child mortality attributable to poor sanitation

Item	Percentage
Directly attributable mortality to sanitation	13
Attributable mortality to sanitation from malnutrition	20
Total attributable mortality to sanitation	33

Table A16. Percent of cases of illness in children under the age of 5 attributable to malnutrition

Item	Percentage
ALRI	16
Malaria	7

A2.2.3 Health treatment practices

In estimating the costs of health care, it is also important to know the total number of cases seeking health care from different providers. Table A17 shows data calculated from the NDHS [46]. It represents information from a national survey of 714 respondents regarding treatment practices for diarrheal diseases. Since the survey is not specific to the type of diarrhea, it is assumed that the percentages apply to the four types of diarrhea covered in the study.

Table A17. Treatment-seeking behavior for diarrheal diseases (%), by provider

Region	Seeking treatment from		Self-treatment	No treatment
	Health facility	Informal care		
NCR	49.6	7.2	7.2	35.9
CAR	36.4	5.1	5.1	53.5
1	60.0	3.4	3.4	33.3
2	28.6	10.6	10.6	50.1
3	54.5	15.3	15.3	14.9
4a	55.0	5.6	5.6	33.9
4b	29.5	18.9	18.9	32.8
5	29.3	21.6	21.6	27.5
6	34.6	15.1	15.1	35.2
7	53.7	3.9	3.9	38.5
8	56.7	10.0	10.0	23.2
9	52.8	15.5	15.5	16.3
10	28.2	17.5	17.5	36.8
11	46.7	18.5	18.5	16.3
12	41.7	11.2	11.2	35.9
13	41.9	23.8	23.8	10.4
ARMM	43.0	18.0	18.0	21.0
Total	**43.7**	**13.0**	**13.0**	**30.3**

Source of basic data: National Statistics Office [46].

A2.2.4 Summary: estimates of disease incidence, treatment practices, and mortality

Given the information above, incidence rates and treatment practices for diarrhea were estimated as follows. First, the total number of cases of acute watery diarrhea, acute bloody diarrhea, cholera, and typhoid were calculated from information on reported cases and treatment practices. This led to an estimated 1.18 million cases of acute watery diarrhea attributable to sanitation (Table A18). Along with acute bloody diarrhea, cholera, and typhoid, the sum for the four diarrheal diseases was estimated to be 1.22 million cases. The estimated cases were then apportioned among people seeking treatment from health facilities, seeking informal care, practicing self-treatment, and not seeking treatment. Second, the information on incidence rates (Table A7) and population data were used to estimate the total number of diarrheal cases in the country, which are attributable to poor sanitation. This generated a total of 38.0 million cases of diarrheal diseases. The difference between estimated total diarrheal cases and the sum for the four diseases was substantial, about 36.8 million cases. Rather than apportion this among the four diseases in the study, the decision was to construct another category called "other" diarrheal diseases. This discrepancy effectively captured the mild cases of diarrhea. To reduce the impact of this category on the results, it was assumed that all cases of "other" diarrhea were not taken to hospitals. In other words, it was only apportioned to informal care, self-treatment, and no treatment.

In the absence of information on treatment practices, it was assumed in the analysis that all cases of malnutrition-related diseases were treated in hospitals.

Table A18. Estimated number of cases seeking care from different providers (attributed to poor sanitation and hygiene)

Disease	Cases (attributable to sanitation)			Treatment practice		
	Reported[2]	% under-reported	Estimated actual cases	Hospital facility	Informal care	Self-treatment
Diarrheal	534,556	7012.1%	38,018,043	16,596,961	4,946,216	4,946,216
Acute watery diarrhea	516,928	101.1%	1,181,183	515,651	153,674	153,674
Acute bloody diarrhea	6,552	127.0%	16,905	7,380	2,199	2,199
Cholera	136	86.6%	289	126	38	38
Typhoid	10,939	110.2%	26,128	11,407	3,399	3,399
Other[1]	na	na	36,793,536	na	8,495,779	8,495,779
Malnutrition-related						
ALRI	248,732	136.7%	588,854	588,854	0	0
Measles	na	na	na	na	0	0
Malaria	6,985	177.4%	19,380	19,380	0	0

Source: Table C1.

Notes: na = not available. [1]The item "Other" represents estimates of non-severe diarrheal cases. [2]Adjusted to account for attribution to sanitation.

Table A19 shows the estimated annual deaths attributable to poor sanitation and hygiene using the methods described above. It indicates that acute watery diarrhea has the highest number of case fatalities at 11,338. Explaining close to 85% of all deaths from diarrheal diseases, most of the fatalities were accounted for by children u5. Table A19 also indicates that 6,917 deaths from malnutrition-related diseases, or about 40% of deaths were among children u5.

Table A19. Estimated number of annual deaths from poor sanitation and hygiene

Disease	Age grouping				
	0-1	1-4	5-15	16+	Total
Diarrheal					
Acute watery diarrhea	1,993	7,442	1,001	902	**11,338**
Acute bloody diarrhea	23	90	12	9	**135**
Cholera	3	20	9	13	**46**
Typhoid	55	845	584	425	**1,909**
Other	-	-	-	-	**-**
Malnutrition-related					
ALRI, measles, malaria	nc	6,917[1]	nc	nc	**6,917**

Notes: [1]Malnutrition deaths for the 0-1 age group were included in the 1-4 age group; nc=not calculated.

A2.3 Health care cost estimation

Health care costs result from diseases associated with sanitation and hygiene. To estimate health costs related to disease, it is necessary to compile information on disease rates for the selected diseases, treatment-seeking rates, as well as health system variables such as treatment practices and unit costs. Since the data on disease incidence and treatment practices were discussed in the previous section, the focus here is on the unit costs of health care only.

Health care costs can fall on both the patient and the public health system, depending on where the sick person seeks care from and the tariff rates in public facilities. Private health care is assumed to be fully financed by the patient. Costs are both financial and economic in nature. Financial costs include the marginal cost to treat patients at public facilities (mainly drugs), patient transport costs, as well as the full costs of treatment in private clinics or self-treatment. In the absence of data on the actual production costs of health care, tariffs are taken to reflect health care costs. Economic cost includes the financial costs *plus* the short-term fixed costs of public health facilities such as staff, capital items, and overhead.

The calculation of the costs associated with the cases seeking health care requires data on treatment practices, the proportion of cases that are admitted for inpatient stay, and the costs associated with health care. In general, the data were generated through informal interviews with doctors and documents from hospitals in Metro Manila. The interviews were used to identify (a) duration of diseases for severe and non-severe cases; (b) medical requirements (tests, type of medicine and dosage); and (c) doctors' fees. Prices of hospital rooms and laboratory services were based on unsubsidized rates from the Philippine General Hospital. Prices of medicine were taken from the "*MIMS Annual 2006*", a compendium of drug information in the Philippines [85]. With respect to self-treatment, doctors were also consulted regarding the likely household practices in treating the symptoms of the disease. From these interviews, this study made the assumption that self-treatment takes the form of (a) oral rehydration salts (ORS) for acute watery diarrhea, acute bloody diarrhea, and "other" diarrheas; (b) ORS and paracetamol for cholera; and (c) paracetamol for typhoid. In the absence of information on informal care, such as traditional healers, this study assumed that the fees paid were one-third of the consultation fees of a doctor. Since most of the price data were taken from Metro Manila, an adjustment was also made to account for differences in cost of living across regions. Hence, health care prices in Metro Manila were adjusted by the factor differences in the wages of hospital workers between Metro Manila and each region. Data on wages were obtained from the National Statistics Office [86].

Table C2 provides a listing of unit costs that have been used in previous studies in the Philippines. Among these, the estimates in this study were comparable with those used in the *Philippine Environment Monitor 2006* [21]. However, compared with values taken from claims with PhilHeath, the inpatient unit costs in this present study were lower, and hence conservative.

Table A20 shows the unit costs for treatment seekers who receive their care on an outpatient basis from hospitals, informal care givers (traditional), and self-treatment. It indicates that outpatient visits (inclusive of doctors' fees and medication) cost anywhere between US$3.90 and US$10.20. Other costs represent transportation expenditures, with the assumption that the patient pays US$0.25 per trip, two-way, or PhP 14. This price was based on the minimum jeepney fare in the Philippines. The costs of self-treatment and informal care were, on average, US$0.20 and US$0.90, respectively.

Table A20. Health service use and unit costs associated with outpatient care, 2005 prices (US$)[1]

Provider and disease	Average patient tariff[2]	Financial cost[3]	Full unit cost[4]	Other costs[5]
Health facility				
Diarrheal diseases				
Acute watery diarrhea	2.88	1.03	3.91	0.25
Acute bloody diarrhea	7.05	1.09	8.13	0.25
Cholera	6.82	1.96	8.77	0.25
Typhoid	6.70	3.46	10.16	0.25
Malnutrition-related				
ALRI, measles, and malaria	7.21	0.77	7.99	0.25
Informal care	0.87	na	0.87	0.25
Self-treatment	na	0.24	0.24	na

Notes: [1]The data used in the study represent prices in 2007. These were converted to 2005 using the GDP deflator and into US dollars using the 2005 exchange rate of PhP55.09/US$. [2]Average patient tariff represents doctors' fees. [3]Financial costs capture expenditures on medicine and laboratory tests. [4]Full unit costs are the sum of the two components. [5]Other costs only capture transport costs.

Table A21 shows key variables for inpatient care in hospitals. Depending on the disease, inpatient costs ranged from around US$9.10 to US$31.40 per day. Hospital stay ranged from 1 to 5 days, depending on the disease. Multiplying these items generates the costs of inpatient care per patient per disease. For example, the cost of hospitalization for typhoid is US$82 (= 5 days x 16.41 per day). The study assumed that 17% of all health seekers are admitted as inpatients. This was based on the weighted average of information from the WHO on the self-reported utilization of health services in rural and urban areas in the Philippines [87].

A2.3.1 Health-related productivity cost estimation

Disease takes people away from their occupations and daily activities, and regular sickness-related absences from school affect the ability of children to keep up with the curriculum and complete their education. Therefore, time lost from work, school, or daily activities has a value. A commonly applied economic valuation technique for time loss is the human capital approach (HCA), which values time lost from productive activities according to what the sick person would be doing with his or her time. Economic evaluation also recognizes that unpaid but productive activities have an opportunity cost, and thus uses shadow–or proxy–prices to reflect the value of these activities to people and to society. Even loss of nonproductive time incurs a welfare loss, as people also value their leisure time [88-91]. Aside from economic 'opportunity cost,' the impacts may also be *financial* in nature, given that disease affects people's productivity and hence, their income. However, assessment of actual financial impact would require primary studies that assess household- and enterprise-coping strategies such as work shifting and worker replacement, which determine the real household and enterprise impacts. In the present study, financial impact was estimated based on the available published literature, average wages, and knowledge about local work patterns and conditions.

Table A21. Health service use and unit costs associated with inpatient care, 2005 prices (US$)

Disease	% cases admitted	Days admission per patient	Per inpatient day[1]			Other patient cost
			Average patient tariff	Financial cost	Full unit cost[2]	
Diarrheal						
Acute watery diarrhea	17	1	8.1	1.0	9.1	0.25
Acute bloody diarrhea	17	5	11.9	1.1	12.9	0.25
Cholera	17	5	11.4	3.6	15.0	0.25
Typhoid	17	5	11.3	5.1	16.4	0.25
Malnutrition-related						
ALRI, measles, malaria	17	5	29.4	2.0	31.4	0.25

Notes: [1]The data used in the study represent prices in 2007. These were converted to 2005 using the GDP deflator and into US dollars using the 2005 exchange rate of PhP 55.09/US$.[2]The full unit cost is the sum of average patient tariff and financial cost.

Given that time off work is determined by the severity of the disease, as well as whether the case was treated or not, assumptions were made on the proportion of cases that are severe, and the treatment-seeking behavior associated with these cases. Table A22 shows the assumptions used in the study. The number of days off daily activities reflects the range of values on the duration of severe and non-severe cases, which are based on interviews with doctors. As a rule, it was assumed that untreated cases will take the maximum number of days for severe and non-severe cases. On the other hand, treated cases will take the minimum number of days.

Table A22. Variables for estimating amount of time lost from disease

Disease	% cases [1]		Days off daily activities			
			Treated		Not treated	
	Severe	Non-severe	Severe	Non-severe	Severe	Non-severe
Diarrheal						
Acute watery diarrhea	100	0	1	na	2	na
Acute bloody diarrhea	100	0	5	na	7	na
Typhoid	100	0	5	na	7	na
Cholera	100	0	5	na	7	na
Others	0	100	na	1	na	2
Malnutrition-related						
ALRI	100	0	5	na	7	na
Measles	100	0	3	na	5	na
Malaria	100	0	5	na	14	na

Notes: [1]The study assumed that all cases taken to health facilities were severe cases, and hence reported in the national statistics. na=not applicable.

Given that time off work has an opportunity cost and, in some instances, a real financial loss, time away from daily activities needs to be given a unit value to estimate overall financial and economic losses associated with the disease. A commonly applied economic valuation technique for time loss is the HCA, which values time loss according to what the sick person could be earning in productive employment. Even when the person would not be earning income (especially in the case of children), time for leisure and other activities can be assumed to have a value greater than zero [88-91]. A second common approach, which measures the sick person's willingness to pay to avoid disease, can more accurately reflect the welfare effects of disease, but due to lack of data on willingness to pay in the study countries, this approach was not used in this study. Hence, HCA was used as it is simple and it reflects the time loss component of disease.

This study distinguished between financial and economic cost. For some adults, time spent away from productive activities will have a direct income loss, whereas, for others, the salary may be paid for a maximum number of sick days per year. Given the self-employed and/or agricultural nature of agrarian societies of many Southeast Asian countries, loss of time from productive activities may not have immediate financial loss but may lead to income losses in the future, unless a family member or business partner replaces their lost labor. To be conservative, financial cost was estimated as immediate income loss for those not paid their wage or earning an income from time lost due to sickness.

For those not directly losing income, there will also be a welfare loss, which may include longer term income-earning potential as mentioned above. In the estimation of economic cost, this study recognized the value of time lost from daily activities, whether productive working time, school time, or leisure time. Given that value of time varies according to what the person is doing with his or her time, economic 'welfare' losses were valued at less than the financial losses described above. Research studies have shown a whole range of results on the value of time. This present study assumed that the economic value of time is 30% of the unit value of time. Furthermore, this study distinguished between the value of adults' and of children's time, given that children do not generally have the same values as adults. On the other hand, children's time is not worthless. Time away from school would mean lost education and eventually lower income levels [92]. Also, for young children of non-school age, sickness will involve more time input from a career, and hence incur a cost. In study countries, caring for a child is mostly the mother's task and thus ill children are more likely to take the time of women than men, thus hindering women from working. Given the limited empirical work on the value of children's time, and very few precedents in terms of valuing children's time, a time value of 50% of adult's time was given in this study [93].

Table A23 shows some alternative sources of economic value by region, comparing GDP per capita, compensation of employees, and minimum wage. Data on regional GDP per capita and minimum wages were obtained from the *Philippine Statistical Yearbook (PSY)* [57]. Minimum wages in the Philippines are determined by regional wage boards and vary across occupational groups. Table A23 only presents the lowest value among the occupational groups in each region, thus leading to conservative estimates in this study. Information on compensation of employees is available from the *National Accounts of the Philippines* [94]. This was converted into compensation per worker using the information on total employment. However, regional data are not available for this variable. This gap was filled by multiplying the national value by a factor that reflects the ratio of regional to national GDP per capita. The annual value was converted to hourly value by assuming 8 working hours per day, and 234 working days per year[18]. Compensation of employees was considered the most appropriate global figure to reflect the average value of time, given that it reflects the amount paid to all formal employees. Other sources of time value were used in sensitivity analysis.

Employed adults represent the proportion of the labor force that have jobs. This was obtained by taking the product of the adult population (ages 15 and over), employment rate, and labor force participation rate. The employment and labor force participation rates in the Philippines for 2005 were 92.6% and 64.8%, respectively [19]. This means that 60% of its adults are employed. This also implies that 40% of the adults do not have jobs.[19]

18 The number of working days account for the 17 regular and special national public holidays.

19 The proportion of the adult population who do not work includes people who are unemployed (i.e., those who do not have jobs but are part of the labor force) and are not part of the labor force.

Table A23. Comparison of alternative sources of time value (US$), 2005

Region	GDP per capita		Average compensation of employees		Minimum wage	
	Annual	Hourly	Annual	Hourly	Annual	Hourly
NCR	3,726.39	1.79	2,268.66	1.09	1,477.22	0.71
CAR	1,523.89	0.73	927.76	0.45	939.19	0.45
1	673.75	0.32	410.18	0.20	769.29	0.37
2	612.51	0.29	372.90	0.18	778.73	0.37
3	923.52	0.44	562.25	0.27	656.02	0.32
4a	1,196.43	0.58	728.40	0.35	575.79	0.28
4b	875.46	0.42	532.99	0.26	514.43	0.25
5	530.77	0.26	323.14	0.16	740.97	0.36
6	1,046.21	0.50	636.94	0.31	660.74	0.32
7	1,195.46	0.57	727.81	0.35	816.48	0.39
8	629.74	0.30	383.39	0.18	809.40	0.39
9	774.21	0.37	471.35	0.23	731.53	0.35
10	1,267.62	0.61	771.74	0.37	948.63	0.46
11	1,209.56	0.58	736.39	0.35	901.43	0.43
12	964.60	0.46	587.26	0.28	943.91	0.45
13	305.78	0.15	186.16	0.09	802.32	0.39
ARMM	568.65	0.27	346.20	0.17	849.52	0.41
Total	**1,281.86**	**0.62**	**780.41**	**0.38**	**818.56**	**0.39**

Sources: GDP and minimum wage were taken from the National Statistics Coordination Board [57]; Compensation of employees was taken from the National Statistics Coordination Board [94].

A2.3.2 Premature death cost estimation

Premature death affects society in a number of ways and has proven to be difficult to value in economic terms with any degree of precision. As a result, economists have employed a range of methods for valuing premature loss of human life [95]. The most tangible economic impact of premature death is the loss of a member of the workforce, with implications for the economic outputs generated. Hence, the HCA approximates welfare loss to society by estimating the future discounted income stream from a productive person, from the time of death until the end of (what would have been) his or her productive life. However, this technique has been criticized for that fact that it values human life exclusively for its productive potential. Empirical evidence indeed proves that life has a value beyond the productive worth of a human, which both society as a whole and individuals are willing to pay for in order to safeguard [96, 97].

Various other methods are available to estimate this broader economic as well as inherent worth of human life. These are as follows.

1. Hedonic pricing: This uses observations about actual market and individual behavior with respect to what they pay to reduce the risk of death (e.g., safety measures) or what they are willing to accept for an increase in the risk of death (e.g., wage premium for risky jobs).
2. Contingent valuation: This uses stated preferences of individuals exposed to risk using interviews.

Both approaches directly estimate the willingness to pay of individuals, or society, for the reduction in the risk of death, and hence are more closely associated with actual welfare loss compared with the HCA.

The problem in valuing life is that the alternative methods can give very different estimates of the value of life, and applications of the same techniques to different contexts can also reveal very different implicit values in reducing the risk of death. For example, 'willingness to pay' studies generally show greater value of life than the HCA. These variations and differences will affect the credibility of economic studies when used for policy decisions, and hence considerable care is needed in estimating and presenting the economic impact of premature loss of life to policymakers. Therefore, in order to sound more plausible to policymakers, this study used the more conservative HCA. Sensitivity analysis explored the implications of alternative values for loss of human life using the willingness to pay approach.

A2.3.3 Human capital approach

The HCA sums the future years of income at the average age of death. Given the lack of data on the exact age of death, three time points of death were used: 2 years of age for the 0-4 age group, 9 years of age for the 5-14 age group, and 40 years of age in the 15+ age group. The discount rate applied was 3%, reflecting the social rate of time preference approximated by the long-term real interest rate. Also, given that per capita income grows over time, a presumed long-term per capita income growth of 2% was applied to future incomes. Average income was taken from the average compensation of employees and adjusted to subnational level by applying GDP per capita ratios. For the younger age groups who will not be in the work force for several years, the net present value of future earnings are further discounted to take this into account. The values are shown in Table A24.

Financial costs of premature death were approximated using the HCA by assuming a coping period following the loss of an adult member of the family. The coping period could be the period after which the income of the lost adult is expected to be replaced. A period of 1 year was used in this study. Therefore, the average compensation of employees for a single year is applied to the number of adult deaths to estimate the financial impact of premature death.

A2.3.4 Willingness-to-pay approach

Given the lack of estimates of willingness to pay for avoiding death in developing countries and in Southeast Asian countries in particular, the benefit-transfer method was applied for the willingness-to-pay method. This essentially involves taking value-of-statistical-life (VOSL) from a meta-analysis of studies in developed countries and transferring the value directly using an adjustment for differences in income. While this approach has many weaknesses [98], the absence of data from developing countries justified the benefit-transfer approach. The VOSL reported in North American and European studies was highly variable, ranging from around US$1 million to more than US$10 million [99-103]. A meta-analysis of 40 VOSL studies reported by Bellavance et al in 2007 reported an average VOSL of US$9.5 million and a median VOSL of US$6.6 million [104]. Developing-country studies are few. A study of the Indian labor market found VOSL varying from roughly US$0.14 million to US$0.38 million [105]. Given the large number of studies from OECD countries, an adjusted benefit transfer is justified, using a highly conservative VOSL estimate of US$2 million. This reflects the lower end of the US$2 million to US$4 million recommended by Abelson for public policy [96]. Direct exchange from higher to lower income countries implies an income elasticity assumption of 1.0, which may not be true in practice. Therefore, the benefit transfer from OECD studies was also made at income elasticity of 0.8 and 0.6. The values are also shown in Table A24. Estimates of financial cost from premature death were conservatively assumed to be 1 year of income loss for adult deaths, using the average compensation of employees of US$780 in the Philippines.

Table A24. Unit values for cost of a premature death

Variable	Value (US$, year 2005)		
	Low	Mid (base case)	High
Human capital approach (economic)[1]			
0-4 years	32,162	45,787	97,621
5-14 years	39,647	54,042	107,646
15+ years	25,440	28,700	36,939
Human capital approach (financial cost)	-	780	-
Willingness to pay using benefit-transfer method[2]			
VOSL income elasticity 1.0 at OER	29,721	59,442	34,751
VOSL income elasticity 0.8 at OER	60,042	120,083	89,781
VOSL income elasticity 0.6 at OER	121,294	242,588	231,955
Input values for WTP approach			
VOSL in USA	1,000,000	2,000,000	4,000,000
GDP per capita at OER in country	1,300	1,300	1,300
GDP per capita at USA OER	43,740	43,740	43,740

Notes: [1]Low and high values are produced by using GDP per capita growth of 1% and 4% (base case 2%). [2]Low and high values are produced by using US$1 and US$4 million as VOSL (base US$2 million). VOSL=value of a statistical life, OER=official exchange rate, WTP=willingness to pay, GDP=gross domestic product.

A3. Water resources

The 2003 United Nations Report "*Water for people, water for life*" states that many rivers, lakes, and groundwater resources are becoming increasingly polluted, and that human excreta is one of the most frequent sources of pollution [106]. In Southeast Asian countries, a significant proportion of human excreta is flushed directly into water resources due to low coverage of treatment for piped sewerage. Human excreta also find its way into water resources through open defecation, leaking septic tanks, or seepage from pit latrines. As a result, levels of suspended solids in rivers in Asia have risen by a factor of four over the last 3 decades and Asian rivers have a higher biological oxygen demand (BOD) and bacterial content than the global average [106]. Polluted water has many effects on human activity. Previously safe drinking water sources are rendered unusable, and water becomes less productive or less usable for agricultural purposes, including fish production, or for industrial and domestic uses. According to the Asian Development Bank, the threat to fish production is especially important, given the economic importance, subsistence value, as well as nutritional value of fish in the Southeast Asian region [107].

Domestic sources contribute to water pollution in most developing countries because majority of households do not have their sewage or wastewater safely disposed of or treated. However, the presence of other sources of water pollution means that overall economic impact of polluted water cannot be attributed to poor sanitation alone. Pollutants that affect water-related economic activity include microorganisms, organics, chemicals, solids, gases, and heat [108]. Pollution originates from a variety of sources:

- Households (sewage and gray water from bathing, laundry, cooking)
- Small industries (garments, washing, brewery)
- Manufacturing industries (production or processing)
- Chemical fertilizers, pesticides, and treatment of acid-sulfate soils
- Animal waste
- Silt release following buildup behind dams
- Salinity intrusion from coastal areas

Major categories of water use include drinking water, domestic uses, crop and fish production, energy production, industry, recreation, and transport. For some of these activities, good-quality water is important–such as for drinking; for other uses, water quality standards are not so strict such as those for agricultural and some industrial uses. Therefore, only selected impacts of polluted water were examined in this study. The basis for selection was the strength of the proven association between poor sanitation and the associated costs.

The remainder of this section describes the methods and data inputs used in the calculation of the impacts on water resources. The formulas that were employed in the process are shown in Equations 3 and 12–17 of Annex B.

A3.1 Water quality measurement

Inland water quality is affected by many variables, the two main ones being the quantity of polluting substances released and the overall quantity of water resources for absorption of the pollution load. Hence, water quality indicators will need to be interpreted based on these two variables, as well as the multitude of factors that determine these variables. Furthermore, the economic impact of polluted water depends on the productive uses the different water resources have or *could have,* assuming improved water quality.

The Environmental Management Bureau (EMB) is tasked with monitoring water bodies in the Philippines. At present, it monitors 238 water bodies for classification or regular water quality assessment. These water bodies are examined for, among others, dissolved oxygen (DO), BOD, total suspended solids (TSS), and fecal coliform. Depending on the resources of the region, monitoring is done either on a monthly or quarterly basis.

A3.2 Contribution of poor sanitation to water pollution

Water pollution from domestic sources can be estimated from the annual release or eventual seepage of untreated feces, urine, and gray water into inland water bodies. It is estimated by accounting for the population and their access to different types of sanitation facilities, the proportion of sewage released to water bodies, and average human (and animal) waste production per year. The study used the following assumptions. Pollution load from human waste was based on 0.15 kilograms of feces and 1.2 liters of urine per person per day. Multiplied by the population and sanitation coverage statistics, this yields the amount of human waste that is processed by different sanitation facilities. A downward adjustment was made on human waste release to account for the fact that septic tanks and sewage facilities reduce the waste being emitted to water bodies and the general environment. In the absence of reliable national data, this was implemented using the assumptions employed by Orbeta and Indab in the Philippines [109]: (a) there is a 10% leakage from sewerage systems and (b) septic tanks have a 10% removal efficiency.

Table A25 shows the assumptions on polluting substances used for discharge per day for urban households with pipe connection (sewerage). It shows that the average individual emits about 50 grams of BOD per day, of which 35 grams is attributable to sewage.

Table A25. Wasteload production, subdivided by gray water and sewage, for urban households with pipe connection

Source	Biological oxygen demand (BOD) (g/cap/d)	Chemical oxygen demand (COD) (g/cap/d)	Coliform (million count/ liter)	Total suspended solids (TSS) (g/cap/d)
Gray water	15	40	100	48
Sewage	35	35	100	20
Total	**50**	**70**	**100**	**68**

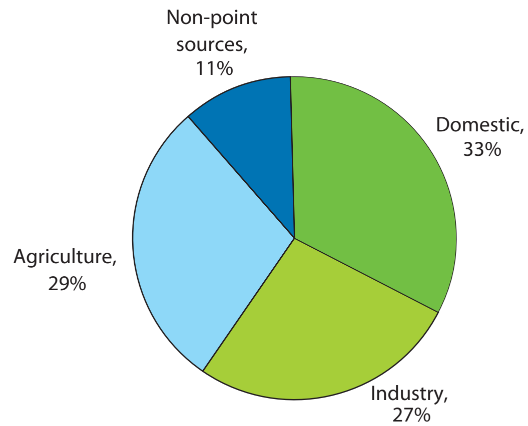
Sources: Sta. Ana and Nauta [110] for BOD, TSS, and COD; Orbeta and Indab [111] for coliform.

The calculation of BOD emissions followed the approach in the *Philippine Environment Monitor 2003* [3]. It assumed that the wasteload for the NCR is different from the rest of the country. In the present study, the wasteloads presented in Table A25 were only used in calculating the BOD emissions from the NCR and Region 4a. For the remaining regions of the country, the wasteload was reduced according to the ratio of the BOD factors in the NCR and other regions in Orbeta and Indab.[20]

In the case of coliform, emissions were measured by multiplying the wasteload with the amount of sewage attributable to sanitation. The latter was computed by multiplying water consumption by the product of the ratios of wastewater to consumption and sanitation to water consumption. The ratio of wastewater to consumption was assumed to be 0.8. This was sourced from an earlier study that attempted to measure the wastewater production of households [3]. On the other hand, the ratio of water for sanitation to total water consumption was assumed to be 37%, based on a survey that sought to determine basic water requirements for Metro Manila and Pangasinan [112].

Figure A2 provides a general idea of the sources of water pollution in the country. It indicates that domestic sources accounted for 33% of BOD emissions in 2005 [20].

Figure A2. Contribution (%) of domestic sources to overall water pollution, using BOD, 2005



Source: Environmental Management Bureau / Department of Environment and Natural Resources [20].

Table A26 provides a regional breakdown of the sources of water pollution from the most recently available data. It indicates that the NCR, Region 3, and Region 4 were the largest sources of water pollution from domestic sources. Collectively, these three regions accounted for 42% of BOD generation in the country for 2000.

The final column in Table A26 shows the share of households in total BOD generation for the different regions of the country. It shows that households contributed about 49% of total BOD generation in the country[21]. This is higher than the 33% reported in Figure 3. In succeeding analysis, it will be assumed that households contribute 33%, and not 49%, of total water pollution for the following reasons. First, the selected value is more recent, representing estimates for 2005. It potentially captures the improvements in sanitation coverage from 2000 onward. Second, the estimated share in Table A26 is based on calculations conducted over different years, meaning that the values are not comparable. Finally, 33% provides a conservative estimate of the impacts of poor sanitation.

A3.3 Cost implications of water pollution for drinking water supply

Water consumers and providers treat water because water sources are not clean. Some households, especially the wealthier ones, even purchase bottled water, which is either chemically treated or obtained from a protected (mineral) source. The more polluted the water source, the more likely the household will take some form of precautionary

20 The wasteloads used in the study apply to Laguna Lake in Region 4a. This is the reason Region 4a was treated separately from the other regions of the country.

21 The study recognizes that the value is just a rough estimate as BOD from the three sources was calculated for different years.

measure, and this can increase the unit cost of treatment. In some cases, households will haul water from less polluted water sources, but it may lead to time or financial costs.

Given that drinking water sources are polluted from several sources and not just from poor sanitary practices, by removing the human (and animal) waste component of polluted water, the need to treat water is not altogether removed. However, the removal of human and animal waste content from water sources may reduce the necessity for treatment or lowers the unit cost of treatment.

Table A27 shows selected drinking water quality standards of the Philippines. These standards are compared with available water quality measures to conclude how polluted water is for drinking purposes. Some of the main indicators, which will cause household members to purchase, treat, or walk farther to access cleaner water, are the perceived presence of infectious pathogens (microbial agents) and heavy metals, bad odor due to organics, turbidity caused by solids, and bad taste due to low pH and solids.

Table A26. Contribution of domestic sources to overall water pollution, BOD in mt, by region

Region	Industry (1998)		Agriculture (1999)		Domestic (2000)		Total		% BOD contributed by domestic
	BOD	%	BOD	%	BOD	%	BOD	%	
NCR	138	42	0	0	192	18	330	15	58
CAR	2	1	19	2	18	2	39	2	46
1	11	3	95	12	57	5	163	7	35
2	1	0	50	6	38	3	89	4	43
3	29	9	75	9	108	10	212	9	51
4	46	14	109	13	159	15	314	14	51
5	10	3	44	5	63	6	117	5	54
6	17	5	67	8	84	8	168	8	50
7	24	7	87	11	77	7	188	8	41
8	4	1	21	3	49	4	74	3	66
9	11	3	43	5	42	4	96	4	44
10	7	2	75	9	37	3	119	5	31
11	22	7	70	9	70	6	162	7	43
12	2	1	32	4	35	3	69	3	51
13	3	1	9	1	28	3	40	2	70
ARMM	0.05	0	25	3	33	3	58.05	3	57
Total	**327**	**100**	**821**	**100**	**1,090**	**100**	**2,238**	**100**	**49**

Source: World Bank after [3]

For purposes of cost estimation, household drinking water sources are subdivided into three categories:

1. Households receiving piped water supply, either from water treatment companies or other sources. Table A28 shows that 47% of households received their water from treatment plants. On the other hand, 32% received their water from other sources such as piped deep and shallow wells.
2. Households purchasing water from other non-piped suppliers, such as tanker truck, water by the bucket, or bottled water. The available information shows that only a small proportion of households obtained their water from this source. Combined, these accounted for less than 3% of the total.
3. Households collecting water from free or low-cost community or public sources. Hauled water accounted for 17% of the total sources of water supply. This represents water collected from dug wells, springs, lakes, rivers, rain, and others.

Table A27. Selected drinking water quality standards

Indicator	Unit	Philippine standard
Color	true color unit	5
pH		6.5-8.5
Suspended solids	mg/L	
Turbidity	nephelometric turbidity unit	5
Total dissolved solids	mg/L	500
Dissolved oxygen	mg/L	
Total coliform	cfu/100 ml	0
Fecal coliform	cfu/100 ml	0
Taste		Unobjectionable
Odor		Unobjectionable
Aluminum	mg/L	0.2
Chloride	mg/L	250
Copper	mg/L	1
Hardness	mg/L	300 (as $CaCO_3$)
Hydrogen sulfide	mg/L	0.05
Iron	mg/L	1
Manganese	mg/L	0.5
Sodium	mg/L	200
Sulfate	mg/L	250
Zinc	mg/L	5

Source: Department of Environment and Natural Resources [113]

Table A28. Sources of drinking water

Source(2000)	% of households
Piped	
Treatment plant	46.7
Other sources	32.0
Other purchased water	
Vendor	2.3
Bottled water	0.4
Hauled water	18.7
Total	**100.0**
Households treating water (2003)	44.2

Sources: National Statistics Coordination Board [19]; National Statistics Office [46]

For all of these categories, households often treat their water for drinking purposes. Table A29 shows that 44% of all households either boil, chlorinate, or use filter equipment to treat their drinking water. Households in the Philippines practice treatment, regardless of water source. Table A29 indicates that about 30% of households boil water that is piped directly into their homes. It also shows that about 24% of households treat water from refilling stations using different techniques. In addition to households, some industries also have to treat water whose properties do not conform to what are required for certain industrial processes. However, these costs are excluded in the present study.

Table A29. Treatment practices of households, 2003 (% households)

Source of drinking water	Nothing	Boiling	Chlori-nation	Filter equipment	Improvised filter	Others
Piped into dwelling	47.6	30.3	1.8	10.8	9.3	0.3
Piped into yard	61.7	24.9	1.2	3.0	9.0	0.2
Public tap	58.2	29.7	1.2	1.8	8.7	0.4
Open dug well	46.1	28.3	1.7	1.3	22.6	0.0
Protected well	60.1	23.8	2.2	2.7	10.6	0.5
Developed spring	64.4	18.3	1.0	1.8	14.5	0.0
Undeveloped spring	62.7	17.5	0.5	1.0	18.0	0.3
River/stream/pond/lake	45.2	29.9	0.7	3.7	19.8	0.7
Rainwater	25.9	26.6	3.3	1.7	40.7	1.7
Tanker truck/peddler	59.3	29.3	2.0	1.5	7.3	0.7
Bottled water/refilling station	75.8	9.4	0.4	7.6	5.6	1.2
Average	**55.8**	**26.0**	**1.6**	**5.5**	**10.6**	**0.4**

Source: National Statistics Office [46].

Various methods are available to estimate the costs of avertive behavior to avoid drinking polluted water. The lower bound on financial cost can be reflected by identifying specific actions to remove bacteria, such as chemical treatment for piped water, open wells, and household treatment. The upper bound can be reflected by apportioning to poor sanitation a fraction of the total cost of water treatment and purchase. However, it is noted that households choose more convenient but more costly water sources for a variety of reasons. These include (but are not limited to) water pollution, convenience of access, time savings, and unavailability of other water sources. Hence, the allocation of household piped water cost to sanitation is adjusted downward by 50% to reflect the other benefits of piped water supply. The economic cost of access to clean drinking water includes not only financial cost but also the efforts made by households to access clean water, such as walking farther to access cleaner water sources or taking time to treat water in the home.

The costs associated with drinking water were calculated using Equation 12 in Annex B. This was applied at the subnational (regional) level, using data available on drinking water sources and prices. The *PSY 2006* contains relatively detailed regional information on drinking water sources [19]. The items were grouped to suit the presentation in Table A28 (see Table C3 for details). Water prices, in general, were more difficult to obtain. In many cases, various assumptions were used to arrive at reasonable estimates of these prices (see Table C4 for details). For example, prices of water from owned and shared faucets were taken from Maynilad and the Manila Water and Local Water Utilities Administration (LWUA). Prices were converted to the year 2005 using the GDP deflator. For water sourced from deep and shallow wells, the most easily available data were prices reported by a World Bank survey of 20 small-town water districts in 2003 [114]. The minimum drinking water per capita was assumed to be 4 liters per day [115]. For hauled water, the proportion of households traveling farther to access cleaner water was based on populations living close to polluted water sources, which are unusable for drinking water purposes (lakes, rivers, and polluted groundwater), while additional journey time was taken from surveys of time for collecting drinking water.

An important question at this point is the attribution to poor sanitation of (a) water pollution, (b) water purchased, and (c) water treatment. The values for each of these aspects are likely to be different. However, in the absence of information, this paper assumed a value of 33%. This was based on Annex A3.2, which showed that 33% of water pollution, as measured by BOD, is attributable to households.

A3.4 Water quality and domestic uses of water

In addition to the uses of surface and groundwater sources for domestic use, industrial use, fisheries, and agriculture, water is an essential ingredient to many other human and nonhuman activities [116]. In this study, it is not possible to conduct an exhaustive analysis of all the different uses of water. However, the following three categories were assessed for relevance:

- Noncommercial household (domestic) activities
- Leisure activities [117]
- Wildlife, covering flora and fauna

Noncommercial activities are concentrated at the household level and include water for cooking purposes, washing clothes, kitchenware, and personal hygiene. Also, some traditional customs as well as leisure activities are closely related to water. Again, some of these require good-quality water, especially those that will be ingested, while others do not require quality water.

Activities affected by below-standard water quality were assessed in the following way:

- Proportion of households and population that use untreated or unprotected surface or groundwater for cooking, washing, and bathing.
- Proportion of households and population that switch water source due to preference to have clean water for domestic activities. For example, for laundry and bathing, purchased water (via pipe or vendor) may be used rather than sourcing them from local water bodies.
- Extent of other cultural and leisure activities related to water and that require water of a minimum quality standard, including swimming.

Wildlife, both animate and inanimate, large and small, is dependent on water resources. For plants and trees, much of the water need is met from rainfall; the issue of pollution is therefore of little relevance. However, some plants and trees and most animals and water creatures rely on standing water. Hence, water pollution from different anthropogenic sources is an important concern.

The water used for domestic purposes comes from the same sources of drinking water. However, it is noted that people pay for piped water perhaps because they can afford it and it is more convenient to get and not necessarily because it is essential to have treated water for all domestic uses. Hence, the allocation of household piped water cost to sanitation is adjusted downward by 50% to reflect the other benefits of piped water supply.

Equation 15 of Annex B was used to calculate the impacts.

A3.5 Water quality and fish production value

A3.5.1 Fisheries in the Philippines

The fisheries sector plays a vital role in the Philippine economy. In 2005, it accounted for about 7% of total employment and 1% of GDP (Table A30). Unlike other sources of food, the country has been a net exporter of fish. In 2005, net exports were valued at US$376 million. The Philippines typically classifies the sector into commercial fisheries, municipal fisheries, and aquaculture. As of 2005, each of these subsectors accounted for about a third of the total value of PhP 146 billion (US$2.7 billion).

Table A30. Selected Philippines fisheries statistics

Item	Value
Quantity of fish production, 2005 (mt)	4,161.8
Growth rate, 2002-05 (%)	7.1
Value of fish production, 2005 (million PhP)	146,392.9
Growth rate, 2002-05 (%)	8.2
Value added in fisheries, 2005, (million PhP, 1985 prices)	51,564.0
% of GDP	1.0
Employment (000 persons)	1,394.0
% of total employment	6.6
Exports (2004)	
Quantity (000 mt)	172.3
Value (free on board, million US$)	413.4
Imports	
Quantity (000 mt)	85.3
Value (free on board, million US$)	37.0
Composition of fisheries, 2005 (shares in total value, %)	
Commercial	32.3
Municipal	34.1
Aquaculture	33.6

Sources: National Statistics Coordination Board [19]; National Statistics Office [118], Bureau of Agricultural Statistics [22].

A3.5.2 Pollution and fish production

Pollution and river diversion have allegedly driven freshwater fisheries into collapse worldwide, and the extinction of freshwater species far outpaces the extinction of mammals and birds [119-121]. Fish populations are affected by a multitude of changes taking place due to human interventions, such as hydroelectric dams, water diversions for agriculture, flood control levees, dredging, water pollution, and habitat degradation such as logging. According to FAO, "the long-term productivity of fish stocks is related to the carrying capacity of their environment, which alters as a result of natural variability and of changes induced by human activity, such as coastal habitat degradation, destructive fishing methods, and pollution." (page 47, [122]). Environmental degradation has been cited as one of the key threats to fisheries in the Philippines [3, 37, 123-125]. Of particular concern for water quality for fish production in Southeast Asia are suspended solids, DO, heavy metals, and pesticides [126]. However, as one of the few publications on water quality and fish production in Asia notes, "data on the effect of water quality on Asian species of fish are not readily accessible" (page 15, [126]). Furthermore, it is difficult to predict the exact impact of water pollution on fish production, given the variations between fish species and the many determinants of fish production.

Domestic sources contribute significantly to water pollution, largely through the BOD exerted by organic matter, which reduces DO levels [127],[22]. Fish living below a sewage treatment plant had significantly higher mortality rate than fish upstream [128-130]. Pharmaceutical discharge in urine can affect fish health directly. The scientific literature testifies, albeit incompletely, to the adverse effects of sewage release on fish reproduction and fish growth, and the

22 A major determinant of fish reproduction, growth, and survival is dissolved oxygen (DO). When an organic waste is discharged into an aquatic system, a biological oxygen demand (BOD) is created. BOD is a measure of the oxygen required to break down organic compounds, and high BOD levels significantly deplete the amount of DO in surface water. Consequently, high BOD levels have a detrimental effect on the health of aquatic species that require elevated levels of DO. From human waste, damages result from direct BOD, as well as increased growth of algae from nitrates and phosphorus contained in human waste. The algae biodegrade the nutrients, thus reducing the amount of DO available.

role of DO [128-138]. For example, experiments undertaken in Canada on native fish and benthic macroinvertebrate species showed that exposure to low DO and low temperatures delayed the hatching of eggs, reduced mass of fish post-hatch, depressed feeding rates, and lowered fish survival [134].

Additionally, microorganisms contained in human and animal waste such as parasites and bacteria have a number of implications for fish health [132, 133, 137-139], as well as safety of fish for human consumption [128, 131, 140-143]. Common illnesses from contaminated fish and shellfish include typhoid, salmonellosis, gastroenteritis, infectious hepatitis, *Vibrio parahaemolyticus* and *Vibrio vulnificus* infections, paralytic shellfish poisoning, and amnesic shellfish poisoning.

A further consideration that needs to be addressed is the fact that, in many contexts, the nutrients from sewage act as a source of food for fish, and this positively affects the production of fish. This happens both intentionally, when sewage is fed to farmed fish in a regulated way, and unintentionally, when fish in open water bodies are exposed to untreated sewage disposed upstream. Hence, in recognizing the benefits of sewage for fish production, the impact analysis addresses only unregulated, unintentional pollution of water with sewage. It should be noted, though, that sewage-fed farmed fish may not be optimally managed, and negative health effects need to be recognized.

A3.5.3 Modeling the relationship between sewage release and fish production

Given the lack of empirical evidence linking water quality and fish production in Southeast Asia, this study used innovative methods to examine the likely importance of sewage release for fish production. While the following three key links are identified, only the first was assessed quantitatively in this study:

1. The proven link between sewage DO levels, and the resulting impact of lowered DO levels on fish production.[23]
2. The proven link between microbiological contents of water and fish disease, and hence survival.
3. The link between microbiological contents of water inhabited by fish and the transmission of disease to humans via fish consumption, due to inadequate decontamination of fish prior to consumption.

This study assessed the water quality indicators available for different freshwater locations where fish are (or used to be) farmed or caught, and assessed the various issues related to fish reproduction, fish population, and overall fish health, and based on the available data, drew links between sewage and gray water as a source of water pollution in those water bodies.

The EMB/Department of Natural Resources (DENR) states that fish need at least 5 mg/L of DO to live [20]. Measured against this criterion, regional data from the Philippines indicate that Region 3 and the NCR have very low DO levels. Most of the other regions appear to have DO levels that meet such standards.

The focus of the present study is on freshwater fish, given that DO is more affected in water bodies where oxygen depletion is more acute, resulting from release of untreated sewage into freshwater. Ignoring aquaculture, this is represented by inland municipal fish production in the Philippines. Table A31 shows that more or less half of the output of this subsector is sourced from Region 4.

23 Dissolved oxygen was selected as the key water quality parameter because aquatic organisms require oxygen in specified concentration ranges for respiration and efficient metabolism and because DO concentration changes above or below this range can have adverse physiological effects. Even short-lived anoxic and hypoxic events can cause high mortality rates of aquatic organisms. Exposure to low oxygen concentrations can have an immune-suppressing effect on fish, which can elevate their susceptibility to diseases for several years. Moreover, the toxicity of many toxicants (lead, zinc, copper, cyanide, ammonia, hydrogen sulfide, and pentachlorophenol) can double when DO is reduced from 10 to 5 mg/L. The amount of oxygen available in the water also decreases in lower temperatures and also decreases when plants die. Oxygen requirements of fish increase at a higher temperature (e.g., an increase in water temperature from 10 to 20 °C at least doubles the oxygen demand). The presence of other pollutants such as nitrogen and marine life overcrowding reduce DO levels. In cloudy conditions, plants use up more of the available DO. Plants proliferate with the presence of nitrate and phosphates from agricultural runoff, sewage and excess fish feed.

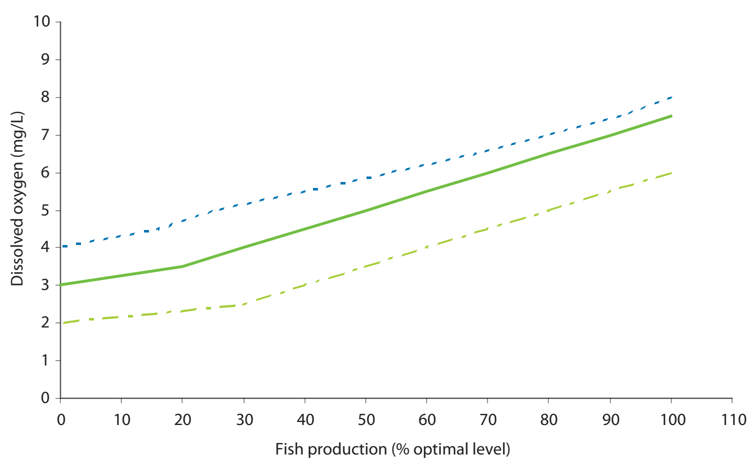
It is recognized that the impact of poor sanitation on fish stock, fish growth, and eventual fish catch is extremely difficult to quantify. Coefficients linking water body pollution and yield reduction have not been developed. For a crude quantification of the possible loss in fish value due to water pollution, a modeled relationship based on assumptions was used, represented in Figure A3. The figure shows the estimated reduction in volume of fish caught at lower levels of DO, for an average fish species in the Philippines.

Table A31. Fish production levels and dissolved oxygen levels, by water body

Region	DO average 2003[1]	Inland municipal production (mt) 2003	Inland municipal production (mt) 2005
NCR	4.3	na	na
CAR	na	1,018	899
1	7.0	1,724	2,278
2	na	6,169	6,801
3	3.7	7,111	9,843
4	6.7	73,961	72,772
5	5.3	1,696	2,825
6	7.7	2,110	5,740
7	6.7	114	170
8	7.2	1,457	2,761
9	5.6	440	584
10	7.8	1,312	1,993
11	7.0	217	175
12	na	14,212	15,811
13	6.9	3,776	3,681
ARMM	na	17,975	17,475
Average	**6.3**	**133,292**	**143,806**

Sources: World Bank [3], Bureau of Agricultural Statistics [22].
Notes: [1]The DO values are simple averages for the different water bodies in the region. A regional breakdown is available in Appendix Table C5.

Figure A3. Modeled relationship between dissolved oxygen levels and fish production (with lower and upper ranges)



Notes: The upper line represents the maximum effect of reduced DO levels on fish production volume, with linear reduction from 8 mg/L to 4 mg/L. In the base case, the linear reduction is from 7.5 mg/L to 3 mg/L, while for the least effect, the linear reduction is from 6 mg/L to 2 mg/L.

The amount of oxygen needed for fish survival varies with time of year and species. Oxygen needs vary, even with the life stage of a species. Young species tend to be more sensitive to low oxygen conditions than adults. Also important is the duration of periods with low oxygen. Most species can survive short periods of reduced oxygen, but they suffer during longer periods. According to Meck [136] and others, the minimum limiting oxygen concentrations for a fish is dependent on species, physical state, level of activity, long-term acclimation, and stress tolerance. A research study from the USA examined the lowest DO at which different fish species survived for 24 h, varying from 6.0 mg/L down to 3.3 mg/L [135]. Usually, larger fish are affected by low DO before smaller fish. Given the lack of published studies on the empirical relationship between these two variables, the following assumptions were made on the basis of a mixture of available scientific literature, internet sources, and expert opinion. A range is assessed in the sensitivity analysis, shown by the dotted line in Figure A3.

- Water with an oxygen concentration of less than 3.0 mg/L will generally not support fish. When concentrations fall to about 3.0-4.0 mg/L, fish start gasping for air at the surface or huddle around waterfalls or higher concentration points.
- Numerous scientific studies suggest that 4.0-5.0 parts per million (ppm) of DO is the minimum amount that will support a fish population for short periods of 12-24 h.
- Above 5.0 mg/L, almost all aquatic organisms can survive indefinitely, provided other environmental parameters are within allowable limits. When there are too many bacteria or aquatic animal in the area, they may overpopulate, using DO in great amounts [129].
- Levels of 6.0 mg/L and above support spawning; those above 7.0 mg/L support growth and activity [134, 135].
- The DO level in good fishing waters generally averages about 9.0 ppm.

To assess likely impacts of polluted water on fish production, geographical locations of principal fish catches and water quality indicators were matched for major selected inland water bodies. Based on the observed DO levels in these water bodies, the function in Figure A3 was applied that estimates the loss of fish catch due to lower than optimal levels of DO.

The current fish production levels were adjusted upward to predict what the fish catch would be in the presence of optimal DO levels using Equation 17 in Annex B.

The impact on fish reproduction and growth due to water pollution was assessed by spatially comparing actual yields under current pollution levels and potential yields under a situation of good water quality, based on a water quality-fish production function. Where fish yields have dropped close to zero, historical records were sought for when fish were previously caught in the given water body.

The focus of the initial analysis is on fish production that is officially recorded in national statistics. Where fish catch values were available, these were recorded; where not available, financial value was estimated by applying current market prices to the average type of fish. The economic impact of low DO levels for unrecorded fish catch was also assessed, by scaling up the financial values by proportion of total fish catch accounted for by unrecorded sources.

To estimate attributed impact to poor sanitation, a proportion of this loss was assigned to sewage and domestic gray water, as compared with other sources of water pollution (industry, agriculture, silt/natural erosion). This was done by estimating the proportion of BOD from these different sources. Due to lack of reliable information on the proportion of BOD from poor sanitation, it was assumed that poor sanitation contributes 33% of BOD to water bodies in the Philippines.

The values in Table A31 indicate that regions having DO readings can be classified into five groups. The first grouping, which was composed of regions with DO readings that were close to 4 mg/L and were therefore assumed to be operating at 30% of optimal fish catch, included the NCR and Region 3. The second grouping, close to 5 mg/L and operating at 50% of optimal fish catch, included Region 5. The third grouping, close to 6 mg/L and operating at 70% of optimal fish catch, included Region 9. The fourth grouping, close to 7 mg/L and operating at 90% of optimal fish catch, included regions 1, 4A, 7, 8, 11, and 13. The last grouping, close to 8 mg/L and operating at 100% of optimal fish catch, included Region 10. Together, these regions accounted for 102,059 metric tons of the total production of 143,806 metric tons.

A4. Environment

The release of waste into the environment has other effects besides water pollution, given the unpleasant smell emanating from feces, urine, and other waste products [144, 145]. In countries where open defecation and unofficial dumping of waste are common, the quality of land is affected, rendering it unattractive and unusable for productive use. Even in Asian countries where municipalities are responsible for collecting solid waste, solid waste collection is not commonly done, or it is inadequately done. Unregulated waste dumping presents a threat to those disposing of waste, those living in the vicinity of the dumping area, as well as the poorest of the poor who often live off the waste (e.g., recycling activities). Waste grounds are also inhabited by stray dogs or other animals, which are diseased and pose a threat to human health. Even where there is a private or public agency taking care of disposal, it is often not performed according to plan. In cities, waste carts stay on the streets for many days, with resulting smell and unsightliness for local inhabitants and tourists. These aesthetic aspects of sanitation cause a loss of welfare for those coming into contact with the waste. However, given the lack of available data on these aspects, there is considerable uncertainty on the overall importance of these impacts.

A4.1 Aesthetics

Aesthetics is not strongly related to productivity or income. Economic evaluation studies do not usually quantify aesthetics such as smell and sight in economic terms. Instead, these aspects are described as a potential additional benefit provided by sanitation program. Studies assessing user preferences for sanitation options, including willingness-to-pay studies, tend to limit the focus to the physical boundaries of the household and do not assess impacts on the broader environment [146, 147]. Hence, findings on welfare aspects of aesthetics in this study are presented mainly in qualitative terms.

A4.2 Land quality

When it has alternative uses, land is a tradable commodity. Hence, land that is used for improper, unofficial disposal of waste will be unusable for other more productive uses, and hence will reflect an economic loss to society. Since there are no specific studies in the Philippines on how waste disposal affects land values, the present study will simply acknowledge that such an effect exists. However, there will be no attempt at quantifying this impact.

A5. Other welfare

The type of sanitation facility that is available to a household has an impact on welfare. An important but difficult-to-quantify aspect is the welfare impact on individuals and families who use a substandard, uncomfortable latrine or who have no latrine at all. Except for the disease impact (covered elsewhere), these less tangible aspects of human welfare have limited direct financial implications but can be quantified as losses using conventional economic techniques. More tangible impacts of substandard latrine or no facilities are on access time and life decisions.

The formulas used to estimate other welfare impacts are shown in Equations 4 and 19-21 of Annex B.

A5.1 Intangible user preferences

User preferences that could be described as 'intangible'–or difficult to quantify–include:

- Comfort and acceptability–the acceptability of the squatting or seating position; the ease with which to perform personal hygiene functions; the freedom from rushing to complete toilet-going due to unhygienic latrine conditions, flies, and foul-smelling air.
- Privacy and convenience–the benefits of not being seen using the toilet or being seen walking to access toilet facilities (women) [11].
- Security –the location of the latrine within or near to the home means that excursions to the outdoor do not need to be made for toilet-going needs, in particular at night, where there may be dangers (theft, attack, rape, and injuries sustained from dangerous animals or snakes).
- Conflict–on-plot sanitation can avoid conflict with neighbors or the community, where tensions exist on the shared facilities, or fields and rivers for open defecation.
- Status and prestige–when visitors come to the house, it gives prestige to the household to be able to offer guests a clean and convenient toilet to use. Families may hold more social events at their house as a result of a clean latrine.

Table A32 provides information on the number of people in the Philippines who are likely to be exposed to the problems raised above. In 2005, more than 9 million Filipinos or about 11% of the total population did not have toilets. The problem was more serious in rural areas, where close to 14% of the population did not have toilets. It also shows that 8% of the total population used unimproved (open) pit latrines.

Table A32. Lack of latrine–indicators of defecation conditions

Area	No latrine		Unimproved pit latrines	
	Number	%	Number	%
Rural	7,927,134	13.9	6,072,074	10.9
Urban	1,210,873	5.0	694,515	2.6
Total	**9,138,007**	**10.9**	**6,766,589**	**8.0**

Source: National Statistics Coordination Board [19]; National Epidemiology Center [15].

A5.2 Access time

The welfare loss from increased access time due to unimproved sanitation can be explained by journey time for open defecation or waiting time for shared latrines. The equation is presented in Annex B. The financial loss was set to zero while economic losses were computed on the basis of forgone income. In the case of adults, this was assumed to be 30% of the average daily compensation of employees. On the other hand, the time value of children was assumed to be half of the value of adult time. These values were estimated at the regional level. Table A33 presents the rural-urban breakdown only. It should be noted that these values represent assumptions. This study did not find any evidence on the average length of time it takes to access shared toilet facilities or to openly defecate. Hence, it was assumed that the absence of optimal access to facilities causes a person to lose 5 minutes per day (or 0.08 hours/day). However, given the frequency at which people use toilets in a given day, the actual value is likely to be higher. On the other hand, not all people who share latrines have suboptimal access in terms of elevated access time. Hence, alternative values were tested in a sensitivity analysis.

Table A33. Toilet access, by location

Location	Population with access time already minimized (%)	Population experiencing suboptimal access (in terms of proximity and waiting time)		Average time access per day for those with suboptimal access	
		Shared latrines (%)	Open defecation (%)	Shared latrines (h)	Open defecation (h)
Rural	69.6	16.7	13.7	0.08	0.08
Urban	74.6	20.3	5.1	0.08	0.08
Total	**71.3**	**17.9**	**10.7**	**0.08**	**0.08**

Source: Table C6.

A5.3 Impact on life decisions and behavior

Running water supply and sanitary latrines in schools are a luxury in most of the developing world and, in many workplaces, latrines are unhygienic, poorly maintained, and do not cater to the special needs of women. The presence of hygienic and private sanitation facilities in schools has been shown to affect enrolment and attendance, especially for girls [148, 149]. Good latrine access at the workplace has implications for women participation at traditionally male-dominated employment areas. Furthermore, sanitary and adequate latrines in schools and workplaces not only affect participation rates but also improve the welfare of all pupils and employees.

Given the complex web of causative factors and eventual life decisions, and the many factors determining absenteeism from school or the workplace, it becomes difficult to quantify the exact relationship between poor sanitation conditions, education and work decisions, and eventual economic outcomes. Moreover, the necessary information to conduct the analysis is incomplete. Nonetheless, an attempt was made in the context of existing conditions in the Philippines.

Table A34 shows the results from a national survey in 2000 on the quality of toilets and running water in schools and workplaces. It indicates that running water, rather than toilets, was a more serious problem in schools. To a lesser extent, the same observation can be made in workplaces. Note, however, that the indicator on toilets in Table A34 refers to the presence of a toilet system and not the physical or hygienic condition of the toilet.

Table A34. Water and sanitation coverage in schools and workplaces (%)

Establishment	Toilets		Running water supply or well close by	
	Sanitary	Unsanitary	Safe	Unsafe
School	96.7	3.3	66.4	33.6
Workplace	85.9	14.1	94.1	5.9

Source: Table C7.

Table A35 provides information on male and female participation rates in school and work. Among primary school, children enrolment and drop-out rates for boys were higher than those for girls. Overall, enrolment rates fell substantially at the secondary level. In the case of boys, the enrolment rate dropped from 90% at the primary level to 59% at the secondary level. The decline in enrolment rates for girls, while still substantial, was smaller compared with that for boys. In fact, at the secondary level, enrolment rates for girls were higher than those for boys. Similarly, the increase in drop-out rates for boys appeared larger than that for girls, in absolute and relative terms. In the case of boys, the drop-out rate went up by about 7 percentage points. In the case of girls, the drop-out rate at the secondary level was considerably lower at 4%. In effect, the values here seem to show that falling enrolment rates and rising drop-out rates at the secondary level were more of a problem for boys than for girls.

Gender appears to be a bigger issue among the working-age population. Table A35 shows that workforce participation among women was about 50% in 2005. This was only about 60% of its counterpart for men. However, unemployment rates did not differ substantially for men and women. In fact, the estimates show that unemployment rates for men were slightly higher than those for women.

Table A35. Male/female participation rates in school and work, 2005[1]

	Female	Male	Total
Primary school (%)			
Enrolment	87.8	89.8	88.9
Completion	66.4	56.4	61.1
Drop-out	1.0	1.7	1.4
Secondary school (%)			
Enrolment	64.6	58.8	61.7
Completion	58.4	42.3	50.2
Drop-out	4.4	9.0	6.7
Teachers (employment rate, %)	74.7	25.4	100.0
Workforce participation (%)	49.8	79.7	64.7
Sectoral employment (%)			
Agriculture	25.9	74.1	100.0
Industry	30.3	69.8	100.0
Services	50.9	49.1	100.0
Unemployment rate	7.3	7.4	7.4

Source: Enrolment, completion, and drop-out rates [150]; workforce participation [150]; employment and unemployment, [19].
Note: [1] The information for schools is for academic year 2005-06.

Table A36 provides information on the reasons why children aged 5 to 17 drop out of school. Based on the responses of parents, the main reasons for girls were lack of interest and education costs. The responses of children indicated similar reasons. However, it was the cost of education rather than the lack of interest that appeared to be the primary cause of dropouts. Hygiene-related issues such as the existence of sanitary toilets and running water in schools were not included in the list of options and hence can only be assumed to have been part of the "others" category. Based on the responses of children, this category accounted for about 9% and 7% for girls and boys, respectively. The difference between the two figures (1.5%) may be crudely attributed to issues that are specific to girls. In other words, if sanitation and hygiene were more important to girls relative to boys, then it explained at most 1.5% of the dropout rates for girls.

Table A36. Reasons for dropping out of school (5-17-year-old children), 2001

Main reason	Number		Percent of total	
Responses of parents/guardians	**Male**	**Female**	**Male**	**Female**
Teachers not supportive	17	2	1.5	0.4
No suitable school available	6	3	0.5	0.7
Child not interested	545	110	48.1	24.3
High cost of schooling	220	139	19.4	30.8
School too far	50	41	4.4	9.1
To help in household enterprise	84	24	7.4	5.3
To help in housekeeping	10	18	0.9	4.0
To work for wages	76	35	6.7	7.7
To start business	2	0	0.2	0.0
Disability/illness	43	24	3.8	5.3
Others	79	56	7.0	12.4
Total	**1,132**	**452**	**100**	**100**
Responses of children				
To engage in paid/self-employment	99	46	9.6	10.8
To help in family business/farm	112	20	10.8	4.7
To attend to sick member of the family	8	16	0.8	3.8
Cannot afford to go to school	237	177	22.9	41.5
Not interested in school	387	72	37.3	16.9
School too far	64	29	6.2	6.8
Disability/illness	39	23	3.8	5.4
Teachers not supportive	14	3	1.4	0.7
To help in housekeeping	3	4	0.3	0.9
Others	74	37	7.1	8.7
Total	**1,037**	**427**	**100%**	**100%**

Source: National Statistics Office [151].

Based on the above, the expected impacts of poor sanitation in schools and workplaces were assessed by estimating school days and workdays lost due to poor sanitation:

1. School participation. The information above does not appear to support inclusion of sanitation as an issue for school enrolment and completion. This is based on the finding that enrolment and completion rates for girls in secondary schools were actually higher than those for boys. Moreover, dropout rates for girls were lower than for boys. Finally, assuming that it matters for women, crude estimates using survey data indicate that sanitation explained at most 1.5% of dropout rates among women.

2. Absenteeism from school. While sanitation may not matter in explaining school participation, it may be relevant in terms of absenteeism in school. However, such information is not available. Given this, the calculations were based on the following. The study assumed that a school-age girl will be absent for 1 day in a month (or 10 days per school year) during her menstrual cycle, if she is exposed to unsanitary facilities in school. Given this, the total number of absences attributable to poor sanitation is shown in Annex B. Following the approach used in valuing health impacts, it was assumed that the value of a girl's time in school is equal to half of the value of the adults.

3. Employment and workforce participation. There is no information on the magnitude by which sanitation, if at all, affects the employment and workforce participation of women. Hence, this study did not compute the potential losses.

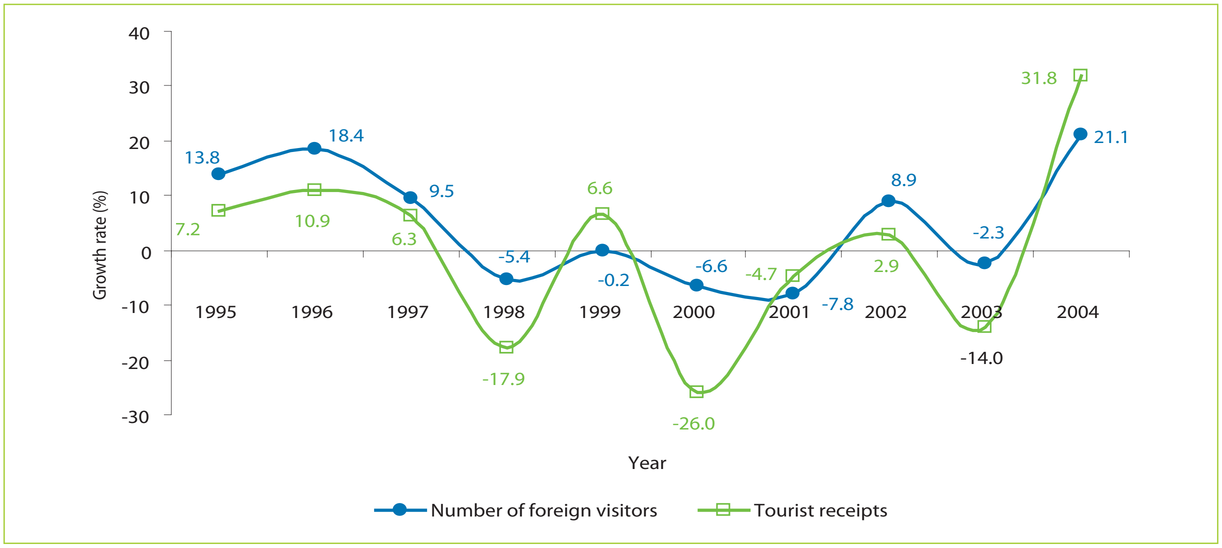
4. Absenteeism from work. The approach in this study was similar to what was adopted for schools, in the sense that it focused on absences from work during the menstrual cycle. The equation is provided in Annex B. The cost was valued according to their lost income. For adults, this was assumed to be 30% of the average compensation of employees.

A6. Tourism

Poor sanitation can have several impacts beyond those traditionally assessed. However, the linkages are sometimes difficult to make because of the lack of data as well as difficulties in isolating specific cause-effect relationships. One such impact, which this study attempts to quantify, is that of tourism. Unarguably, the total number of tourists choosing a country for their holiday is partially related to the general sanitary conditions of the country and as to whether the country has experienced specific events such as a cholera epidemic. Better sanitary conditions can lead to attracting 'high-value' tourists, those who are willing to pay more for their holiday. The attractiveness of a country for tourists is related to several aspects of sanitation–quality of water resources (either for enjoyment or for use), quality of the environment (smell, sightlines), food safety (hygiene in food preparation), general availability of toilets offering comfort and privacy in restaurants, bus stations, etc., and health risks. This study evaluated the economic impacts arising from the suboptimal exploitation of tourism potential. It attempted to estimate the possible losses to tourism incomes arising from unimproved sanitation. Another impact of sanitation in this regard is the specific costs to tourists associated with health-related episodes arising from poor sanitation. However, this component was not covered in the study because of the lack of data.

Tourism is a booming industry and continues to experience double-digit growth in many developing countries around the world [152], fuelled by falling airfare costs and coupled with the realization of developing-country governments and the private sector of the potential economic benefits of tourism. Measured against such a standard, however, the performance of the Philippines over the past 10 years has been rather sluggish. Between 1994 and 2004, foreign visitor arrivals in the country only grew at an average annual rate of about 5% (Figure A4). Moreover, the pattern has been quite erratic. After double-digit growth in 1995 and 1996, tourist arrivals dropped from 1998 to 2001 and again in 2003. However, the 21% growth in 2004 led to about 2.2 million visitors, the highest over the period of analysis. In the same period, tourist receipts only grew by an average rate of 0.3% per year. Measured against the rate of growth in visitor arrivals, this reflects declining expenditures per tourist over time. Despite its stop-and-go type performance over the past 10 years, tourism has nonetheless remained as an important source of income and employment for the country. Between 2002 and 2005, the sector accounted for about 2% of Philippine GDP (see Table C8). It also employed about 3.6% of its workforce.

Figure A4. Growth rates (%) of foreign travelers and tourist receipts, 1994-2004



Source: National Statistics Coordination Board [19].

Indeed, some Asian countries have done better than others at exploiting the opportunities in a growing tourist trade. Tourist preferences clearly play a key role in this; but there are a number of factors that determine tourists' choice of destination, and sanitation will be one among many. Tourist growth depends on what the country can offer such as tourist transport infrastructure, quality of accommodation and restaurants, type of experience offered (culture, climate, culinary, relaxation), and safety. Also, prices of tourist services determine the relative attractiveness of a country for foreign tourists, which are partially determined by the stability and level of the local currency.

Tourists are often heavily influenced in their choice of destination by the availability of information (positive media) on a destination, the offer of package tours or package deals in their home country, and/or the ease of booking flights and hotels on the internet or by phone. The availability of package deals and the ease of bookings are themselves a function of the level of development of a tourist destination. Hence, there is a self-reinforcing loop, which can–over time–lead to large resort complexes and tourist destinations such as the various coasts and islands of southern Europe and the Caribbean, the coastal areas of Thailand and Malaysia, and the well-known tropical islands (Zanzibar, Maldives), among others.

What role does sanitation play in a country's attractiveness for tourists? The environment is one of the key attracting elements of a tourist destination–as a popular refrain goes, "sun, sea, and sand". But, if the sea is brown from the pollution released by the country's rivers, if the sand or roadsides are soiled with the excreta of the local inhabitants, and if food preparation standards are low, then the tourism potential of a location is clearly limited [153]. Tourist perceptions about the sanitary conditions of a potential tourist destination are gathered from their own research and experience, as well as from the stories and perceptions circulating via travel agencies and social networks. Important aspects for sanitary conditions to tourists include, but are not limited to

- Aesthetics of the local environment (sight, smell)
- Cleanliness of water for swimming or sightseeing
- Availability of clean latrines and water, soaps and towels for personal hygiene, in accommodation, restaurants, bus stops, etc.
- Expectations of getting sick either from food poisoning or environmental factors

While there is evidence that the standard of tourist facilities in the study countries are improving over time, the present study assumes that the sanitary standards remain suboptimal. Hence, it is hypothesized that more tourists could be attracted to the countries now and in the future: one of the aspects that must improve for that to happen is hygiene and sanitation.

Given the limited options for countries to boost tourist numbers and hotel occupancy rates from improved sanitation in the near term, tourist losses are not estimated as a financial cost. However, in the longer term, it is assumed that study countries cannot only increase hotel occupancy rates under the existing capacity constraints of tourist infrastructure (airport, hotels, internal transport, restaurants), but also expand tourist infrastructure as well as making tourist destinations more attractive for tourists to accommodate significantly increased foreign tourist arrivals. Infrastructure requirements were based on mid- to long-term government targets for tourist growth and total numbers; where these were not available, realistic assumptions were made of the tourist growth achievable over a 5-year period until 2010. A target occupancy rate of 80-90% was assumed, depending on seasonal factors. For example, a 90% target occupancy is unrealistic in countries where the climate is unattractive for tourists several months of the year. The formula is shown in Equation 22 of Annex B, and the values used are presented in Table A37.

Economic losses are reflected by the gap between current and potential tourist revenues that would be possible at significantly higher tourist visit numbers. There are two issues that need to be addressed prior to estimation. One is the potential number of tourists. Since it takes a while before the country's capacity can be expanded to accommodate the higher volume of tourists, the second issue is how long it will take for such an event to take place. In addressing these issues, the study simply assumed that the government can achieve its tourism target of 5 million visitors by 2010 [2]. This is nearly two times more than the tourist numbers in 2005.

Table A37. Inputs for calculating financial losses in tourism

Variable/parameter	Symbol	Value
Actual occupancy rate[1] (%)	oc_A	61%
Potential occupancy rate[3] (%)	oc_O	80%
Contribution of sanitation to tourist losses[4] (%)	δ	5%
Actual number of tourists[2] (million)	ta	2.62
Average expenditure per tourist[2] (US$)	et	681

Notes: [1]Department of Tourism, average occupancy rate from January to September 2005. [2]National Statistics Coordination Board [19], average expenditure from January to June 2005. [3]Values were assumed. [4]The assumption that δ is 0.05 means that 5% of the gap between actual and optimal tourist numbers is attributable to poor sanitation.

The potential annual revenue is the average of the present values of the tourist earnings in each year up to 2010. It was calculated as follows. First, the study calculated the growth rate (g) necessary for the country to achieve its target for 2010. Given the tourist numbers implied by an 80% occupancy rate for 2005, this was estimated to be 10% per year. Second, the estimated values were multiplied by the spending per tourist reported in Table A37. Third, the present value was calculated using a discount rate of 3%, the rate used in calculating incomes with the HCA. Fourth, the average of the annual values was calculated.

The tourist earnings for 2005 were subtracted from the present value of the average annual earnings in the future. This measures losses arising from the fact that current tourism earnings are below the target. The value was then multiplied by δ in order to calculate the magnitude of the lost earnings attributable to poor sanitation, i.e., economic losses.

A7. Impact mitigation associated with improved sanitation and hygiene

A7.1 Health

The economic gains from improved sanitation and hygiene will be a proportion of the total losses estimated for diseases associated with poor sanitation and hygiene. The proportion of costs avertable will depend on the expected effectiveness of the interventions employed to prevent disease. No health intervention, as implemented in practice, will be 100% effective in reducing the overall loss. However, sanitation and hygiene interventions have been proven to be effective in a number of field trials [154, 155]. Given that good-quality epidemiological studies are limited in number and have already been reviewed in previous meta-analyses, no additional country-level studies were used to estimate disease cases prevented. Hence the estimates of intervention effectiveness are based on the international literature, which includes the most up-to-date reviews on effectiveness [154-157].

The latest and most authoritative review by Fewtrell et al presented summaries of effectiveness from a meta-analysis of field trials on water, sanitation, and hygiene (WSH) separately, as well as together [155]. The reader is referred to the paper for details of individual studies. Table A38 shows the summary of the meta-analysis.

Table A38. Summary of meta-analysis results on WSH intervention efficacy for diarrheal disease reduction

Intervention	Number of studies included[1]	Estimate of effect (relative risk)[2]		
		Low	Mid	High
Household treatment of water	8	0.46	0.61	0.81
Water supply	6	0.62	0.75	0.91
Sanitation	2	0.53	0.68	0.87
Hygiene	8	0.40	0.55	0.75
Multiple interventions	5	0.59	0.67	0.76

Source: Fewtrell et al. [155].
Notes: [1]Includes only studies of good quality, as defined by Fewtrell et al [155]. [2] Relative risk of disease when intervention was tested against baseline of no intervention (relative risk of 1.0).

These relative risk reductions were used to estimate the expected rates of diarrhea under a situation of basic improved sanitation and hygiene practices, and carried through to estimation of health care cost, productivity and income, and premature deaths. Hence, based on the literature, the following reductions of disease incidence were predicted:

- Sanitation: % incidence reduced = 32% (range 13% to 47%)
- Hygiene: % incidence reduced = 45% (range 25% to 60%)

Note however, that hygiene and sanitation interventions implemented together will not have the sum of the individual effects. The literature does not provide evidence for the proposition that two interventions are more effective than one. This point needs to be taken into account in interpreting the estimations of economic loss avoided from health interventions.

A7.2 Other economic losses due to poor sanitation

Given that the attributed costs of poor domestic sanitation have been estimated, the effect of improving sanitation will be the full losses, assuming that the interventions are fully effective in isolating human waste (at least in its harmful form) from the environment. In other words, by removing totally the pollution source, the economic losses will no longer be incurred. This is true for water resources, land resources, other welfare impacts, and tourism. However, for some environmental effects where the environment has been degraded considerably over time, there will also need to be expenditure on a clean-up operation to bring the land and water resources back to usable or fully productive condition. These costs are not estimated in the present study.

A7.3 Market for sanitation inputs

There is also a potential for improving livelihoods of poor people through sanitation programs, largely through health improvement and employment generation [11].

Given the needs of sanitation program for human labor and materials, sanitation programs will have a number of economic effects, whether it be for small local entrepreneurs or larger companies. Table A39 presents the unit costs of different sanitation options, which reflect the cost of installing sanitation equipment. The values represent economic costs, ignoring the fact that financial costs might be lower because of nonpurchased inputs such as household—and community-provided labor. These were multiplied by the expected coverage with different sanitation options to estimate total potential market values. Table A39 also shows that the approach adopted in the analysis was that all affected households-i.e., those who do not have access to toilet facilities or have unimproved pit latrines–will receive or invest in one of the four types of facilities in the table. The assumptions are as follows. First, 10% of affected households in rural areas received an EcoSan-type facility. This translated to about 2.2% of all rural households. Moreover, it was assumed that facilities were distributed evenly between Type 1 and Type 2 facilities. Second, 30% of affected households in urban areas received an EcoSan-type facility. These were also evenly distributed between Type 1 and Type 2 facilities. Third, the remaining households in urban and rural areas either received a ventilated improved pit latrine (VIP) or a septic tank. The allocation was based on the existing shares of pit latrines and septic tanks.

Table A39. Unit prices and allocation of different sanitation improvement options[1]

Item	VIP	EcoSan Type 1	EcoSan Type 2[2]	Septic tanks[3]
% of households receiving each treatment				
Rural	5.2	1.1	1.1	15.5
Urban	0.5	1.3	1.3	5.6
National	3.6	1.2	1.2	12.1
Unit costs (US$)	90.8	363.0	757.7	600.0

Sources: VIP cost was taken from the Philippine Center for Water and Sanitation [158]; EcoSan Type 1 and EcoSan Type 2 costs were taken from Ignacio [159]; septic tank cost was taken from the Solid Waste Management Association of the Philippines [160].
Notes: [1]Costs do not include maintenance and operating expenses. All prices were initially converted into their 2005 levels using the GDP deflator. These prices were then converted into US$ using the exchange rate for 2005 (PhP 55.09 = 1 US$). [2]EcoSan Type 1 toilets utilize light building materials, while EcoSan Type 2 is built with a concrete structure. [3]The price is for a septic tank that has a capacity of 1,500 gallons.

At this point, it is worth noting two important limitations of the study. First, households without toilet facilities or unimproved pit latrines are likely to be poor and unable to afford the costs of installing the equipment. The analysis therefore assumed that funding can be made available either through the government or donor agencies. Second, the costs exclude the expenditures for the maintenance and operation of such facilities. These can be substantial in some instances. For example, a study by the Foundation for Sustainable Society Inc. shows that the costs of cleaning septic tanks in 2004 could range from PhP 2,400 to PhP 6,000 per truckload [161]. Taken together, these limitations suggest that the values should not be considered as exact estimates of the benefits. Rather, these are only designed to provide a glimpse of the potential benefits to markets for sanitation inputs.

A7.4 Market for sanitation outputs

Where human excreta are used as fertilizer, the availability of nutrients from human excreta can lead to the replacement of chemical fertilizer, which saves costs [162]. Furthermore, where fertilizer was not being used optimally before, the nutritional content and economic value of crops may increase. Also, there are long-term benefits of reducing the use of chemical and mineral fertilizers, especially taking into account the fact that some fossil resources are in increasingly short supply (e.g., phosphorus). Alternatively, families with livestock may instead invest in a biogas reactor, which provides biofuel for cooking, space heating, and can even be used for lighting where other improved sources (electricity) are not available [163].

In 2004, about 1.6 million metric tons of fertilizer were sold in the Philippines [164]. Based on retail prices per 50-kg bag, each metric ton cost PhP 13,012. In other words, total sales in 2004 were about PhP 20.82 billion. Converted to 2005 prices using the GDP deflator, this was about PhP 22.07 billion (US$401.13 million).

In 2006, sales of organic fertilizer in the Philippines amounted to about 4,683 metric tons [165]. Based on retail prices of 50-kg bags, a metric ton of organic fertilizer cost PhP 4,522 (or about PhP 4,300 at 2005 prices). This means that retail sales of organic fertilizer in the Philippines reached PhP 21.18 billion; PhP 20.14 billion (US$366.05 million) if valued at 2005 prices.

What is clear from the information above is that there is a large untapped market for organic fertilizer. Given this, this study adopted a simple approach by which the sales of organic fertilizer, based on the recycling of human waste, will increase by a fixed factor.

A8. Uncertainty analysis

Tables A40 to A42 provide alternative input values to reflect three main types of data uncertainty in the present study:

1. Uncertainty in the estimation of overall impacts, such as in the epidemiological and economic variables (Table A40).
2. Uncertainty in the attribution of the overall impact to poor sanitation (Table A41).
3. Uncertainty in the actual size of impact mitigation achievable (Table A42).

Table A40 presents the main uncertain economic variables and the alternative low and high values used in the one-way sensitivity analysis. Where available, the high and low values were taken from available alternative estimates. For example, GDP per capita was used as the high estimate in valuing the hourly value of time. If alternative estimates were not available, however, as was the case with most of the variables, the approach was to work with a value that was 25% higher or lower than the base case.

Table A41 shows the assumptions regarding the links between poor sanitation and its impacts. The first experiment used different disease incidence rates for diarrhea. The low (conservative) estimate assumed that incidence rates were 70% lower than the base case. On the other hand, the high estimate used WHO rather than DHS incidence rates. It is also worth noting that the high estimate only assumed changes in incidence rates. The number of deaths caused by diarrhea was assumed to be the same. In other words, the experiment only captured the impacts on heath care costs and productivity losses. Since there is very little information available for the other experiments, the high and low values were chosen to be plus or minus 25% of the base case.

Table A42 shows the alternative assumptions for impact mitigation. With the exception of sanitation- and hygiene-related diseases, the case assumed that improvements in sanitation will eliminate all the harmful impacts of poor sanitation. However, for variables in which such estimates were not available, the estimate was assumed to be 50% of the base case.

Table A40. Alternative assumptions and values used in one-way sensitivity analysis

Variable selected	Low (conservative) estimate	Base case estimate	High (optimistic) estimate
Health			
Hourly value of productive time (all, see Table A23)	75% of base case	Compensation of employees (US$0.40), adjusted for the employment status of adults	GDP per capita (US$0.60)
Hourly value of productive time for children	Children given value of zero	Children given 50% value as adults (US$0.20)	Children given same value as adults (US$0.40)
Premature death (see Table A24)	Human capital approach, low, using 1% growth and GDP (US$32,416.00)	Human capital approach, mid estimates, using 2% growth and GDP (US$42,842.80)	VOSL benefit transfer from US$ using 0.6 income elasticity, mid-estimate (US$242,588)
Water			
Fish production impact (Figure A3)	Lower range used (fish less affected by low DO). Implication: forgone fisheries output was 2.4% of current production value of inland municipal fisheries	Mid range used. Implication: forgone fisheries output was 11.3% of current production value of inland municipal fisheries	High range used. Implication: forgone fisheries output was equivalent to 324.5% of the current production value of inland municipal fisheries
Other welfare			
Time access	3.75 min per journey	5 min per journey	6.25 min per journey
Hourly value of productive time	75% of base case (US$0.30)	Compensation of employees (US$0.40)	GDP per capita (US$0.60)

Table A41. Alternative assumptions for links between poor sanitation and impacts

Variable selected	Low (conservative) estimate	Base case estimate	High (optimistic) estimate
Health			
Disease incidence attributed to poor sanitation and hygiene (diarrhea only)	DHS incidence rates for all age groups and 70% of incidence attributed to sanitation and hygiene	DHS incidence rates for all age groups and 88% of incidence attributed to sanitation and hygiene	WHO incidence rates for all age groups and 88% of incidence attributed to sanitation and hygiene
Water			
Water pollution attributed to poor sanitation	24.8%	33%	41.3%
Other welfare			
School absences due to poor sanitation[1]	0.025	0.033	0.041
Workdays lost due to poor sanitation[2]	1.27	1.69	2.11
Tourism			
Attributable fraction to poor sanitation	2.0%	5.0%	10.0%

Notes: [1]Represents the number of days absent out of 10 potential absentee days/person/year for girls in school. [2]Represents the number of days absent out of 12 potential absentee days/person/year for working women.

Table A42. Alternative assumptions for impact mitigation[1]

Variable selected	Low (conservative) estimate	Base case estimate	High (optimistic) estimate
Health			
Sanitation-related diseases mitigated	13%	32%	47%
Hygiene-related diseases mitigated	25%	45%	60%
Water			
Sanitation-related drinking water pollution costs mitigated	50%	100%	Not tested[1]
Sanitation-related fish production costs mitigated	50%	100%	Not tested[1]
Other welfare			
Sanitation-related life choices affected	50%	100%	Not tested[1]
Tourism			
Sanitation-related tourist losses mitigated	50%	100%	Not tested[1]
Sanitation markets			
Sanitation output coverage (% households without improved sanitation adopting EcoSan)	50%	100%	Not tested[1]

Note: [1]Value cannot be greater than 100%.

Annex B. Algorithms

B1. Aggregating equations

Total costs of sanitation and hygiene

$$C = CH + CW + CL + CU + CT \quad (1)$$

Health-related costs of poor sanitation and hygiene

$$CH = CH\_HC + CH\_P + CH\_D \quad (2)$$

Water-related costs of poor sanitation and hygiene

$$CW = CW\_Drink + CW\_Domestic + CW\_Fish \quad (3)$$

Other welfare losses of poor sanitation and hygiene

$$CU = CU\_T + CU\_AS + CU\_AW \quad (4)$$

Tourism losses from poor sanitation

$$CT = CT\_RL \quad (5)$$

B2. Health costs related to poor sanitation and hygiene

Total health care costs

$$CH\_HC = \sum_i CH\_HC_i \quad (6)$$

Health care cost per disease

$$CH\_HC_i = \alpha_i \cdot pop \cdot \beta_i \cdot \sum_h \chi_{ih} \cdot v_{ih} \cdot phealth_{ih} \quad (7)$$

Total productivity costs

$$CH\_P = \sum_i CH\_P_i \quad (8)$$

Productivity cost of disease type i

$$CH\_P_i = \alpha_i \cdot pop \cdot \beta_i \cdot dh_i \cdot ptime \quad (9)$$

Total cost of premature death

$$CH\_D = \sum_i CH\_D_i \quad (10)$$

Cost of premature death per disease

$$CH\_D_i = \sum_a death_{ia} \cdot \gamma_{ia} \cdot pdeath_a \quad (11)$$

B3. Water-related costs associated with poor sanitation and hygiene

Total cost associated with accessing clean drinking water

$$CW\_Drink = \sum_m CW\_Drink_m \quad (12)$$

Cost of accessing clean drinking water per source/treatment method

$$CW\_Drink_m = h_m \cdot wdrink_m \cdot pwater_m \cdot \delta \cdot \pi_m \quad (13)$$

Total domestic water access cost (excluding drinking water)

$$CW\_Domestic = \sum_m CW\_Domestic_m \quad (14)$$

Domestic water access cost by source/method

$$CW\_Domestic_m = h_m \cdot wdom_m \cdot pwater_m \cdot \delta \cdot \theta_m \quad (15)$$

Fisheries loss

$$CW\_Fish = AFP - PFP \quad (16)$$

Potential fish production level

$$PFP = \frac{AFP}{\varepsilon} \quad (17)$$

B4. Land costs (not activated for the Philippines)

$$CL = ql \cdot pland \quad (18)$$

B5. Other welfare cost algorithm

Time access cost for unimproved latrine

$$CU\_T = pop\_u \cdot taccess \cdot ptime \cdot 365 \quad (19)$$

Cost of days absent from school

$$CU\_AS = egirls \cdot \phi \cdot das \cdot pstime \quad (20)$$

Cost of days absent from work

$$CU\_AW = ewomen \cdot \eta \cdot daw \cdot pwtime \quad (21)$$

B6. Tourism losses

Lost revenues

$$CT\_RL = \varphi \cdot \left(\frac{oc_O}{oc_A} - 1 \right) \cdot ta \cdot et \quad (22)$$

Tourist health cost and welfare loss (not active for the Philippines)

$$CT\_HT = td \cdot \mu \cdot (pahc + pawl) \quad (23)$$

B7. Variable definition summary

Table B1. Subscripts

Code	Description	Elements[1]
a	Age group	Less than 1 yr, 1-4 yrs, 5-14 yrs, 15-65 yrs, more than 65 yrs
i	Disease type	Diarrhea, cholera, typhoid, malnutrition-related diseases, etc.
h	Health care provider	Public hospital, private hospital, informal care, self-treatment
m	Treatment method	Piped water, nonpiped water, home-treated, hauled water

[1] Varies by country.

Table B2. Variables

Symbol	Description
C	Total cost of poor sanitation and hygiene
CHC	Health costs of poor sanitation and hygiene
CH_HC	Health care costs of all diseases
CH_HC_i	Health care cost of disease type i
CH_P	Productivity costs of diseases
CH_P_i	Productivity cost of disease type i
CH_D	Premature death costs of diseases
CL	Land cost
CT	Tourism losses associated with poor sanitation and hygiene
CT_RL	Revenue losses
CT_HT	Tourist health and welfare losses
CU	Other welfare losses associated with poor sanitation and hygiene
CU_T	Time access cost for unimproved latrine
CU_AS	Cost of days absent from school
CU_AW	Cost of days absent from work
CW	Water related costs of poor sanitation and hygiene
CW_Drink	Clean water drinking access costs
CW_Drink_m	Clean water drinking access cost for method m
$CW\_Domestic$	Domestic water access costs
$CW\_Domestic_m$	Domestic water access cost for method m
CW_Fish	Fisheries production loss
$death_{ia}$	Number of premature deaths, by disease type i and age group a
dh_i	Number of days taken off work or daily activities due to disease i
das	Days per girl per year taken off school due to poor sanitation
daw	Days per woman per year taken off work due to poor sanitation
$egirls$	Number of adolescent girls enrolled in school
et	Expenditure per tourist (US$)
$ewomen$	Number of women in paid employment
h_m	Number of households using water source or treatment method
oca	Actual occupancy rate (%)
oco	Optimal occupancy rate (%)
$pahc$	Average health care cost per case
$pawl$	Average welfare cost per case
$pdeath_a$	Value of premature death for age group a

Table B2. (continued)

PFP	Potential fish production value
$phealth_{ih}$	Unit price of care (per visit or day) for disease type *i* at health facility *h*
pland	Unit value of land per m^2
ptime	Daily value of time
pstime	Daily value of school time lost
pwtime	Daily value of work time lost
$pwater_m$	Water price or time value per m^3 of water
pop	Population
pop_u	Population with unimproved access to sanitation
ql	Quantity of land made useable by poor sanitation
ta	Actual number of tourists
taccess	Average access time (journey or waiting) per day
td	Total diseases suffered by tourists
v_{ih}	Visits to or days for disease type *i* at health facility *h*
$wdrink_m$	Consumption per household of drinking water (m^3) from water source/treatment method *m*
$wdom_m$	Consumption per household for domestic purposes (m^3) from water source/treatment method *m*

Table B3. Parameters

Symbol	Description
α_i	Incidence rate per person of disease type *i*
β_i	Proportion of episodes attributed to poor sanitation for disease type *i*
χ_{ih}	Proportion of cases seeking care for disease type *i* and provider *h*
γ_{ia}	Proportion of deaths attributable to poor sanitation, by disease type *i* and age group *a*
δ	Attributable water pollution to poor sanitation
ε	Ratio of fish production at current DO level to fish production at optimal DO level
ϕ	Proportion of schools with inadequate sanitation facility
η	Proportion of workplaces with inadequate sanitation facilities
μ	Proportion of diseases related to sanitation
π_m	Importance of averting drinking polluted water in relation to overall benefits of piped water supply; where $\pi_m = 1$ for $m \neq$ piped water
θ_m	Importance of averting using polluted water in domestic activities in relation to overall benefits of piped water supply; where $\theta_m = 1$ for $m \neq$ piped water

Annex C. Detailed Data Inputs

Table C1. Estimated number of diarrhea cases seeking care from different providers, by region

Disease	Cases			Treatment Practice		
	Reported	% under reported	Estimated actual cases	Hospital facility	Informal care	Self-treatment
NCR						
Diarrhea						
AWD[1]	71,971	77	127,590	63,334	9,206	9,206
ABD[2]	81	77	144	71	10	10
Cholera	9	77	16	8	1	1
Typhoid	280	77	496	246	36	36
Other	-	na	4,622,402	-	662,235	662,235
Malaria	-	na	2,495	2,495	-	-
ALRI[3]	36,382	108	75,797	75,797	-	-
Measles	-	na	-	-	-	-
CAR						
Diarrhea						
AWD	16,692	142	40,384	16,692	3,208	3,208
ABD	1,026	142	2,482	1,026	197	197
Cholera	-	na	-	-	-	-
Typhoid	1,438	142	3,479	1,438	276	276
Other	-	na	660,667	-	52,488	52,488
Malaria	-	na	348	348	-	-
ALRI	5,081	108	10,586	10,586	-	-
Measles	-	na	-	-	-	-
Region 1						
Diarrhea						
AWD	39,217	47	57,518	39,217	1,929	1,929
ABD	-	-	-	-	-	-
Cholera	28	47	41	28	1	1
Typhoid	719	47	1,055	719	35	35
Other	-	na	1,841,729	-	154,449	154,449
Malaria	458	108	953	953	-	-
ALRI	13,902	108	28,963	28,963	-	-
Measles	-	na	-	-	-	-
Region 2						
Diarrhea						
AWD	28,021	208	86,194	28,021	9,164	9,164
ABD	29	208	89	29	9	9
Cholera	-	-	-	-	-	-
Typhoid	1,054	208	3,242	1,054	345	345
Other	-	na	1,283,421	-	191,123	191,123
Malaria	333	108	694	694	-	-
ALRI	10,117	108	21,077	21,077	-	-
Measles	-	na	-	-	-	-

Table C1. (continued)

Disease	Cases			Treatment Practice		
	Reported	% under reported	Estimated actual cases	Hospital facility	Informal care	Self-treatment
Region 3						
Diarrhea		0				
AWD	62,811	61	101,359	62,811	15,479	15,479
ABD	50	61	81	50	12	12
Cholera	4	61	6	4	1	1
Typhoid	569	61	918	569	140	140
Other	-	na	3,633,379	-	1,220,414	1,220,414
Malaria	930	108	1,938	1,938	-	-
ALRI	28,264	108	58,882	58,882	-	-
Measles	-	na	-	-	-	-
Region 4a						
Diarrhea						
AWD	61,491	60	98,432	61,491	5,497	5,497
ABD	1,664	60	2,664	1,664	149	149
Cholera	19	60	30	19	2	2
Typhoid	493	60	789	493	44	44
Other	-	na	4,482,589	-	555,980	555,980
Malaria	1,166	108	2,429	2,429	-	-
ALRI	35,424	108	73,801	73,801	-	-
Measles	-	na	-	-	-	-
Region 4b						
Diarrhea						
AWD	19,319	198	57,635	19,319	10,864	10,864
ABD	492	198	1,468	492	277	277
Cholera	-	-	-	-	-	-
Typhoid	165	198	492	165	93	93
Other	-	na	1,064,367	-	284,564	284,564
Malaria	284	108	591	591	-	-
ALRI	8,626	108	17,970	17,970	-	-
Measles	-	na	-	-	-	-
Region 5						
Diarrhea						
AWD	37,203	201	111,868	37,203	24,206	24,206
ABD	628	201	1,888	628	409	409
Cholera	-	-	-	-	-	-
Typhoid	243	201	731	243	158	158
Other	-	na	2,405,876	-	735,983	735,983
Malaria	632	108	1,316	1,316	-	-
ALRI	19,191	108	39,981	39,981	-	-
Measles	-	na	-	-	-	-

Table C1. (continued)

Disease	Cases			Treatment Practice		
	Reported	% under reported	Estimated actual cases	Hospital facility	Informal care	Self-treatment
Region 6						
Diarrhea						
AWD	33,525	154	85,228	33,525	12,860	12,860
ABD	2,478	154	6,300	2,478	951	951
Cholera	5	154	13	5	2	2
Typhoid	1,910	154	4,856	1,910	733	733
Other	-	na	2,951,457	-	681,106	681,106
Malaria	703	108	1,465	1,465	-	-
ALRI	21,366	108	44,513	44,513	-	-
Measles	-	na	-	-	-	-
Region 7						
Diarrhea						
AWD	61,439	64	100,599	61,439	3,915	3,915
ABD	670	64	1,097	670	43	43
Cholera	2	64	3	2	0	0
Typhoid	885	64	1,449	885	56	56
Other	-	na	2,666,055	-	224,287	224,287
Malaria	658	108	1,371	1,371	-	-
ALRI	20,001	108	41,668	41,668	-	-
Measles	-	na	-	-	-	-
Region 8						
Diarrhea						
AWD	36,255	55	56,254	36,255	5,647	5,647
ABD	-	-	-	-	-	-
Cholera	-	-	-	-	-	-
Typhoid	554	55	860	554	86	86
Other	-	na	1,949,095	-	452,049	452,049
Malaria	498	108	1,038	1,038	-	-
ALRI	15,136	108	31,534	31,534	-	-
Measles	-	na	-	-	-	-
Region 9						
Diarrhea						
AWD	33,398	67	55,702	33,398	8,612	8,612
ABD	-	-	-	-	-	-
Cholera	12	67	20	12	3	3
Typhoid	1,908	67	3,182	1,908	492	492
Other	-	na	1,504,819	-	492,524	492,524
Malaria	380	108	791	791	-	-
ALRI	11,537	108	24,035	24,035	-	-
Measles	-	na	-	-	-	-

Table C1. (continued)

Disease	Cases			Treatment Practice		
	Reported	% under reported	Estimated actual cases	Hospital facility	Informal care	Self-treatment
Region 10						
Diarrhea						
AWD	24,026	212	74,990	24,026	13,123	13,123
ABD	-	-	-	-	-	-
Cholera	-	-	-	-	-	-
Typhoid	-	-	-	-	-	-
Other	-	na	1,739,688	-	423,986	423,986
Malaria	443	108	924	924	-	-
ALRI	13,469	108	28,060	28,060	-	-
Measles	-	na	-	-	-	-
Region 11						
Diarrhea						
AWD	11,533	89	21,748	11,533	4,031	4,031
ABD	-	-	-	-	-	-
Cholera	-	-	-	-	-	-
Typhoid	131	89	247	131	46	46
Other	-	na	1,841,778	-	640,130	640,130
Malaria	451	109	941	941	-	-
ALRI	13,718	108	28,579	28,579	-	-
Measles	-	na	-	-	-	-
Region 12						
Diarrhea						
AWD	23,173	111	48,954	23,173	5,490	5,490
ABD	328	111	693	328	78	78
Cholera	58	111	123	58	14	14
Typhoid	726	111	1,534	726	172	172
Other	-	na	1,721,488	-	330,904	330,904
Malaria	427	108	889	889	-	-
ALRI	12,967	108	27,014	27,014	-	-
Measles	-	na	-	-	-	-
Region 13						
Diarrhea						
AWD	14,360	110	30,141	14,360	7,179	7,179
ABD	-	-	-	-	-	-
Cholera	-	-	-	-	-	-
Typhoid	430	110	903	430	215	215
Other	-	na	1,113,016	-	456,461	456,461
Malaria	286	108	595	595	-	-
ALRI	8,681	108	18,085	18,085	-	-
Measles	-	na	-	-	-	-

Table C1. (continued)

Disease	Cases			Treatment Practice		
	Reported	% under reported	Estimated actual cases	Hospital facility	Informal care	Self-treatment
ARMM						
Diarrhea						
AWD	12,984	105	26,588	12,984	4,792	4,792
ABD	-	-	-	-	-	-
Cholera	18	105	37	18	7	7
Typhoid	926	105	1,896	926	342	342
Other	-	na	1,311,710	-	414,594	414,594
Malaria	289	109	603	603	-	-
ALRI	8,789	108	18,310	18,310	-	-
Measles	-	na	-	-	-	-
Total						
Diarrhea						
AWD	587,418	101	1,181,183	587,418	145,203	145,203
ABD	7,446	127	16,905	7,446	2,134	2,134
Cholera	155	87	289	155	31	31
Typhoid	12,431	110	26,128	12,431	3,269	3,269
Other	-	na	36,793,536	-	7,973,277	7,973,277
Malaria	7,938	144	19,380	19,380	-	-
ALRI	282,650	108	588,854	588,854	-	-
Measles	-	na	-	-	-	-

Notes: [1]AWD=acute watery diarrhea; [2]ABD=acute bloody diarrhea; [3]ALRI=acute lower respiratory infection.

Table C2. Health care unit cost studies from the Philippines

Study/disease		Service	Setting/ location	Health service level	Currency	Year for which data apply	Unit cost/patient	
							Prices used in study	US$ at 2005
Cortez et al. [166]	Typhoid and paratyphoid	Hospitalization	Cebu	Hospitals	PhP	1992	853	
	Diarrhea	Hospitalization	Cebu	Hospitals	PhP	1992	358	
	Infectious hepatitis	Hospitalization	Cebu	Hospitals	PhP	1992	742	
	Schistosomiasis	Hospitalization	Cebu	Hospitals	PhP	1992	222	
Department of Vaccines and Biologicals (DOVB) [167]	Diarrhea	Direct	Urban	Hospital/ public	US$	Ns	66	
		Direct	Urban	Hospital/ private	US$	Ns	719	
		Direct	Rural	Hospital/ public	US$	Ns	72	
		Direct	Rural	Hospital/ private	US$	Ns	128	
	Pneumonia	Direct	Urban	Hospital/ public	US$	Ns	209	
		Direct	Urban	Hospital/ private	US$	Ns	1,011	
		Direct	Rural	Hospital/ public	US$	Ns	118	
		Direct	Rural	Hospital/ private	US$	Ns	165	
WHO [168]		Outpatient visit	Ns	Primary	PhP	2000	107	
		Outpatient visit	Ns	Secondary	PhP	2000	151	
		Outpatient visit	Ns	Tertiary	PhP	2000	224	
World Bank [3]	Diarrhea	Outpatient	National	Nr	PhP	2000	632	
		Inpatient	National	Nr	PhP	2000	3,274	
	Typhoid	Outpatient	National	Nr	PhP	2000	Nr	
		Inpatient	National	Nr	PhP	2000	12,426	
World Bank [21]	Diarrhea	Medical costs	National	Nr	PhP	2006	3,936	71
	Schistosomiasis	Medical costs	National	Nr	PhP	2006	6,322	115
	Typhoid and paratyphoid	Medical costs	National	Nr	PhP	2006	6,190	112
	Hepatitis A	Medical costs	National	Nr	PhP	2006	6,641	121
	Cholera	Medical costs	National	Nr	PhP	2006	5,584	101

Notes: Nr = not reported; Ns = not specified.

Table C3. Sources of drinking water for households (%), 2000

Region	OF	SF	OTPDW	STPDW	TPSW	Dug well	SLRR	Peddler	BW	Others
NCR	50.8	24.3	4.0	9.7	0.6	0.6	0.2	6.3	1.3	2.2
CAR	34.3	26.8	5.0	9.8	4.0	4.0	12.3	1.6	0.4	1.8
1	16.8	8.9	23.3	25.6	14.9	6.9	2.3	0.1	0.1	1.0
2	11.9	6.8	17.2	26.2	18.1	14.2	4.6	0.2	0.0	0.9
3	30.8	12.6	20.0	20.2	11.4	1. 5	1.4	0.7	0.3	1.3
4	34.4	17.7	10.1	14.8	7.2	5.6	5.2	2.8	0.4	1.8
5	20.2	21.8	7.5	14.0	8.3	13.9	10.2	2.8	0.1	1.3
6	14.1	13.8	8.7	22.2	8.7	17.3	9.8	2.1	0.3	3.0
7	21.6	24.7	3.4	15.7	4.2	11.7	13.7	2.3	0.4	2.4
8	17.6	33.5	4.4	14.5	5.8	11.6	9.1	1.0	0.0	2.5
9	19.2	24.7	2.9	9.3	5.1	15.8	19.7	1.7	0.1	1.7
10	29.6	28.9	2.5	8.8	3.0	5.1	20.0	0.8	0.1	1.2
11	24.2	19.4	6.7	16.9	7.0	4.3	18.5	1.1	0.1	1.8
12	18.1	15.3	10.5	15.9	9.6	10.8	16.6	1.7	0.1	1.3
13	20.1	29.4	4.6	15.5	5.7	6.6	16.2	0.9	0.0	1.1
ARMM	9.8	8.31	4.7	7.5	7.8	23.9	31.1	1.6	0.1	5.3
Total	**27.3**	**19.3**	**9.1**	**15.8**	**7.2**	**7.9**	**8.8**	**2.3**	**0.4**	**1.9**

Source: National Statistics Coordination Board [19].
Symbols: OF = own faucet, SF = shared faucet, OTPDW = own tap/piped water from deep well, STPDW = shared tap/piped water from deep well, TPSW = tubed/piped water from shallow well, SLRR = spring, lake, river, rain, BW = bottled water
Notes: 1. Row totals may not add up to 100% due to rounding. 2. Available data do not distinguish between Regions 4a and 4b. The percentages for these regions were assumed to be the same as Region 4. 3. The following equations relate the items above to the presentation in the text:

Piped water = OF + SF + OTPDW + STPDW + TPSW
Other purchased water = peddled water + BW
Hauled water = dug well + SLRR + others

Table C4. Water prices used in the analysis, at 2005 prices (PhP per liter)

Region	OF and SF	OTPDW, STPDW, TPSW	Peddler	Bottled water
NCR	0.0165	0.0128	0.0824	17.9362
CAR	0.0144	0.0128	0.0721	17.3490
1	0.0181	0.0128	0.0905	17.3490
2	0.0179	0.0128	0.0895	17.3490
3	0.0152	0.0128	0.0759	17.3490
4a	0.0135	0.0128	0.0676	17.3490
4b	0.0135	0.0128	0.0676	17.3490
5	0.0153	0.0128	0.0764	17.3490
6	0.0169	0.0128	0.0843	17.3490
7	0.0111	0.0128	0.0553	17.3490
8	0.0143	0.0128	0.0713	17.3490
9	0.0137	0.0128	0.0683	17.3490
10	0.0136	0.0128	0.0679	17.3490
11	0.0147	0.0128	0.0737	17.3490
12	0.0154	0.0128	0.0770	17.3490
13	0.0154	0.0128	0.0768	17.3490
ARMM	0.0118	0.0128	0.0592	17.3490

Symbols: OF = own faucet, SF = shared faucet, OTPDW = own tap/piped water from deep well, STPDW = shared tap/piped water from deep well, TPSW = tubed/piped water from shallow well

Notes:

- Prices for OF and SF were taken from the Manila Water, Maynilad, and LWUA. All prices were converted to 2005 prices using the GDP deflator.
- In the absence of reliable regional data on the prices of water from piped deep and shallow wells, the values used in this study were drawn from a World Bank survey of 20 small town water districts in 2003 [114]. The prices were assumed to be the same for all regions and inflated to 2005 prices using the GDP deflator.
- In the absence of reliable regional data on the prices of peddled water, values were obtained through a literature search. A 1998 survey in Cebu indicated that prices of vended water were almost 5-10 times higher than piped water [169]. Given this information, prices of peddled water were assumed to be five times higher than the prices of OF and SF.
- The prices of bottled water were obtained through an informal survey of prices in supermarkets in the NCR and Region 4a. Prices for Region 4a were then assumed to be the same as the other regions in the country. Prices were deflated to their 2005 levels using the GDP deflator.

Table C5. Water quality scorecard for surface water (rivers, lakes, bays)

Region	Name of river (R) /lake/ bay	Location (province)	Class	DO (mg/L)[1] Average (range)	BOD (mg/L)[2] Average (range)	Rating[3]
NCR Metro Manila	Paranaque R.	Metro Manila	C	3.07 (0 9.5)	25.62 (7.0 - 54.0)	U
	San Juan R.	Metro Manila	C	3.00 (0 - 8.0)	38.81 (8.0 - 72.0)	U
	NMTT R. [5]	Metro Manila	C	2.80 (0 - 7.5)	25.23 (7.0 - 54.0)	U
	Marikina R.	Metro Manila	C	5.03 (0 - 8.0)	12.11 (1.0 -42.0)	U
	Pasig R. [4]	Metro Manila	C	3.67 (0 - 6.5)	17.07 (2.0 - 59.0)	U
	Manila Bay	Metro Manila / R III/ R IV	C	4.77 (3.9 - 5.4)	3.23 (2.5 - 4.1)	S
	Laguna de Bay	Metro Manila / Region IV	C	7.86 (6.1 - 14.0)	1.8 (0.2 - 7.0)	S
CAR			ND			
I Ilocos	Laoag R.	Ilocos Norte	A	6.69 (4.0 - 7.8)		S
	Amburayan R.	Benguet/Ilocos Sur	C	8.35 (6.0 - 11.0)		S
		La Union				
	Dagupan R.	Pangasinan	A/C	5.96 (2.0 - 11.8)		M
	Agno R. [4]	Benguet/ Pangasinan	A/C	6.78 (1.4 - 11.1)		S
II Cagayan Valley			ND			
III Central Luzon	Pampanga R. [4]	Nueva Ecija/ Pampanga	C	5.86 (4.8 - 7.2)	3.78 (1.0 - 15.0)	M
	Marilao R.	Bulacan	C	1.75 (0 - 5.7)	34.64 (10.0 – 147)	U
	Meycauayan R.	Bulacan	C	1.35 (0 - 5.5)	54.94 (11.0 – 170)	U
	Bocaue R.	Bulacan	C	6.19 (0.3 - 9.0)	11.13 (6.0 - 20.0)	S
	Labangan R.	Bulacan		5.33 (2.5 - 7.3)	18.48 (3.3 - 50.0)	M
	Sta Maria R.	Bulacan		3.10 (0.1 - 5.2)	33.5	U
	Guiguinto R.	Bulacan	C	3.03 (1.5 - 3.8)	14.81	U
	San Fernando R.	Pampanga	C	2.86 (1.9 - 3.8)	29.4 (27.0 - 32.0)	U

Table C5. (continued)

Region	Name of river (R)/ lake/ bay	Location (province)	Class	DO (mg/L) Average (range)	BOD (mg/L) Average (range)	Rating
IV Southern Tagalog	Mogpong R.	Marinduque	C	5.72 (3.4 - 7.8)	6.03 (4.7 - 8.0)	M
	Pagbilao R.	Quezon		5.28 (4.0 - 6.5)	6.26 (4.0 - 8.6)	M
	Bacoor R.	Cavite		6.10 (5.3 - 7.4)		S
	Taal Lake	Batangas	B	7.40 (7.0 - 8.2)	1.5 (1.0 - 2.0)	S
	Palico R.	Batangas	C	6.95 (4.8 - 8.3)	1.11 (1.0 - 1.5)	S
	Pagbilao R.	Quezon		7.75 (6.2 - 10.2)	2.1 (1.0 - 5.0)	S
	Pagbilao Bay	Quezon		6.65 (4.7 - 7.1)		S
	Boac R.	Marinduque	C	10.42 (6.2 - 17.1)		S
	Calancan Bay	Marinduque		7.14 (4.8 - 8.5)		S
	Cajimos Bay	Romblon		6.89 (6.0 - 9.0)		S
	Puerto Galera Bay	Mindoro Oriental	SA	7.67 (6.7 - 10.0)		S
	Naujan Lake	Mindoro Oriental	B	8.00 (1.0 - 9.6)	12.3	S
	Calapan R.	Mindoro Oriental		1.46 (0 - 7.0)	30.0 (2.0 - 225.0)	U
V Bicol	Bicol R. [4]	Camarines Sur	A	5.28 (2.3 - 10.7)		M
VI Western Visayas	Jaro-Aganan R.	Iloilo	C	8.79 (0.9 - 14.5)	3.45 (.06 - 15.6)	S
	Panay R. [4]	Iloilo	A	7.58 (1.4 - 12.8)	4.63 (0.4 - 52.0)	S
	Jalaur R.	Iloilo	C	8.30 (0.5 - 12.9)	6.4	S
	Iloilo R.	Iloilo		5.64 (1.7 - 10.4)	6.67 (0.8 - 265.0)	M
	Panay R. [4]	Iloilo	A	7.69 (1.4 - 23.2)		S
	Iloilo coasts	Iloilo		8.34 (7.4 - 10.0)		S

Table C5. (continued)

Region	Name of river (R)/lake/ bay	Location (province)	Class	DO (mg/L) Average (range)	BOD (mg/L) Average (range)	
VII Central Visayas	Guindarohan R.	Cebu	A	7.21 (6.5 - 8.3)	1.53 (0.4 - 4.0)	S
	Guadalupe R.	Cebu	C	4.32 (0.5 - 7.5)	1.9	U
	Dalaguete-Argao R.	Cebu	A/B	7.85 (6.9 - 10.1)	1.07 (0.3 - 2.6)	S
	Guinhulugan R.	Cebu	A/B	7.74 (7.1 - 8.4)	1.13 (0.6 - 2.4)	S
	Luyang R.	Cebu	A/B/C	7.17 (5.7-8.4)	1.1 (0.9 - 1.3)	S
	Cotcot R.	Cebu	A	6.56 (1.4 - 7.9)	3.06 (0.6 - 8.0)	U
	Bassak R.	Cebu		8.3	0.5 (0.2 - 0.8)	S
	Mananga R.	Cebu	A	5.50 (5.0 - 6.0)	7.1 (5.3 - 7.8)	M
	Balamban R.	Cebu	A/B	7.35 (6.3 - 8.7)	1.07 (0.2 - 2.5)	S
	Guinabasan R.	Cebu	A	8.05 (5.1 - 11.1)	2.13 (0.4 - 9.8)	S
	Minglanilla	Cebu		6.25 (2.1 - 9.7)		S
	Mandaue to Consolacion	Cebu		5.27 (0.0 - 14.0)		M
	Liloan to Compostela	Cebu		7.15 (4.1 - 14.0)		S
	Inabanga R.	Bohol	A/C	6.40 (5.4 - 7.4)	1.2 (0.8 - 1.6)	S
	Inabanga Beach	Bohol		6.93 (5.5 - 7.9)		S
	Ipil R.	Bohol	A	4.15 (2.8 - 5.2)	2.48 (1.2 - 4.0)	M
	Manaba R.	Bohol	B/C	7.65 (4.5 - 16.9)		S
	Matul-id R.	Bohol	A	5.77 (5.7 - 5.9)	1.2 (1.2 - 1.2)	S
	Canaway R.	Negros Oriental	A	7.25 (6.9 - 7.4)	1.2 (0.6 - 1.8)	S
	Cawitan R.	Negros Oriental	A	7.73 (7.5 - 7.9)	0.5 (0.2 - 1.0)	S
	La Libertad R.	Negros Oriental	A	8.55 (7.9 - 9.2)	1.25 (0.1 - 6.6)	S
	Siaton R.	Negros Oriental	A	7.67 (7.3 - 7.9)	0.57 (0.1 - 1.3)	S
	Sicopong R.	Negros Oriental	A/B	3.21 (0.2 - 7.5)	40.73 (0.4 - 100)	U
	Tanjay R.	Negros Oriental	A/B	7.05 (6.8 - 7.3)	0.85 (0.7 - 1.0)	S
VIII Eastern Visayas	Danao Lake	Leyte		7.20 (6.3 - 7.9)		S
IX Western Mindanao	Mercedes R.	Zamboanga del Sur	B/C	5.16 (1.5 - 8.3)	4.72 (0.4 - 17.0)	M
	Saaz R.	Zamboanga del Sur	A/B	4.85 (1.7 - 7.8)		U
	Manicahan R.	Zamboanga del Sur		5.92 (2.5 - 9.4)	2.76 (0.1 - 8.0)	M
	Vista del Mar	Zamboanga del Sur		6.77 (4.9 - 8.8)	2.03 (0.1 - 5.4)	S
	Cawacawa Beach	Zamboanga del Sur		5.40 (2.1 - 8.5)		M

Table C5. (continued)

Region	Name of river (R)/ lake/ bay	Location (province)	Class	DO (mg/L) Average (range)	BOD (mg/L) Average (range)	Rating
X Northern Mindanao	Cagayan de Oro R. [4]	Misamis Oriental	A	8.08 (5.7 - 9.9)		S
	Iponan R	Misamis Oriental	A	7.51 (2.1 - 9.2)	3.59 (0.7 - 17.0)	S
XI Southern Mindanao	Silway R.	South Cotabato		8.22 (5.6 - 73.0)		
	Malalag Bay	Davao del Sur		6.30 (5.7 - 7.0)		
	Digos R.	Davao del Sur	B/C	7.33 (5.8 - 9.0)	1.55 (0.1 - 7.8)	
	Hijo R.	Davao del Norte	D	7.35 (5.8 - 9.0)	0.94 (0.3 - 4.0)	
	Sibulan R.	Davao del Sur	A/B	7.69 (6.5 - 8.6)	1.68 (0.1 - 4.0)	
	Pujada Bay	Davao Oriental		6.11 (3.2 - 6.8)		
	Talomo R.	Davao City	B	7.47 (6.4 - 8.3)	2.73 (0.5 - 12.2)	
	Padada R.	Davao del Sur	D	5.85 (0.0 - 7.4)	1.84 (0.3 - 18.0)	
	Tuganay R.	Davao del Norte	B	6.02 (0.2 - 8.0)	1.37 (0.3 - 4.7)	
	Agusan R. [4]	Agusan del Norte	C	7.01 (2.6 - 8.1)	1.01 (0.1 - 5.6)	
	Ilang R.	Davao City	C	6.69 (4.4 - 8.4)	2.29 (0.7 - 9.0)	
	Lasang R.	Davao City	B	7.57 (6.3 - 8.5)	1.36 (0.4 - 3.0)	
	Lipadas R.	Davao City	AA/A	7.29 (5.3 - 8.5)	1.88 (0.3 - 8.7)	
	Davao R. [4]	Davao City	A/B	7.46 (5.8 - 8.6)	1.06 (0.1 - 2.4)	
	Tagum R. [4]	Davao del Norte	A	6.46 (4.8 - 7.8)	1.71 (0.3 - 36.0)	
XII Central Mindanao			ND			
CARAGA	Agusan R. [4/]	Agusan del Norte/ Agusan del sur	A/B/C	5.94 (2.6 - 8.0)		M
	Magallanes R.	Agusan del Norte	A/B/C	7.7		S
ARMM			ND			

Source: World Bank [3].

Notes: ND = no data. [1]Monitored for at least 3 years within the period 1996 - 2001 for annual mean DO and BOD levels; DO criteria: Class A, SB = 5 mg/L. [2]Monitored for at least 3 years within the period 1996 - 2001 for annual mean DO and BOD levels; BOD criteria: Class A, SB = 5 mg/L. [3]S = satisfactory, M = marginal, U = unsatisfactory. [4]Major river as per NWRB classification. [5]NMTT = Navotas-Malabon-Tenejeros-Tullahan

Table C6. Toilet access, by geographical location and region

Region	Private	Shared	Open defecation
Total	0.71	0.18	0.11
Rural	0.70	0.17	0.14
Urban	0.75	0.20	0.05
NCR	0.76	0.21	0.02
Rural	na	na	na
Urban	0.76	0.21	0.02
CAR	0.75	0.21	0.04
Rural	0.75	0.20	0.05
Urban	0.74	0.23	0.02
Region 1	0.77	0.21	0.02
Rural	0.78	0.20	0.02
Urban	0.76	0.23	0.01
Region 2	0.75	0.23	0.03
Rural	0.75	0.22	0.03
Urban	0.73	0.25	0.01
Region 3	0.77	0.18	0.05
Rural	0.77	0.17	0.06
Urban	0.77	0.20	0.03
Region 4a	0.75	0.15	0.10
Rural	0.74	0.15	0.11
Urban	0.77	0.18	0.05
Region 4b	0.75	0.15	0.10
Rural	0.75	0.15	0.10
Urban	0.77	0.18	0.05
Region 5	0.66	0.16	0.18
Rural	0.66	0.15	0.19
Urban	0.71	0.19	0.10
Region 6	0.71	0.13	0.16
Rural	0.68	0.12	0.20
Urban	0.75	0.15	0.10
Region 7	0.60	0.17	0.23
Rural	0.57	0.15	0.27
Urban	0.65	0.20	0.14
Region 8	0.61	0.13	0.26
Rural	0.60	0.12	0.28
Urban	0.69	0.16	0.15
Region 9	0.67	0.17	0.16
Rural	0.65	0.15	0.20
Urban	0.70	0.20	0.10

Table C6. (continued)

Region	Private	Shared	Open defecation
Region 10	0.75	0.17	0.07
Rural	0.75	0.16	0.09
Urban	0.77	0.19	0.04
Region 11	0.71	0.22	0.07
Rural	0.71	0.21	0.08
Urban	0.72	0.24	0.04
Region 12	0.69	0.22	0.10
Rural	0.68	0.21	0.11
Urban	0.70	0.25	0.05
Region 13	0.74	0.14	0.11
Rural	0.73	0.14	0.13
Urban	0.77	0.17	0.06
ARMM	0.53	0.24	0.23
Rural	0.53	0.23	0.24
Urban	0.58	0.30	0.12

Sources: National Epidemiology Center [15] and National Statistics Coordination Board [19] .

Table C7. Water and sanitation coverage in schools and workplaces (%), by region

Establishment	Sample (no.)	Toilets (%)		Water supply (%)	
		Sanitary	Unsanitary	Safe	Unsafe
Schools	**548**	**96.7**	**3.3**	**66.4**	**33.6**
NCR	64	100	0	76.6	23.4
CAR	31	100	0	54.8	45.2
1	32	93.7	6.3	59.4	40.6
2	32	100	0	59.4	40.6
3	35	97.1	2.9	28.6	71.4
4	30	93.3	6.7	46.7	53.3
5	32	93.7	6.3	87.5	12.5
6	29	100	0	48.3	51.7
7	34	97	3	79.4	20.6
8	34	94.1	5.9	75.8	24.2
9	36	100	0	58.3	41.7
10	32	96.9	3.1	81.3	18.7
11	32	100	0	59.4	40.6
12	33	93.9	6.1	45.5	54.5
13	32	96.9	3.1	45.2	54.8
ARMM	30	90	10	27.6	72.4
Workplaces	**1,454**	**86**	**14**	**94**	**6**
NCR	370	87	13	96	4
CAR	76	79	21	86	15
1	101	98	2	94	6
2	67	100	0	100	0
3	35	67	33	91	9
4	92	91	9	95	6
5	70	96	4	80	20
6	87	100	0	98	2
7	89	81	19	89	11
8	77	88	12	95	5
9	98	100	0	100	0
10	68	86	14	93	7
11	31	61	39	97	3
12	51	64	37	98	2
13	87	95	5	95	5
ARMM	55	55	45	93	7

Source: Festin et al. [6].

Table C8. Volume and importance of tourist sector in the Philippines

Variable	2002	2003	2004	2005	2006
Number of tourists[1]	1,848,923	1,806,902	2,187,605	2,497,689	2,550,615
Asia	1,091,720	1,061,854	1,274,840	1,477,442	1,605,141
Europe	181,848	175,618	210,215	243,928	260,394
North America	449,886	441,480	543,616	602,250	648,929
Others	125,469	127,950	158,934	174,069	36,151
Average expenditure per tourist	903.37	797.00	817.43	681.31[d\]	na
Tourist income - total (million US$)[2]	1,670.27	1,440.10	1,788.21	1,701.71	na
As % of GDP	2.17	1.81	2.06	1.73	na
Government expenditure on tourism total (million US$)	22.85	21.82	25.96	25.61	na
As % of total expenditure	0.16	0.14	0.17	0.15	na
Employment in tourism[3]	1,124,777	1,024,393	1,160,153	1,222,538	na
As % of jobs	3.7	3.3	3.7	3.8	na

Sources: Department of Tourism, World Travel and Tourism Council [170] and National Statistics Coordination Board [19].
Notes: [1]As measured by visitor arrivals. Excludes overseas Filipinos.[2] Million US dollars, average expenditure/tourist x total number of tourists. .[3]Expenditure per tourist in 2005 was measured using information from January to June only. na = not available.

Table C9. Definitions of the five main improvement options

A	B	C	D	E
Latrine physical access	**Improved toilet system**	**Hygiene practices**	**Treatment or disposal**	**Reuse**
• Close and improved latrine for those using open defecation • Improved population- toilet ratios through increased coverage of latrines (less queuing time)	• Improved position or type of toilet seat or pan • Safe, private, and secure structure: walls /door/roof • Improved and safe collection system (tank vault, pit) • Improved ventilation • Improved waste evacuation	• Availability of water for anal cleansing • Safe disposal of materials used for anal cleansing • Hand washing with soap • Toilet cleaning	• Improved septic tank functioning and emptying • Sealed top of pit latrine to withstand flooding • Household connection (sewerage) with treatment • Sewers with non-leaking pipes and a drainage system that can handle heavy rains • Wetlands or wastewater ponds	• Urine separation, composting of feces, hygienization • Use of human waste products in commercial aquaculture, composting (fertilizer) • Biogas production (anaerobic digestion)

Annex D. Detailed Results

Table D1. Inpatient and outpatient, rural and urban, cost breakdown

Disease	Hospitals	Informal care	Self-treatment	Patient transport	Total
Rural area					
Diarrheal diseases					
Acute watery diarrhea	1,108,925	44,400	12,148	55,657	1,221,130
Acute bloody diarrhea	10,434	344	94	326	11,198
Cholera	264	5	2	5	275
Typhoid	52,206	995	81	1,307	54,589
Other	0	2,533,235	693,093	597,912	3,824,240
Malnutrition-related					
ALRI, measles, malaria	8,995,113	nc	nc	52,650	9,047,764
Total	10,166,942	2,578,979	705,418	707,858	14,159,196
Urban area					
Diarrheal diseases					
Acute watery diarrhea	1,632,704	77,571	21,223	112,314	1,843,812
Acute bloody diarrhea	56,212	1,416	387	1,863	59,878
Cholera	1,279	20	7	37	1,344
Typhoid	85,901	1,541	126	2,278	89,846
Other	0	4,503,699	1,232,212	1,428,334	7,164,245
Malnutrition-related					
ALRI, measles, malaria	12,079,457	nc	nc	101,920	12,181,376
Total	13,855,553	4,584,247	1,253,956	1,646,746	21,340,502
National					
Diarrheal diseases					
Acute watery diarrhea	2,741,630	121,971	33,371	167,971	3,064,943
Acute bloody diarrhea	66,645	1,760	481	2,189	71,076
Cholera	1,543	25	9	42	1,619
Typhoid	138,107	2,536	207	3,585	144,435
Other	0	7,036,934	1,925,305	2,026,246	10,988,485
Malnutrition-related					
ALRI, measles, malaria	21,074,570	nc	nc	154,570	21,229,140
Total	24,022,495	7,163,226	1,959,374	2,354,604	35,499,698

Table D2. Selected water quality measurements for Regions 3, 6, and 12, 2005

Name of river	Year	Average concentration (mg/L)					
		Dissolved oxygen		Biological oxygen demand		Total suspended solids	
		Average	Status[1]	Average	Status[1]	Average	Status[1]
Region 3							
Angat River	2005	7.8	P	2.3	P	28.1	F
Bocaue River	2002-04	3.4	F	10.1	F	27.2	P
Marilao River	2002-04	2.2	F	53.4	F	56.5	F
Meycauayan River	2002-04	3.0	F	43.8	F	73.2	F
Pampanga River	2003-05	6.2	P	19.3	F	128.4	F
Mabayuan River	2003-04	7.7	P	1.7	P	17.6	P
Binictican River	2003-04	-		-		19.3	P
Malawaan River	2003-04	-		-		24.5	P
Binanga River	2004	7.6	P	1.0	P	28.5	P
El Kabayo River	2004	7.3	P	1.0	P	17.5	P
Ilanin River	2004	7.5	P	1.0	P	20.5	P
Triboa River	2004	7.3	P	1.0	P	20.5	P
Benig River	2002	3.5	F	51.7	F	190.3	F
Region 6							
Iloilo River	2001-05	4.6	F	3.4	P	103.3	F
Jaro-Tigum-Aganan River	2001-05	7.2	P	3.1	P	188.0	F
Jalaur River	2001-05	7.1	P	4.6	P	85.6	F
Panay River	2001-05	7.2	P	2.5	P	122.3	F
Region 12							
Allah River	2004-05	7.4	P	3.8	P	116.8	F
Banga River	2003	7.4	P	2.4	P	21.6	P
Kapingkong River	2005	7.0	P	2.6	P	239.6	F
Silway Klinan River	2002	8.1	P	5.2	F	39.4	P
Buayan River	2003	7.6	P	2.7	P	89.3	F
Maribulan River	2003	7.9	P	2.4	P	42.3	P
Malaang River	2004-05	7.9	P	2.4	P	13.0	P
Kabacan River	2005	7.2	P	2.4	P	27.2	P
Kipalbig River	2004	8.1	P	3.2	P	148.4	F
Lun Masla River	2005	7.6	P	1.5	P	40.6	P
Lun Padidu River	2003	7.9	P	1.7	P	9.2	P
Malasila River	2003	8.4	P	2.3	P	6.0	P
Marbel River	2001	8.3	P	7.7	F	38.0	P
Siguel River	2005	8.6	P	2.1	P	78.6	F
Lake Sebu	2002	9.1	P	5.5	F	6.4	P

Source: Environmental Management Bureau/Department of Environment and Natural Resources [171-173].
Note: [1]P= passed, F=failed.

Table D3. Drinking water access costs (US$), by region[1]

Region	Household treatment	Purchased piped water	Purchased nonpiped water	Hauled water	Total
NCR	10,779,144.3	697,837.8	23,331,737.8	42,513.6	34,851,233.5
CAR	1,274,388.7	76,637.9	947,526.0	14,454.6	2,313,007.2
1	3,685,949.5	252,246.5	675,666.9	10,384.5	4,624,247.4
2	2,188,725.1	151,652.9	190,796.9	12,464.1	2,543,639.0
3	7,936,145.2	497,675.0	3,305,820.7	11,139.5	11,750,780.4
4a	8,738,523.9	497,118.9	6,339,770.1	51,675.1	15,627,088.1
4b	2,127,804.3	121,047.0	1,543,715.0	9,207.1	3,801,773.3
5	3,618,206.4	230,771.6	1,003,618.4	23,353.4	4,875,949.8
6	4,503,930.3	294,809.0	3,064,063.4	72,807.1	7,935,609.7
7	4,167,310.1	215,347.7	3,292,694.1	67,764.1	7,743,116.0
8	2,796,785.6	189,110.7	305,615.9	20,262.1	3,311,774.3
9	2,093,104.7	116,980.2	422,982.8	31,390.4	2,664,458.0
10	2,968,038.7	169,394.5	559,378.9	44,324.3	3,741,136.4
11	3,007,050.4	185,201.1	697,581.4	40,902.7	3,930,735.6
12	2,623,141.3	160,180.9	538,900.9	34,926.0	3,357,149.1
13	1,698,739.6	116,529.2	179,638.7	5,992.1	2,000,899.6
ARMM	1,451,472.6	57,083.8	394,112.0	31,927.5	1,934,595.9
Total	**65,658,460.6**	**4,029,624.6**	**46,793,620.0**	**525,488.2**	**117,007,193.4**

Note: [1]Economic losses only

Table D4. Water access costs for domestic uses (US$) (drinking water excluded)[1]

Region	Purchased piped water	Purchased nonpiped water	Household water treatment	Hauled water	Total
NCR	90,176,352	9,653,920	-	407,253	100,237,526
CAR	17,957,228	3,977,767	-	32,948	21,967,942
1	1,768,850	122,687	-	11,202	1,902,740
2	5,527,607	34,691	-	8,048	5,570,346
3	3,030,413	31,662	-	9,660	3,071,735
4a	11,759,457	313,174	-	8,633	12,081,265
4b	11,688,686	1,294,154	-	40,048	13,022,888
5	2,846,160	315,123	-	7,136	3,168,418
6	4,797,219	750,725	-	18,099	5,566,042
7	5,899,234	839,253	-	56,425	6,794,913
8	4,340,597	529,398	-	52,517	4,922,512
9	3,611,088	198,395	-	15,703	3,825,186
10	2,383,439	256,542	-	24,328	2,664,308
11	3,744,424	144,033	-	34,351	3,922,808
12	3,983,852	223,329	-	31,700	4,238,880
13	3,391,396	328,430	-	27,068	3,746,894
Total	**176,906,000**	**19,013,283**	**-**	**785,119**	**196,704,402**

Note: [1]Economic losses only

Table D5. Time used in accessing latrines

Location	Population size		Total time spent accessing (days)		Value (US$)		
	Open defecation with travel time	Shared facility with waiting time	Open defecation with travel time	Shared facility with waiting time	Open defecation with travel time	Shared facility with waiting time	Total
NCR	**245,817**	**2,403,794**	**311,539**	**3,046,475**	**945,673**	**6,701,874**	**7,647,547**
Rural	-	-	-	-	-	-	-
Urban	245,817	2,403,794	311,539	3,046,475	945,673	6,701,874	7,647,547
CAR	**65,800**	**328,922**	**83,393**	**416,863**	**105,910**	**363,074**	**468,985**
Rural	57,912	245,611	73,395	311,278	93,213	271,113	364,326
Urban	7,889	83,311	9,998	105,585	12,697	91,961	104,658
Region 1	**92,291**	**923,689**	**116,966**	**1,170,647**	**65,064**	**456,915**	**521,979**
Rural	83,043	723,151	105,245	916,493	58,544	357,716	416,260
Urban	9,248	200,538	11,721	254,154	6,520	99,199	105,719
Region 2	**80,109**	**703,814**	**101,527**	**891,986**	**51,908**	**311,545**	**363,453**
Rural	74,825	598,570	94,831	758,604	48,485	264,959	313,443
Urban	5,283	105,244	6,696	133,383	3,424	46,587	50,010
Region 3	**428,603**	**1,545,396**	**543,194**	**1,958,575**	**414,586**	**1,046,383**	**1,460,969**
Rural	368,261	1,097,573	466,720	1,391,021	356,218	743,163	1,099,381
Urban	60,341	447,824	76,474	567,554	58,368	303,220	361,588
Region 4a	**994,910**	**1,568,854**	**1,260,911**	**1,988,305**	**1,254,773**	**1,363,542**	**2,618,315**
Rural	859,576	1,127,012	1,089,394	1,428,331	1,084,090	979,523	2,063,613
Urban	135,334	441,842	171,517	559,974	170,682	384,019	554,702
Region 4b	**242,258**	**382,011**	**307,028**	**484,146**	**223,567**	**242,947**	**466,513**
Rural	226,493	325,581	287,048	412,629	209,018	207,059	416,077
Urban	15,765	56,430	19,980	71,518	14,549	35,888	50,437
Region 5	**937,741**	**805,881**	**1,188,456**	**1,021,342**	**534,070**	**302,643**	**836,712**
Rural	896,845	723,707	1,136,627	917,198	510,779	271,783	782,562
Urban	40,895	82,174	51,829	104,144	23,291	30,860	54,151
Region 6	**1,109,733**	**909,514**	**1,406,432**	**1,152,682**	**1,222,369**	**692,458**	**1,914,827**
Rural	857,488	524,970	1,086,747	665,327	944,522	399,686	1,344,208
Urban	252,245	384,543	319,685	487,355	277,847	292,772	570,619
Region 7	**1,383,549**	**1,032,414**	**1,753,456**	**1,308,442**	**1,743,802**	**896,360**	**2,640,162**
Rural	1,075,479	602,593	1,363,020	763,703	1,355,515	523,182	1,878,696
Urban	308,070	429,822	390,436	544,739	388,287	373,178	761,465
Region 8	**1,079,716**	**519,764**	**1,368,390**	**658,729**	**728,281**	**232,221**	**960,502**
Rural	985,537	419,856	1,249,031	532,109	664,756	187,584	852,340
Urban	94,180	99,908	119,360	126,620	63,525	44,637	108,162
Region 9	**535,851**	**549,412**	**679,116**	**696,303**	**443,745**	**302,407**	**746,152**
Rural	421,742	328,255	534,499	416,018	349,250	180,679	529,929
Urban	114,108	221,156	144,617	280,285	94,495	121,729	216,224
Region 10	**287,722**	**684,258**	**364,647**	**867,202**	**387,567**	**622,726**	**1,010,293**

Table D5 continued

Rural	214,982	371,369	272,460	470,658	289,585	337,973	627,559
Urban	72,740	312,889	92,187	396,543	97,982	284,753	382,734
Region 11	**271,994**	**904,413**	**344,714**	**1,146,218**	**348,686**	**788,414**	**1,137,099**
Rural	221,084	574,815	280,194	728,498	283,422	501,089	784,511
Urban	50,910	329,598	64,521	417,720	65,264	287,324	352,588
Region 12	**361,835**	**813,769**	**458,575**	**1,031,339**	**372,554**	**559,809**	**932,363**
Rural	318,484	607,772	403,635	770,266	327,919	418,099	746,019
Urban	43,350	205,997	54,941	261,073	44,635	141,710	186,344
Region 13	**278,096**	**350,316**	**352,449**	**443,977**	**91,142**	**75,925**	**167,067**
Rural	242,489	256,520	307,321	325,104	79,473	55,596	135,069
Urban	35,607	93,796	45,127	118,873	11,670	20,329	31,998
ARMM	**650,715**	**657,292**	**824,691**	**833,026**	**396,635**	**264,873**	**661,509**
Rural	634,322	617,551	803,915	782,660	386,643	248,859	635,502
Urban	16,393	39,740	20,776	50,366	9,992	16,014	26,007
Total	**9,046,738**	**15,083,513**	**11,465,484**	**19,116,257**	**9,330,332**	**15,224,115**	**24,554,446**
Rural	7,538,563	9,144,905	9,554,081	11,589,897	7,041,432	5,948,062	12,989,493
Urban	1,508,176	5,938,607	1,911,403	7,526,360	2,288,900	9,276,053	11,564,953

Annex E. Individuals and organizations consulted

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