

Economic Impacts of Sanitation in Cambodia Summary

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

Water and Sanitation Program - East Asia and the Pacific (WSP-EAP)
World Bank
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Cambodia is developing in all sectors, gradually lifting its people out of poverty as well as improving their living standards. Along with such development, the Royal Government of Cambodia, led by Samdech Akka Moha Sena Padei Techor Hun Sen, Prime Minister of the Kingdom of Cambodia, acknowledged in the National Forum on Rural Sanitation and Hygiene on 13th – 14th November 2007 the issue of poor sanitation coverage and hygiene practices of the Cambodian people living in rural areas. The Prime Minister Samdech Techor said, "In Cambodia, poor sanitation and hygiene is one of the factors contributing to the poverty of Cambodian people and blocking the efforts of the Royal Government in national economic development." The lack of good sanitation and hygiene practices severely affects the lives of rural people, especially poor households and vulnerable people who are at higher risk from water-borne and hygiene-related diseases.

Sanitation and hygiene has received very limited attention from relevant institutions within Cambodia. Very limited information exists on the impacts of poor sanitation and hygiene, or the institutional policy options and strategies to improve sanitation and hygiene. Sanitation and hygiene improvement is one of the priorities of the Ministry of Rural Development, who needs better understanding of the impacts of poor sanitation and hygiene both in the present and in the future. Ultimately this will enable the implementation of pro-poor strategies in line with the policies of the Royal Government of Cambodia.

For the above reasons, the Water and Sanitation Program of the World Bank, East Asia and the Pacific region, supported the research program "Economic Impacts of Sanitation" in Cambodia. The study aim is to provide

scientific evidence and information related to economic benefits of improved sanitation and hygiene options. The principal focus of this study is to examine the economic and social losses associated with poor sanitation and hygiene, and conversely, the potential economic and social gains of improving sanitation and hygiene.

On behalf of the Ministry of Rural Development, as the government institution in charge of rural water supply, sanitation and hygiene, I would like to express my sincere thanks to the Water and Sanitation Program of the World Bank, East Asia and the Pacific region, for including Cambodia as one of the collaborating countries in this useful research program. The results of the research will be valuable for inclusion in the National Strategy on Rural Sanitation and Hygiene Promotion in Cambodia, which the Ministry is planning in the year 2008. I would encourage concerned institutions to use the data and information from this study to improve the planning of rural sanitation and hygiene programs in Cambodia.



The Sanitation Impact Study was conducted under the Economics of Sanitation Initiative (ESI) 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-EAP), with the contribution from WSP teams in each of the participating countries. The study took one year to complete, and has undergone two major peer review processes. This summary report is based on four full-length country reports and a full-length synthesis report (see CD-Rom in this publication, inside the back cover).

Guy Hutton (WSP-EAP senior water and sanitation economist) led the development of the concept and methodology for ESI, and the management and coordination of the country teams. The study benefited from the continuous support of other WSP-EAP staff. Isabel Blackett was the task team leader; Jemima Sy, Brian Smith, Almud Weitz and Richard Pollard provided input to the 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 Cambodia consisted of Phyrum Kov (Economic Institute of Cambodia, country lead), Hach Sok (EIC director), Sophanara Roth and Kongkea Chhoeun. Jan Willem Rosenboom (WSP Cambodia) contributed importantly to the study.

The ESI was 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 Philippines study received co-funding from the United States Agency for International Development (USAID), Environmental Cooperation-Asia (ECO-Asia), and Water and Sanitation 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 Cambodia country draft report were: Hilda Winarta (UNICEF), Jan Lam (SNV), Chea Samnang (Ministry of Rural Development), Ruud Corsel (Niras-Scanagri, Vietnam), Oun Syvibola (Plan International), Jan Willem Rosenboom (WSP Cambodia), Isabel Blackett (WSP-EAP), and Brian Smith (WSP-EAP). The Cambodia 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 Philippines country draft report were: Jema Sy and Andy Robinson (consultant). 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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This Policy Brief is an abbreviated version of the technical report. A more comprehensive discussion is available in the detailed research report: "Economic impacts of sanitation in Cambodia". Kov P, Sok H, Roth S, Chhoeun K, Hutton G. World Bank, Water and Sanitation Program. 2008.

References for other reports:

- Economic impacts of sanitation in Southeast Asia. Hutton G, Rodriguez UE, Napitupulu L, Thang P, Kov P. World Bank, Water and Sanitation Program. 2008.
- Economic impacts of sanitation in Indonesia. Napitupulu L and Hutton G. World Bank, Water and Sanitation Program. 2008.
- Economic impacts of sanitation in the Philippines. Rodriguez UE, Jamora N, Hutton G. World Bank, Water and Sanitation Program. 2008.
- Economic impacts of sanitation in Vietnam. Thang P, Tuan H, Hang N, Hutton G. World Bank, Water and Sanitation Program. 2008.

WSP and the country team appreciate the inputs of local stakeholders – Department of Rural Health Care of Ministry of Rural Development, Department of Planning of Ministry of Health, Phnom Penh Water Supply Authority (PPWSA), and other institutions. A complete list of key informants is given in the table below.

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1	Mr. Mak Soeun	FAO	Water resource impact
2	Mr. Sin Somuny	MediCam	Health impact
3	Mr. Nang Phirun	MoE	Water resource impact
4	Mr. Phin Rady	MoE	Water resource impact
5	Mr. Saron Sambo	MoE	Environment impact
6	Mr. Pen Saroeun	MoEYS	User preference
7	Mrs. Kuy Phalla	MoEYS	Sanitation at school
8	Ms. Khoun Engmuny	MoH	Health impact
9	Mr. Sok Touch	MoH	Health impact
10	Mr. Veng Thay	MoH	Health & environmental health
11	Dr. San Sary	MoH	Hospital
12	Mr. Pok Vanthat	MoLV	User preference (workplace)
13	Ms. Hou Neamita	MoWA	Gender
14	Mr. Mao Hak	MoWRM (MRC)	Water quality and river flow
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18	Mr. Mao Bunsoth	NIPH	Health impact
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22	Mr. Sao Kun Chhon	PPWM	Waste management
23	Mr. Ros Kim Leang	PPWSA	Water supply
24	Mr. Khuth Vuthearith	PPWSA	Water supply
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26	Mr. Jan Lam	NBP	Small-scale biogas
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28	Ms. Sieng Leakna	UNDP	Gender specialist
29	Ms. Hilda Winarta	UNICEF	Sanitation

Table of Basic Country Data - Cambodia

Variable	Cambodia
Population	
Total population (millions)	13.8
Rural population (%)	83.8%
Urban population (%)	16.2%
Annual population growth	1.9%
Under 5 population (% of total)	12.3%
Under 5 mortality rate (per 1,000)	83
Female population (% of total)	51.5%
Population below poverty line (million)	35%
Currency	
Currency name	Riel
Year of cost data presented ¹	2005
Currency exchange with US\$	4,050
GDP per capita (US\$)	447
Sanitation	
Improved rural (%)	15.7%
Improved urban (%)	56.1%
Urban sewage connection treated (%)	28.9%

¹Except tourism loss where the cost is estimated based on 2006 figure

In 2004, only about 17% of Cambodian people had access to improved sanitation, meaning that there were still more than 11 million Cambodians living with an unimproved latrine or with no latrine at all. Although the figure given by the Cambodia Demographic and Health Survey (CDHS) in 2005 indicates the increase of access coverage to nearly 22% in 2005, it is estimated that about 204,000 people need to gain access to improved latrines each year if Cambodia is to achieve the internationally-set Millennium Development Goal target of reducing by half in 2015 the proportion of people without improved sanitation from the base year of 1990.

While there is a consensus that lack of access to clean water and improved sanitation has a variety of impacts, there is often a lack of evidence to affirm that poor sanitation imposes a significant burden on society. In response, the “Sanitation Impact” study, initiated by the World Bank Water and Sanitation Program, aims to generate sound evidence on the negative impacts of existing sanitation and hygiene conditions and the potential benefits of improvements in sanitation and hygiene in Cambodia.

In this study, quantitative assessment is conducted on the economic impacts of poor sanitation and hygiene on health, water resource, tourism and other welfare impacts. In addition to the quantitative evaluation, the study also discusses the effects of poor sanitation on various qualitative dimensions including health-related quality of life, intangible user preferences, life decisions, and the quality of the surrounding environment. The study also presents some of the benefits of improved sanitation when impacts mentioned above are completely or partially eliminated.

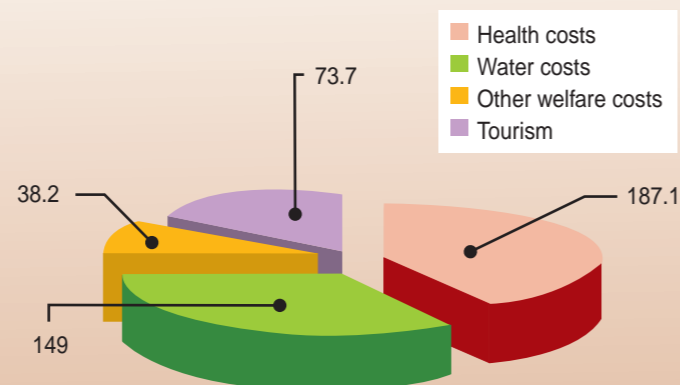
The analysis focused on a narrow definition of sanitation, related to human excreta. However, there were instances in which sanitation as it relates to gray water and solid waste were also included. In measuring the impacts, the study uses a peer-reviewed methodology developed specifically for this study, which draws on established methods and, where these do not exist, develops new approaches to capture the impacts of poor sanitation. For improving policy

interpretation of the results, the study distinguishes between financial and economic impacts, and presents for rural/urban areas and different geographical groupings at zonal level.

Overall, the study finds that poor sanitation leads to economic losses of US\$448 million, per year which translates into per capita loss of approximately US\$32. These economic losses are equivalent to 7.2% of the Cambodia’s Gross Domestic product (GDP) in 2005. This amount is roughly equivalent to the contribution of the fishery sector, to the GDP, or twice the contribution of the forestry sector.

The health impact is the largest contributor of quantified costs. Health-related economic impacts amount to US\$187 million accounting for 42% of the total economic costs. The next main contributor is the water costs which share roughly one third of the total economic losses being nearly US\$150 million. Moreover, tourism sector which may also be affected by poor sanitation and hygiene practice in the country, is also estimated to cause losses of about US\$74 million per year, or 16% of total cost. Other welfare costs – specifically the loss of time to access defecation sites – equals roughly US\$38 million, or 9% of the total cost.

Economic costs of poor sanitation in 2005, by impact (US\$ million)
(Overall economic costs = US\$448 million)



Having estimated the impacts, the study also evaluated the benefits associated with improved sanitation and hygiene practices. The results showed that improved hygiene practices such as hand washing can reduce health-related costs by approximately US\$84 million. Improved physical access to sanitary toilets can reduce economic costs associated with time use by about US\$38 million. Improved toilet systems can reduce health costs by US\$60 million. Improvement in the treatment or disposal of waste has a large impact in water resources and tourism, which can reduce costs totaling US\$223 million where US\$149 million is from mitigated water impacts and US\$74 million is from tourism gain.

The findings of this study indicate that poor sanitation has significant economic costs. It also shows 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 the costs, such as the value of human excreta used for fertilizer.

This is the first regional study to compile economic evidence on a range of impacts of poor sanitation. The results are a wake-up call to the Cambodian government and the development community. Poor sanitation affects everyone, but especially the poor and vulnerable (children, women, disabled and senior people). The considerable socio-economic importance of sanitation shown in this study, and the

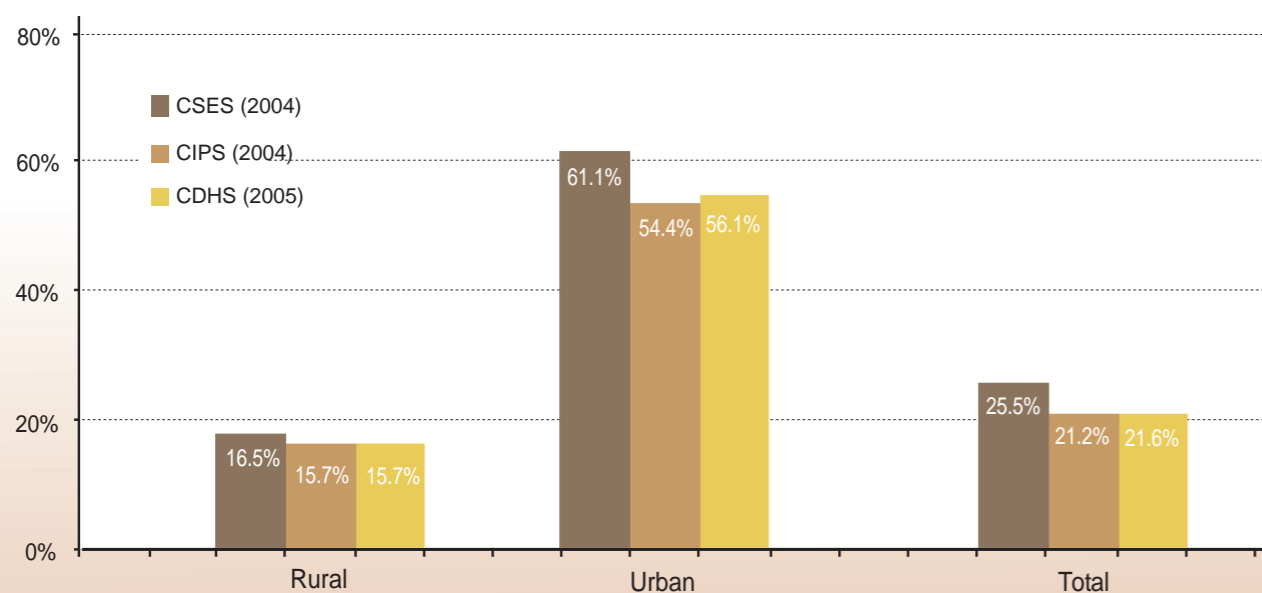
key links improved sanitation has with other development goals (poverty and hunger reduction, gender equality, child health, access to safe drinking water, and quality of life of slum-dwellers), demonstrates that sanitation should receive far greater attention from players whose interest is the equitable socio-economic development of Cambodia. Decision-makers should act now and in a concerted way to increase access to improved sanitation and hygiene practices.



Sanitation is a global concern. One of the targets of the Millennium Development Goals (MDG) is to halve – from 1990 to 2015 – the proportion of people without access to sanitation [1]. Given that Cambodia lags far behind other countries in the region in terms of rural coverage of improved sanitation, the national policy on rural water and sanitation sets the vision: “Every person in rural communities has sustained access to safe water supply and sanitation services and lives in a hygienic environment by 2025”. Obviously, this vision emphasizes the need for more investment in sanitation in rural areas. What is more, the Cambodia Millennium Development Goal (CMDG) target for sanitation coverage is set to be 30% for rural areas and 74% for urban areas, to be achieved by 2015 [2]. Based on current coverage and existing resource allocations to sanitation, however, it is unlikely that these targets will be reached by 2015.

In Cambodia, various data sources are available for sanitation coverage, of which three data are presented in Figure 1: the Cambodia Socioeconomic Survey (CSES) 2004, the Cambodia Inter-censal Population Survey (CIPS) 2004, and the Cambodia Demographic and Health Survey (CDHS) 2005. It is observed that different surveys give different results of sanitation coverage. However, the CDHS tends to be more reliable compared to other sources of data. It can be observed that CDHS (2005) has utilized the WHO/UNICEF Joint Monitoring Program (JMP) definitions of improved and unimproved sanitation¹.

Figure 1. Improved sanitation coverage measured in different surveys in Cambodia



¹ The latrine is improved if it is used only by household members and not shared with others, and if the system can separate human waste from human contact. The types of facilities that are likely to achieve this may consist of flush or pour flush to piped sewer/septic tank/pit latrine, ventilated improved pit (VIP) latrine, pit latrine

with slab, and composting toilet. The unimproved sanitation facility, however, refers to the shared latrine and other types of latrine which do not effectively separate human waste from human contact.

Figure 1 shows clearly that sanitation coverage is lagging far behind other global development goals. In the CDHS survey in 2005, only a total of 21.6% of the population had access to improved sanitation. Furthermore, the rural-urban disparity is evident as only 15.7% of the rural population in 2005 had access to improved sanitation compared to 56.1% for the urban population.

Despite the importance of water and sanitation in the development process, there is limited data and research to document the impact of poor sanitation which makes this study necessary to generate concrete evidence for decision-makers. The study is conducted under the Water and Sanitation Program’s (WSP) Economics of Sanitation Initiative (ESI), implemented by the organization’s East Asia and Pacific office. ESI aims to compile and generate evidence on the following aspects:

- Economic impacts of poor sanitation on health, water and the environment.
- The links between sanitation and broader human activities, such as education, productivity, tourism, and business investment climate.
- Population preferences concerning latrine options and environmental sanitation, and their contribution to quality of life.
- How much improved sanitation can alleviate these burdens and generate economic savings to society and improve quality of life.

The target audience of ESI is primarily national level policy makers with influence over the allocation of resources to sanitation, including central ministries (e.g. Prime Minister’s office, MEF), line ministries (e.g. MRD, MIME, MoLMUPC) and external funding partners (multilateral, bilateral and non-governmental agencies). The study is also targeted at sub-national decision making levels where results and conclusions of this study are also relevant.



2.1 Study approach

This Sanitation Impact study employs a standardized peer reviewed methodology [3]. It follows the methodology adopted in four other countries (Indonesia, Lao PDR, the Philippines, and Vietnam) with a view toward generating comparable outputs for Southeast Asia.

The aim of the study is to present impacts in disaggregated form, to aid interpretation and eventually policy recommendations about the overall negative impacts of poor sanitation and the potential benefits of implementing different types of sanitation improvement. Geographical disaggregation of results is presented for some types of economic impact, i.e. at the zonal level which groups together several provinces. Rural/urban disaggregations are made for impacts where feasible. Furthermore, health impacts are disaggregated by age groups for selected diseases and descriptive gender analyses are conducted for selected impacts.

The study uses a modeling approach, drawing almost exclusively on existing studies and survey data from routine sources. The study presents impacts

in primary units of measurement (e.g. disease episodes, water quality), and converts these to monetary equivalents using conventional economic valuation techniques. Lack of existing economic valuation approaches for some impacts required further methodological development (e.g. fisheries, tourism). Results on economic impact are presented in United States Dollars (US\$) for a single year – the latest available data were for 2005 for most variables, while for some variables 2006 was the latest year. For those impacts where quantification in economic terms is problematic, the impacts are examined and reported descriptively.

2.2 Scope of sanitation

Sanitation is used to describe many different aspects of hygiene and the disposal or recycling of waste. Despite the focus of the MDG target on human excreta, this study recognizes other aspects of sanitation relevant to the economic impacts, thus the management of human and animal excreta, solid waste, other agricultural waste, toxic waste, wastewater, food safety, and associated hygiene practices were included. Table 1 summarizes the aspects of sanitation included and excluded from this study.

Table 1. Aspects of sanitation included and excluded in the present study

Included	Excluded
<ul style="list-style-type: none"> Practices related to human excreta: <ul style="list-style-type: none"> Quality, safety and proximity of latrine system 	<ul style="list-style-type: none"> Drainage and general flood control measures
<ul style="list-style-type: none"> Disposal or treatment of waste and impact on the (inhabited) outdoor environment 	<ul style="list-style-type: none"> Industrial effluents, toxic waste and medical waste Other agricultural waste
<ul style="list-style-type: none"> Hygiene practices 	<ul style="list-style-type: none"> Vector control
<ul style="list-style-type: none"> Practices related to disposal or treatment of gray water 	<ul style="list-style-type: none"> Broader food safety
<ul style="list-style-type: none"> Practices related to disposal or treatment of household solid waste 	<ul style="list-style-type: none"> Broader environmental sanitation
<ul style="list-style-type: none"> Practices related to use or disposal of animal excreta 	

2.3 Impacts evaluated

Poor sanitation has many actual or potential negative effects on populations as well as the national economy. Based on initial assessment of a long list of potential impacts, a shortened list was selected for evaluation in this present study. These are:

- Health impacts
- Water resource impacts
- Environmental impacts (focus on the outdoor environment)
- Other welfare impacts
- Tourism impacts

For these impacts, the estimated economic costs include additional expenditures, incomes or productivity losses, and value of premature death. Non-pecuniary welfare impacts were also assessed, but not quantified in monetary units. Except the estimate of time loss accessing toilet, all the impacts i.e. health impacts, water pollution, and tourism were estimated based on an attributable fraction.

2.4 Impact mitigation

Having estimated the losses resulting from poor sanitation, from a policy viewpoint it is important to know how much these losses can be reduced by implementing improved sanitation options. For some impacts such as health, sanitation options have less than 100% effectiveness, and hence the overall estimated losses cannot be fully mitigated.

There exist many types and configurations of sanitation improvement. This present study estimates potential benefits obtainable for a selected number of features of sanitation improvements. This study provides an initial tentative estimate of the likely gains possible from improving these sanitation features (see Table 2). It is the aim of the second study of ESI to estimate the costs and benefits of specific sanitation options.



Table 2. Features of sanitation interventions for assessing economic gains

Intervention	Detail	Gains evaluated
Making toilets cleaner and safer	Improved: position or type of toilet seat or pan; structure; collection system; ventilation; waste evacuation	Avert health impacts (32% reduction)
Hygiene	Availability of water for anal cleansing; safe disposal of materials for anal cleansing; hand washing with soap; toilet cleaning	Avert health impacts (45% reduction)
Latrine access	Toilets closer and more accessible (private rather than shared or public)	Save latrine access time
Isolation of human waste from water resources	Improved: septic tank functioning and emptying; flood-proof; treatment; drainage system	Avert costs of accessing clean water for drinking and other household uses; avert losses to fish production
Sanitary conditions for tourists	Culturally appropriate improved tourist toilet facilities (hotel, restaurants, tourist attractions) and general sanitary conditions	Avert tourist losses
Reuse of human waste	Composting of feces for fertilizer; biogas production	Value of replaced fertilizer and fuel

3.1 Health impacts

Poor sanitation and hygiene in Cambodia have a substantial impact on health, causing morbidity and deaths as shown in Table 3.

It is estimated that the number of cases associated with poor sanitation and hygiene in 2005 totaled nearly 9.7 million cases. Of those cases, 97% are

diarrheal diseases. Moreover, it is observed that the total deaths related to poor sanitation and hygiene is conservatively close to 10,000 in 2005, most of them are resulted from diarrheal diseases (67%), while the rest are from ALRI (18%), malaria (10%), and measles (4%).

Table 3. Summary of health impacts by disease due to poor sanitation and hygiene

Disease	Cases		Deaths	
	Reported ¹	Estimated Total ¹	Reported ²	Estimated Total ¹
Diarrheal diseases	621,353	9,364,210	99	6,600
Skin disease	101,393	144,596	-	-
Malnutrition	574	852	-	-
ALRI	50,164	159,706	926	1,786
Measles	-	-	1	420
Malaria	1,295	19,108	282	1,033
Total	774,778	9,688,471	1,308	9,840

¹ With adjustment for attribution to poor sanitation and hygiene

² Without adjustment for attribution to poor sanitation and hygiene

The economic impacts assessed in this study include spending on (1) health care, (2) loss of income or production associated with disease (productivity costs), and (3) the value associated with premature loss of life. Table 4 shows a summary of the financial and economic costs of different health impacts due to poor sanitation and hygiene in Cambodia. The health-related financial cost is US\$13 million, while the economic cost is US\$187 million. Health care costs account for more than 80% of the financial loss, while it accounts for only 7% in the

economic loss. The majority of economic cost is accounted for by premature death which shares up to 90% (US\$169 million) of the health-related economic costs. In terms of disease, diarrhea is the main financial loss accounting to 94% of the total financial losses. In addition, it is also a major contributor to economic costs amounting to nearly 70% of total costs. ALRI and malaria are the next contributors to the total economic losses sharing 17% and 10% of the total costs respectively.

Table 4. Total health-related costs

Disease	Total financial costs (million US\$)				Total economic costs (million US\$)			
	HC	PROD	DEATH	Total	HC	PROD	DEATH	Total
Diarrhea	9.9	2.5	0.2	12.5	12.3	5.0	112.8	130.1
Skin disease	0.4	0.0	0.0	0.4	0.5	0.0	0.0	0.5
ALRI ¹	0.4	0.0	0.0	0.4	0.5	0.1	30.8	31.3
Measles ¹	0.0	0.0	0.0	0.0	0.0	0.0	7.2	7.2
Malaria ¹	0.1	0.0	0.0	0.1	0.1	0.0	17.8	17.9
Total	10.7	2.5	0.2	13.3	13.4	5.1	168.6	187.1

¹ Indirect disease burden related to malnutrition

Figure 2 shows the contribution of different costs to overall cost, by disease. It is seen that premature death is the main economic cost for diarrhea and diseases associated with malnutrition (indirect diseases). However, health care costs are the most important costs for malnutrition and skin diseases.

3.2 Water resource impacts

The economic impacts of polluted water resources depend on three main factors: the extent of water resources in the country, the release

of polluting substances in water resources, and the eventual uses of water. Despite the fact that Cambodia has many water resources – surface water, ground water and rain water – most land-based water resources suffer from pollution due to human activities. The water bodies near cities or populated areas are usually more polluted than the remote water bodies due to excessive discharge of pollutants generated by humans. Table 5 shows the total daily release of human excreta to water bodies, totaling 234 tons of feces, 2,335 cubic meters of urine, and 8,154 cubic meters of gray water per day. This generates approximately 497 tons of biological oxygen demand (BOD) on a daily basis.

Figure 2. Contribution of different costs to total cost, by disease

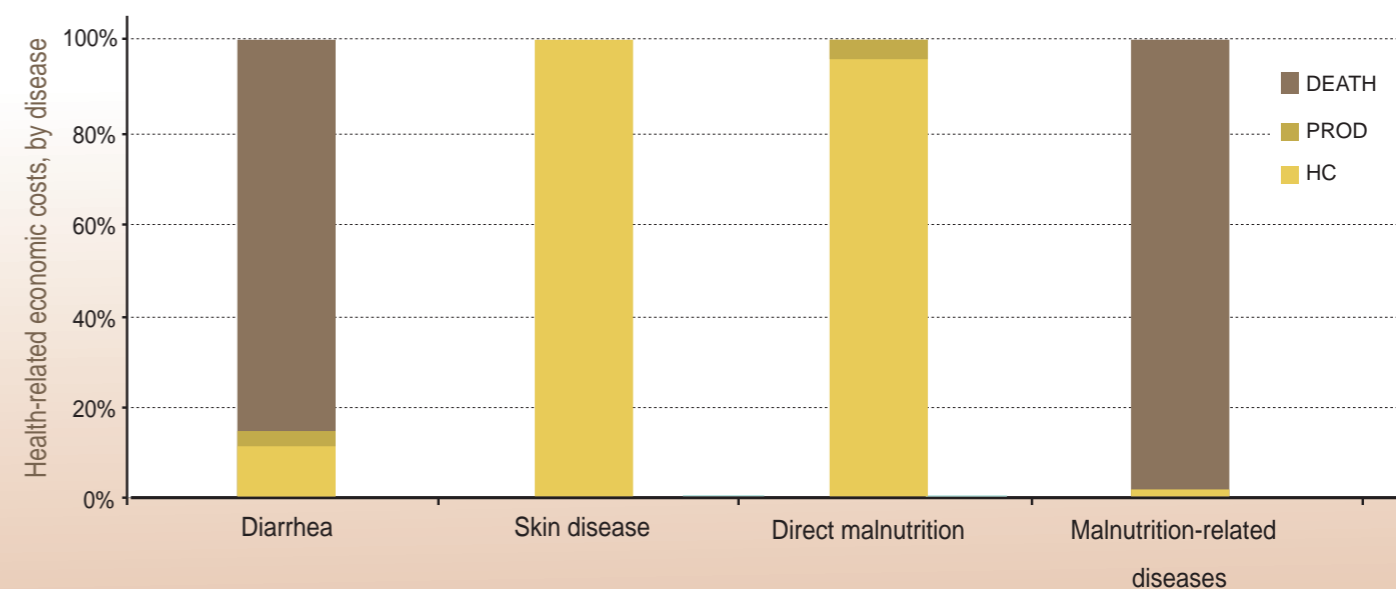


Table 5 . Daily release of polluting substances to inland and ground water bodies

Region	Total release (volume)			Polluting substances
	Feces (Tons)	Urine (m3)	Graywater (m3)	BOD (Tons)
Phnom Penh	29	287	607	58
Plains	71	713	1,777	196
Tonlé Sap	77	765	3,100	150
Coastal	26	257	1,305	37
Plateau	31	314	1,365	57
Total	234	2,335	8,154	497

Given the large volumes of water in the main rivers and lakes in Cambodia, these pollutants become diluted and hence less harmful to wildlife and human activity. Despite this, the water quality of many surface waters is still unsafe for untreated consumption due to the presence of bacteria. Table 6 shows the water quality measurements in Cambodia from various surface water locations

from two different institutions, namely Phnom Penh Water Supply Authority (PPWSA) who supply drinking water to Phnom Penh citizens, and the Mekong River Commission (MRC) who tests water quality at different locations along the Mekong River and its tributaries. Indicators showing water quality such as total suspended solids (TSS) and dissolved oxygen (DO) are presented here.

Table 6. Selected water quality measurements in Cambodia

River (location) (wet season)	Total release (volume)	Polluting substances
	TSS	DO
Tonlé Sap River ¹ (Phum Prek)	120	3.4
Mekong River ¹ (Chroy Changva)	175	5.5
Tonlé Sap Lake ² (Phnom Krom)	661	6.5

Sources: ¹PPWSA, ²MRC

Due to the scarcity of data on costs that are used for the estimation of economic costs of water resource, some assumptions based on discussion with stakeholders and experts are made to enable estimation of economic impacts. Table 7 shows the unit costs of different water sources as well as water treatment via boiling used in the study. According to the table, piped water tariff is US\$0.07 per m3 in urban area, while it is more than US\$0.3 per m3 in rural area. This can be explained by the fact that water supply in urban areas is more efficient than in rural areas. The water tariff for purchased water from vendor is roughly 15 times more than piped water tariff in rural areas, and 35 times that in urban areas. The bottle water is even more expensive with average cost of US\$43 per m3 calculated from a standard 20-liter bottle water. Boiling is the main household water treatment method used in Cambodia. According to the table, the cost of boiling water in urban areas is roughly US\$16.5 per m3 while it is only US\$8 per m3 in rural areas due to abundant fuel wood which can be used for boiling water.

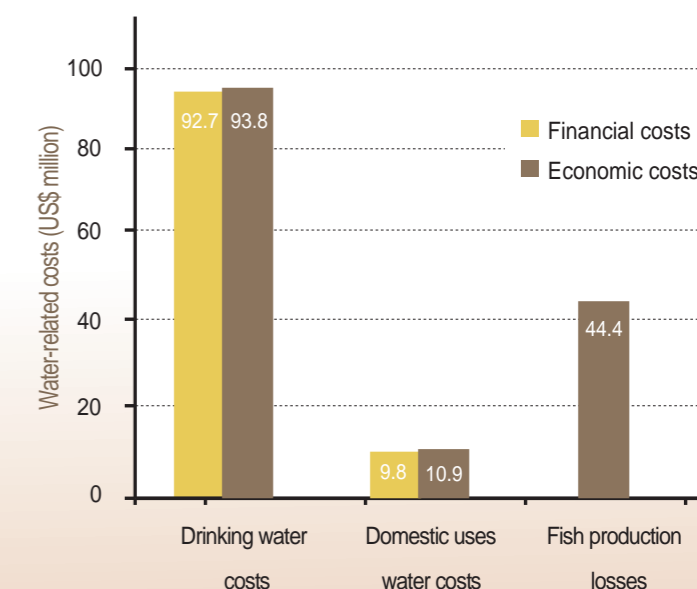
Table 7. Unit cost of water

Type of water use	Unit cost (US\$/m3)
Piped water tariff	
Rural	0.34
Urban	0.07
Purchased water (vendor)	
Rural	4.94
Urban	2.47
Purchased water (bottled)	
Rural	43.21
Urban	43.21
Water treatment cost	
Rural	8.23
Urban	16.46

Estimate based on market prices of goods and materials

Figure 3 presents the financial and economic costs of polluted water attributed to poor sanitation. These costs include drinking water access costs, water access costs for domestic uses (other than drinking water), and fish production losses due to poor sanitation. The results show that US\$149 million, in economic terms, is lost due to polluted water attributed to poor sanitation. Drinking water costs is the dominant factor sharing about 63% of the total economic costs, while fish production losses contribute 30% and domestic uses water costs contribute 7% to the total costs.

Figure 3. Water-related financial and economic costs due to poor sanitation



3.3 Environmental impacts

In terms of environmental impact, the present study focuses on assessing the impacts of solid waste in terms of aesthetics and land quality, largely in qualitative terms. Based on interviews with stakeholders, it is confirmed that solid waste management in Cambodia has gradually been improved, although there is a lot more to be done to keep the country environmentally clean. Many areas of Cambodia's cities, including Phnom Penh, are still without adequate waste collection service. Many tons of wastes are dumped into rivers and ponds, burned, or left uncollected to be scattered by animals, thus blocking the drains and creating unsanitary conditions. Waste collection is relatively weak in outlying areas of the cities, and in unplanned settlements that are home to thousands of the city's poorest families. Besides, the official designated dumpsites of solid waste are reaching capacity, particularly in Phnom Penh city where nearly 1,000 tons of waste is dumped everyday.

The greatest perceived impact of solid waste on aesthetics is the fact that waste produces odor, and spoils visual appearance, especially in towns and cities. In most towns and cities of Cambodia, household solid waste is usually disposed of in front of houses, on sidewalks, or in some cases on open land. Those wastes sometimes decompose prior to being picked up by waste collectors, thus producing bad smells to the surrounding environment. This polluted air quality creates unpleasant atmosphere to not only the households nearby, but also the pedestrians, travelers, and tourists passing by the areas. In addition to the odor, the scattered wastes have damaged the visual aesthetics of many cities of the country, which make the cities less attractive to tourists (see Section 3.5 on Tourism impacts). Solid waste also poses health hazards for the local population, which until now has not been quantified.

Besides household solid waste, the management of waste at most marketplaces has been very poor. In most cases, the wastes are untidily scattered around

the sellers and at best loaded on the edge of their stalls or in the entrance to the market. Waste products produce bad odors and transform the marketplace into unregulated dumpsites for the households situated nearby. While a market should be a pleasant place which needs to be attractive to customers, the market with improper waste disposal keeps away its customers. This causes loss of sales to sellers in the market.

In addition to scattered household and market wastes, the impact of the so-called designated dumpsite on the nearby residents is even more severe. The ten-hectare dumpsite in Phnom Penh is situated not far from the residential areas. While bad odor from the dumpsite is disturbing the livelihood of the residents, the smoggy air pollution due to burning of waste can be harmful to the health of the residents as well as dumpsite scavengers. In addition, the dumpsite may contaminate ground water quality, and damage local land quality through the penetration and spillover of waste and chemically-contaminated water.

It should also be noted that in Cambodia the designated dumpsites are available only in urban areas. In rural areas, however, the waste is normally burned or buried into the ground for disposal. It is argued that the land used for dumpsite is normally hard to convert to agriculture land. This is because the waste is usually mixed between the composted waste and the non-composted waste such as plastics and other materials. However, the conversion of the dumpsite for other selected non-agriculture purpose may be possible.

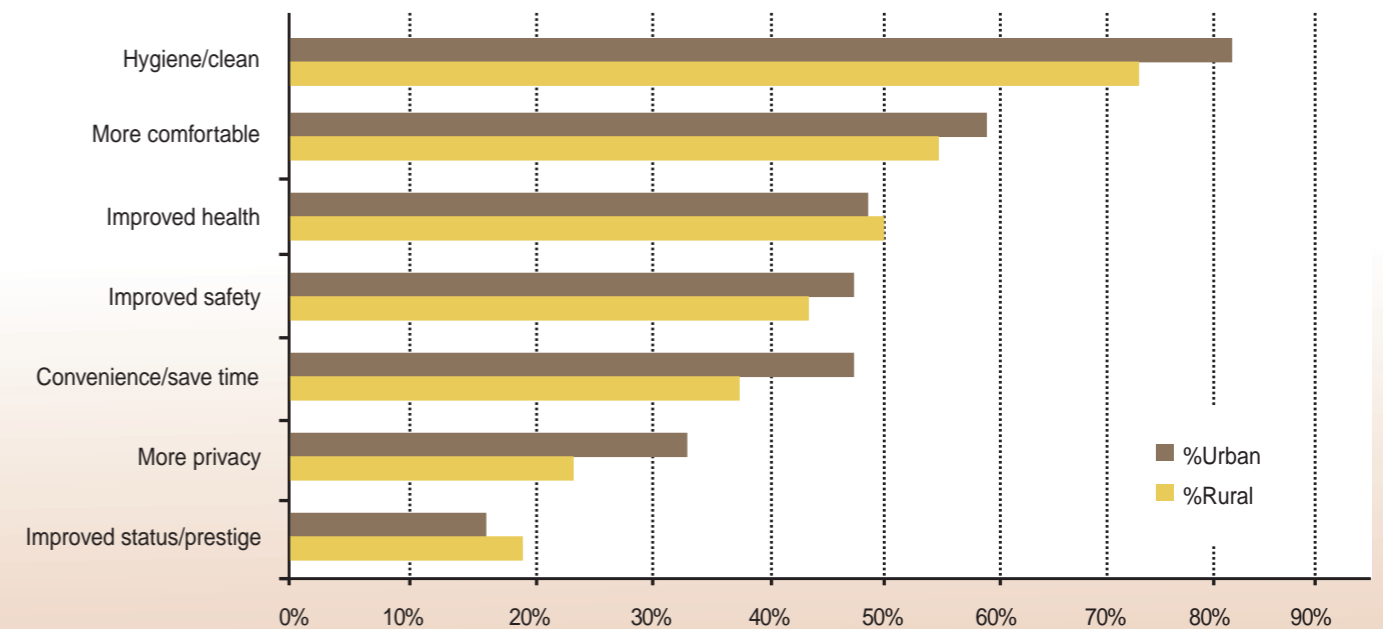
Therefore, although the environmental impact is not easily quantifiable, it affects the well-being, livelihood and health of populations. Moreover, the loss of land value due to unregulated unsanitary dumpsites is significant.

3.4 Other welfare impacts

According to a recent study by Water and Sanitation Program (WSP) in three selected provinces and Phnom Penh, it is found that hygiene and cleanliness is the main perceived benefits of latrine [4]. Based on the study, more than 80% of urban and 70% of rural households recognize that improved latrine will provide better hygiene and a generally clean environment for living. In

addition, comfort, health improvement, safety, and convenience are the next most perceived benefits of an improved latrine. It is also claimed that privacy, improved family status and prestige are other advantages of having a latrine at home. Figure 4 shows that rural and urban people tend to have a similar pattern of perception regarding the benefits of latrine.

Figure 4. Perceived importance of improved latrine to households



In order to estimate time losses from accessing unimproved sanitation, and in the absence of field data, this study assumes that the average access time for open defecation is 10 minutes per person per day, and the waiting time for people who share toilet facilities is 3 minutes per person per day. It is estimated that the total annual economic losses associated with time spent accessing open defecation is about US\$37.5 million and of shared facility

is roughly US\$0.7 million (Table 8). These costs include both the adults and children's welfare losses assuming adult's time value is 30% of average income, and children's time value is 50% of adult's time value. It should be noted that the evaluation of toilet access time provided below does not include the time for urination which can be a time-consuming daily activity, especially for women.

Table 8. Time used accessing latrines

Location	Population size (million)		Total time spent accessing (million hours)		Value (US\$ million)		
	Shared facility ¹	Open defecation	Shared facility ¹	Open defecation	Shared facility ¹	Open defecation	Total
Rural	0.5	9.0	8.7	549.5	0.5	34.7	35.3
Urban	0.2	0.7	2.9	44.1	0.2	2.8	3.0
Total	0.6	9.8	11.6	593.5	0.7	37.5	38.2

¹Refers to population with shared facilities who are assumed to have inadequate toilet. Using by many people, the shared facilities cause waiting time to users.

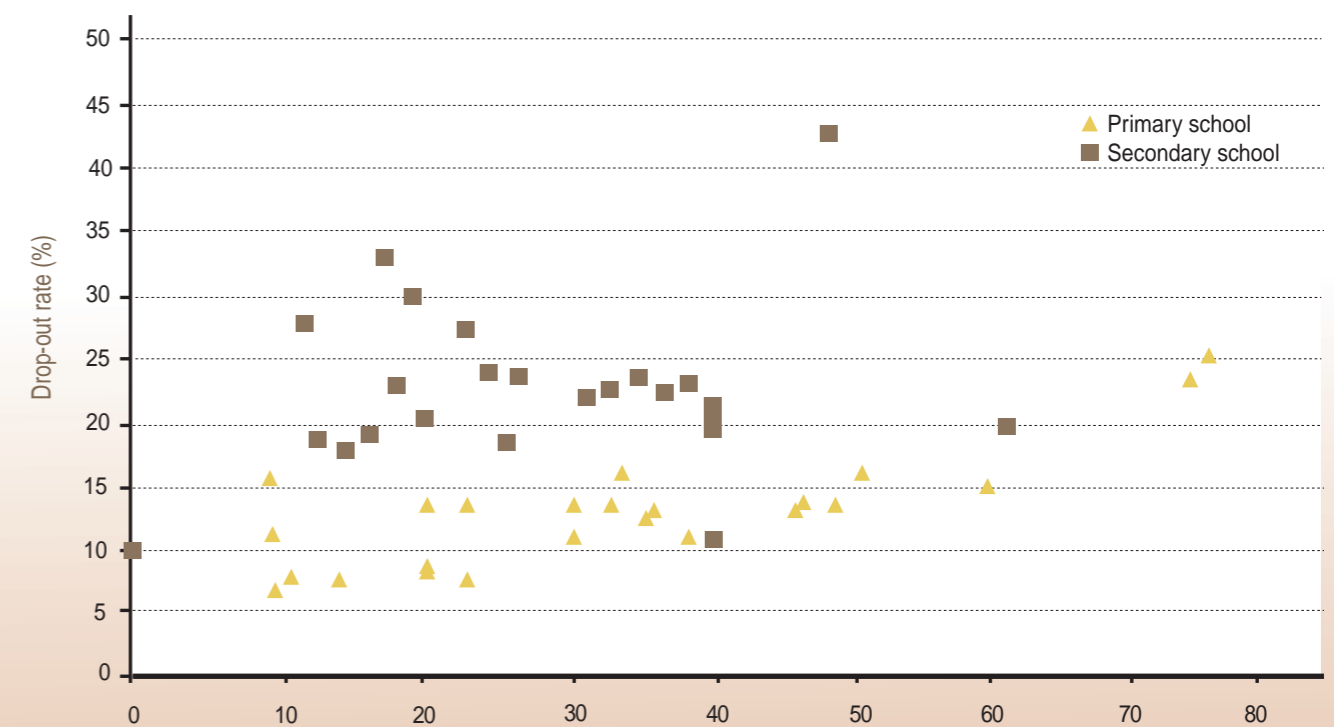
This study also attempts to explore the relationship between poor sanitation in schools and the participation of girls in education, i.e. rates of female school drop-out. Although there are many different reasons for school drop-out among school girls, the lack of toilet facility at school is potentially one of the reasons. According to the Figure 5 below, it is interesting to note that the drop-out rates

among school girls are higher in the provinces with high rates of without-toilet schools. It can be also noticed from Figure 5 that the impact tends to be more sensitive for secondary school students as the drop-out rate is higher than that of the primary school students. This can be explained by the fact that when the girls are getting older, more privacy for toilet going is needed.

Not only does poor sanitation negatively impact on education sector, but also on workplace where adequate sanitation and hygiene facility is important. It is recognized that poor sanitation affects the health of workers or employees, which in turn reduces the productivity of workers. Therefore, while poor health

negatively affects the quality of life and income of the workers, the reduced productivity may have some further economic losses for the employers and the country as a whole.

Figure 5. Female school drop-out rate vs. school sanitation



3.5 Tourism impacts

The growth in the number of tourist arrivals, from 1.05 million in 2004 to 1.70 million in 2006, has contributed to the recent high economic growth in Cambodia [5]. The share of tourism in Gross Domestic Product (GDP) has expanded from 11% in 2004 to nearly 15% in 2006. In absolute terms, income from tourism has grown sharply from only US\$580 million in 2004 to more than US\$1 billion in 2006. In addition, the tourism sector has provided employment to 225,000 people in Cambodia, contributing to about 3% of total employment in 2005.

Given the tourism growth and its potential growth in the near future, it is important to address some of the challenges facing further tourism growth in Cambodia. One of these challenges is sanitation. Poor sanitation in the country generally, and in tourist sites specifically, can have important implications for the eventual number of tourists visiting the country, their length of stay, and their desire to return. Also, once tourists are on-site, they may get sick from a sanitation or hygiene-related disease, and thus experience a reduction in enjoyment of their holiday. Getting sick is a bad experience in itself, but it also

wastes time in their holiday, and may incur some expenses related to treatment. Being sensitive to their environment, tourists will enjoy their stay less if exposed to the smells and sights of people defecating openly and uncollected or scattered solid waste. So, the tourists will be discouraged to come again, or the bad experience is spread among their friends and families which, in the long-run, results in less tourists coming to the country.

The losses to tourism are estimated as the gap between the current and potential tourist numbers (at an assumed occupancy rate of existing tourist hotels of 80%), a proportion of which (10%) is attributed to poor sanitation in Cambodia. The attributed economic cost of lower tourist numbers is estimated at US\$74 million per year (see Table 9). It should be noted that the economic cost of the number of tourists getting sick attributed to poor sanitation is not evaluated in this study due to lack of data. Yet, it can be assumed that the fact that tourists falling sick will undermine Cambodia's tourism prospects which, in the long-run, will affect the country's economy as a whole.

Table 9. Economic impact of lower tourist numbers

Region	Current tourism value (million US\$)	Hotel occupancy rate (%)		Potential value (Million US\$)	Attribution to sanitation	Annual economic loss ¹ (million US\$)
		Current	Target			
Cambodia	1,049	54.8	80.0	1,786	10%	73.7

Source of tourist numbers and value: Ministry of Tourism

¹Calculated as the gap between current and potential, multiplied by the attribution to sanitation

3.6 Overall economic impacts of poor sanitation

This section summarizes the overall losses of poor sanitation and estimated gains of improved sanitation in Cambodia. As Figures 6 and 7 indicate, the annual economic losses from poor sanitation and hygiene are estimated at around US\$448 million, amounting to about 7.2% of the Cambodia's GDP in 2005. The per capita economic cost is around US\$32 compared to the GDP per capita of about US\$450. It should be noted that in contrast to financial losses where health-related losses are much less than water access costs, health-related costs (US\$187 million) are the main contributor at 42% of the

overall economic costs of poor sanitation and hygiene. The water costs are the next major loss in economic impacts of poor sanitation, amounting to about US\$149 million and making one third of the total costs. The economic loss of tourism due to poor sanitation and hygiene is roughly US\$74 million, which shares about 16% of the total economic costs. The economic loss due to access time to unimproved sanitation is US\$38 million, contributing 9% to the total costs.

Figure 6. Financial and economic losses due to poor sanitation, 2005

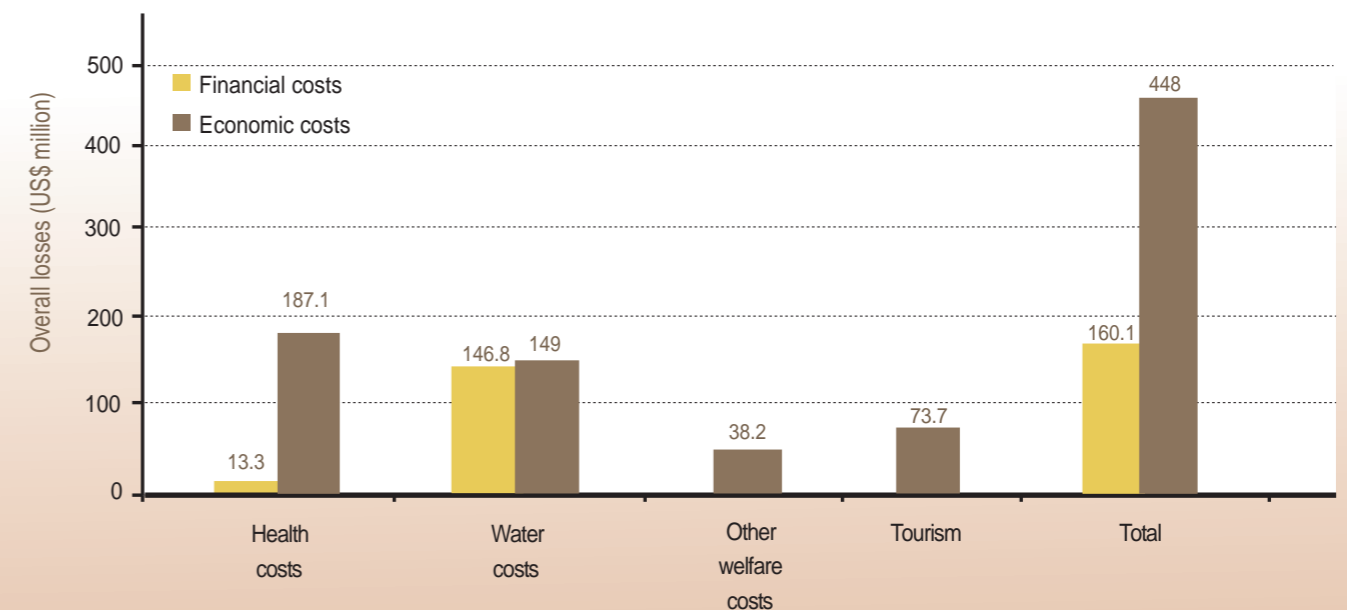
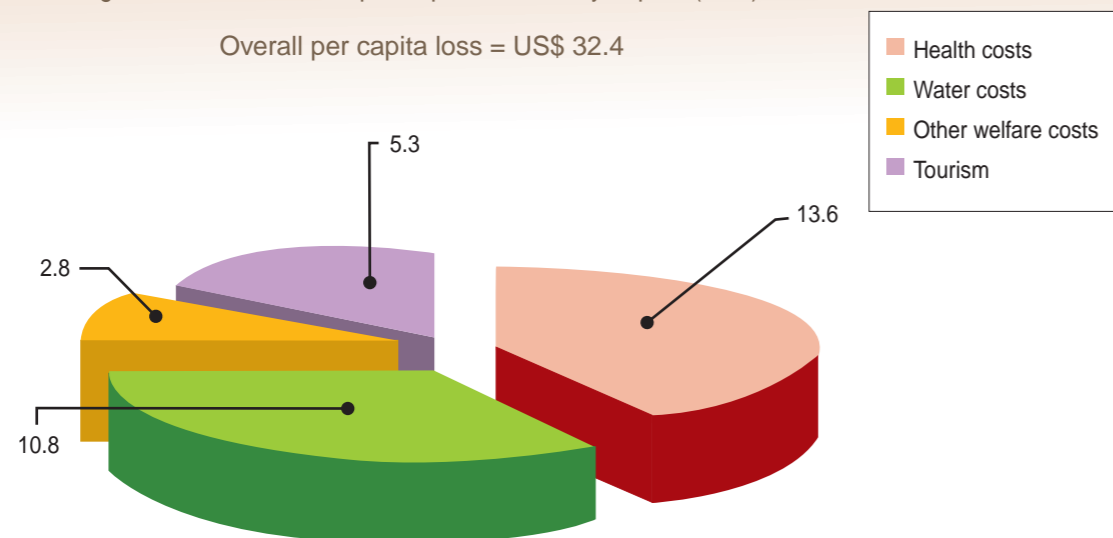


Figure 7. Economic cost per capita in 2005, by impact (US\$)



Besides looking at the economic losses due to poor sanitation and hygiene, it is also important to look into the possible economic gains from improved sanitation and hygiene. Five options are given in the Table 10 below where each option corresponds to the impact on selected benefit categories.

In general, all of the costs measured can be averted from one or more of the improvement options, except the health benefits, given that basic improved

sanitation or hygiene only reduces by a proportion of 30-50% of the overall sanitation and hygiene related diseases. In addition, the results from the sanitation market studies are presented, including potential annual market size for sanitation inputs based on market prices, and potential annual benefits of sanitation outputs based on the cash saving by using biogas.

Table 10. Predicted financial and economic gains from improved sanitation

Impact area (million US\$)	A		B		C		D		E	
	Hygiene practices		Latrine physical access		Improved toilet system		Treatment or disposal		Reuse	
	Fin.	Econ.	Fin.	Econ.	Fin.	Econ.	Fin.	Econ.	Fin.	Econ.
Health	6.0	84.2			4.3	59.9				
Water							146.8	149.0		
User preferences				38.2						
Tourism								73.7		
Sanitation markets			0.3	0.3	1.2	1.2			1.8	1.8
TOTAL	6.0	84.2	0.3	38.6	5.5	61.1	146.8	222.7	1.8	1.8

Recommendation 1.

Provide greater priority for investments in sanitation

With around four-fifths of the Cambodian population exposed to unimproved sanitation, it is clear that more investments are needed in the sector. The Government of Cambodia and other stakeholders should jointly reassess the current and planned spending levels in the sanitation and related sectors, covering health, water resources, environment, rural and urban planning and development, fisheries, and tourism. Increased political importance and budget allocations should be given to sanitation.

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.

Recommendation 2.

Target investments to rural regions as well as low-income urban areas

Priority should be given to populations with no latrine, recognizing that effective demand may be low in these groups due to low incomes and poor awareness of the benefits of investing in sanitation. As well as stimulating demand through public health and latrine advocacy messages, governments should target programs, subsidies and financing mechanisms to the most disadvantaged population groups.

The priority for rural regions arises from the finding that access to improved sanitation is lower in rural areas and a large proportion (84%) of the population is rural. 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 low-income populations in urban areas. Such areas have high population densities which are more likely to be exposed to poor sanitation, and where, in such a confined space, poorly disposed or untreated human excreta pollutes water resources and increases health risks.

Recommendation 3.

Strengthen education and information campaigns for promoting personal hygiene

The study 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 practices can be an effective and cheaper means to directly reduce the disease incidence and the impacts of poor sanitation indirectly.

Recommendation 4.

Collect further information on key variables related to sanitation

The present analysis 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. Also, the absence of well-defined and established relationships between sanitation and the evaluated impacts also constrained the quantitative analysis, in particular fish losses and tourism. This not only limited the scope of the study but also introduced uncertainty in the impacts presented.

Recommendation 5.

Evaluate the available options/technologies for improving sanitation in the country

Having estimated the economic benefits from improving sanitation, the next step is to evaluate potential measures to address the problem. This involves analyzing the options which are available to concerned agencies/institutions. Such studies should carefully weigh the costs of each option relative to the benefits.

ALRI	Acute Lower Respiratory Infection
BOD	Biological Oxygen Demand
CDHS	Cambodia Demographic and Health Survey
CIPS	Cambodia Inter-censual Population Survey
CMDG	Cambodia Millennium Development Goals
CSES	Cambodia Socio-Economic Survey
DO	Dissolved Oxygen
EAP	East Asia and the Pacific
Ecosan	Ecological Sanitation
EIC	Economic Institute of Cambodia
ESI	Economics of Sanitation Initiative
GDP	Gross Domestic Product
JMP	Joint Monitoring Program (WHO, UNICEF)
Kg	Kilograms
MAFF	Ministry of Agriculture, Forestry and Fisheries
MDG	Millennium Development Goal
MEF	Ministry of Economy and Finance
MIME	Ministry of Industry, Mines and Energy
MoEYS	Ministry of Education, Youth and Sport
MoLMUPC	Ministry of Land Management, Urban Planning & Construction
MPP	Municipality of Phnom Penh
MRC	Mekong River Commission
MRD	Ministry of Rural Development
NBP	National Biogas Program
NGO	Non-Governmental Organization
PPWM	Phnom Penh Waste Management
PPWSA	Phnom Penh Water Supply Authority
TSS	Total Suspended Solids
VIP	Ventilated Improved Pit (latrine)
WHO	World Health Organization
WSP	Water and Sanitation Program

1. WHO/UNICEF/JMP, Meeting the MDG Drinking Water and Sanitation target: the urban and rural challenge of the decade. 2006. Joint Monitoring Programme. World Health Organization, Geneva; and the United Nations Children's Fund, New York.
2. Ministry of Planning, Cambodia. National Strategic Development Plan 2006-2010. 2005.
3. Hutton, G. Evaluation of the Economic Impacts of Sanitation: Methodology and Guideline. 2007. Unpublished document. World Bank, Water and Sanitation Program. 103 pages.
4. Roberts, M. and A. Long, Demand Assessment for Sanitary Latrines in Rural and Urban Areas of Cambodia. 2007. World Bank Water and Sanitation Program. 28 pages.
5. Neou, S., et al., Cambodia Economic Watch. Vol. 6. April 2007. Phnom Penh: Economic Institute of Cambodia.
6. Bellavance, F., G. Dionne, and M. Lebeau. The value of a statistical life: a meta-analysis with a mixed effects regression model. 2007. Canada Research Chair in Risk Management; Working Paper 06-12.
7. Department of Fisheries. Cambodia post-harvest fisheries overview. 2005. Ministry of Agriculture Forestry and Fisheries: Phnom Penh.
8. Doyle, B. Increasing education and other opportunities for girls and women with water, sanitation and hygiene. 1995. UNICEF, New York.
9. World Travel and Tourist Association and Accenture, Travel and tourism traveling to new heights. Executive summary. 2006. <http://www.wttc.org/2006TSA/pdf/World.pdf>.
10. Ministry of Tourism. Tourism statistical report: First semester 2007. Statistics and Tourism Information Department, Ministry of Tourism: Phnom Penh.
11. Ministry of Agriculture, Forestry and Fisheries, and SNV Netherlands Development Organisation. National Biogas Programme Cambodia: Information Folder. November 2006. National Biogas Programme Cambodia.
12. Chandarot, K. and L. Dannel. Biogas User Survey Report. May 2007. National Biogas Programme.

