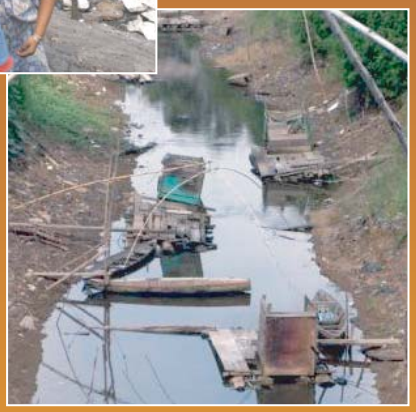
Research Report August 2008

Economic Impacts of Sanitation in Indonesia

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



30 years wsp water and sanitation program

Water and Sanitation Program
East Asia and the Pacific (WSP-EAP)
World Bank Office Jakarta
Indonesia Stock Exchange Building Tower II/13th Fl.
Jl. Jend. Sudirman Kav. 52-53
Jakarta 12190 Indonesia
Tel: (62-21) 5299-3003
Fax: (62-21) 5299-3004

Printed in 2008.

Economic Impacts of Sanitation in Indonesia

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

30 years wsp water and sanitation program


AMBIL AIR
SENDIRI
ABMI.
AMBIL-AIR
SENDIRI

Executive Summary

At 55% in 2004, sanitation coverage in Indonesia is below the regional average for Southeast Asian countries of 67%. Nationwide, sanitation coverage has increased by 9 percentage points since 1990, representing significant progress towards the target of 73% set by the Millennium Development Goal joint water supply and sanitation target. However, at current trends Indonesia will fall short of the MDG sanitation target by 10 percentage points, equivalent to 25 million people. The Government of Indonesia recognizes that in terms of providing adequate water supply and sanitation facilities, it is facing a "…losing battle in keeping up with the population increase".

This study shows that the high number of people living with unimproved household sanitation is imposing large financial and economic costs to the Indonesian economy, not only to private individuals but also to the public and commercial sectors. The results of this study support the need for greater investment in water and sanitation infrastructure and in promoting improved hygiene practices. The results will be of interest to national policy makers, local authorities, civil advocacy groups, universities and donor agencies.

Unimproved sanitation and hygiene have a wide array of impacts, which can be categorized into impacts on: health, water-related activities, the external environment, life choices, population preferences, and tourism. For Indonesia, impacts are evaluated for all these categories since they are all important at the national level. The study is based on information from national and provincial data and surveys, smaller scale research studies, and consultations with experts.

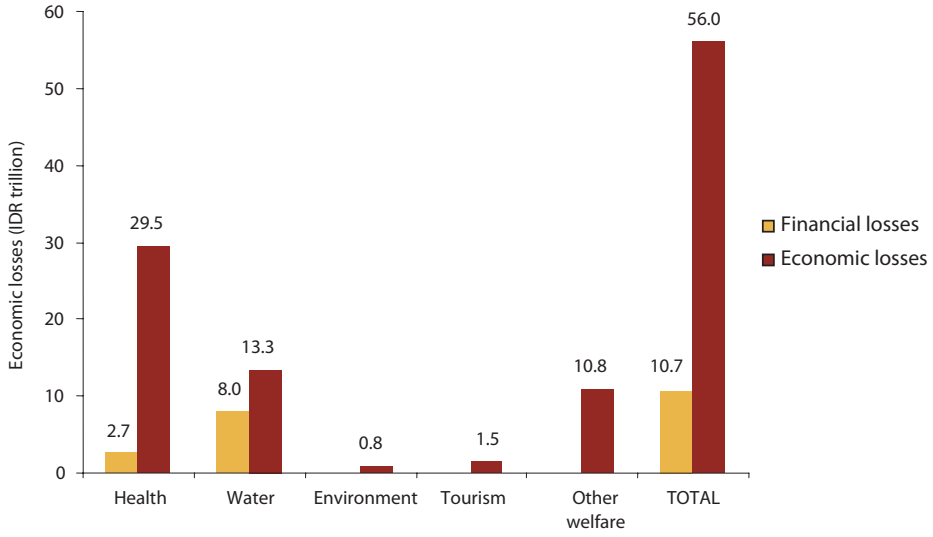
In 2006, Indonesia lost an estimated IDR 56 trillion (USD 6.3 billion) due to poor sanitation and hygiene, equivalent to approximately 2.3% of gross domestic product (GDP). Figure A shows overall economic losses by impact type.

At IDR 275,000 (USD 31.10) annually in urban areas, per capita costs of poor sanitation and hygiene were estimated to be higher than in rural areas at IDR 224,000 (USD 25.40); however, significantly more people still do not have access to improved sanitation in rural areas.

Of the impacts evaluated, health and water resources contribute most to the overall economic losses estimated in the study. These impacts are expected to cause financial losses to populations, as shown in Figure A, who have to pay for health services or who pay more to access clean water supplies, or who may lose income due to poor health.

Poor sanitation, including hygiene, causes at least 120 million disease episodes and 50,000 premature deaths annually. The resulting economic impact is more than IDR 29 trillion (USD 3.3 billion) per year. Poor sanitation also contributes significantly to water pollution—adding to the cost of safe water for households, and reducing the production of fish in rivers and lakes. The associated economic costs of polluted water attributed to poor sanitation exceed IDR 13 trillion (USD 1.5 billion) per year. Poor sanitation also contributes up to IDR 11 trillion (USD 1.2 billion) per year in population welfare losses (due to additional time required to access unimproved sanitation), IDR 1.5 trillion (USD 166 million) per year in tourism losses, and IDR 0.9 trillion (USD 96 million) in environmental losses due to loss of productive land. A number of intangible effects, relating to the population's preferences for a safe, convenient and private place to defecate, were not quantified in this study but are known to influence population behavior and overall welfare.

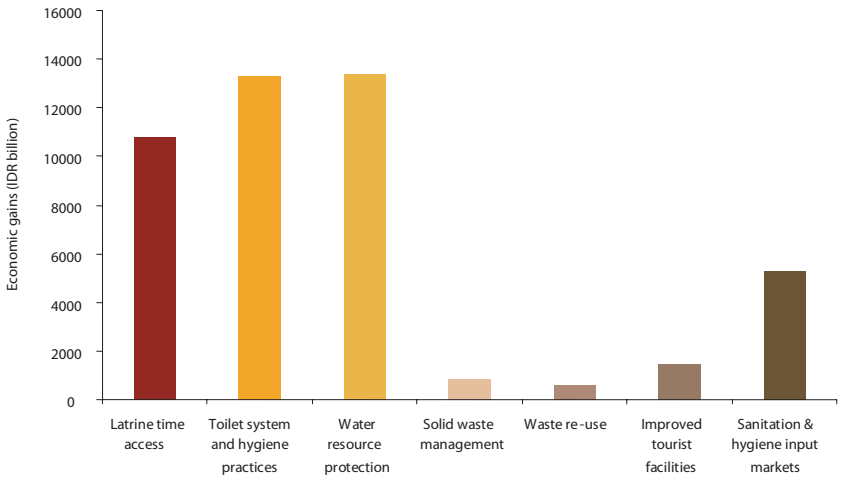
Figure A. Economic and financial impacts of poor sanitation (IDR trillion)



With the universal implementation of improved sanitation and hygiene, it is assumed that all the attributed impacts shown in Figure A would be mitigated, except for health impacts, for which up to 45% of the estimated losses would be mitigated.

Figure B shows the gains according to different components of sanitation improvement. The overall economic saving would be IDR 40 trillion (USD 4.5 billion) annually. In addition, the implementation of ecological sanitation approaches (biogas and fertilizer) in 900,000 households would be worth an estimated IDR 0.6 trillion (USD 67 million) annually; and input markets generated from improved sanitation and hygiene—corresponding to 2.3 million households reached per year to attain the sanitation MDG target—could be worth an estimated IDR 5.3 trillion (USD 600 million) per year, generating jobs and revenue for the private sector.

Figure B. Economic gains resulting from improvement in sanitation (IDR billion)



This is the first study in Indonesia to compile economic evidence on a range of impacts of poor sanitation and hygiene. The results indicate that poor sanitation and hygiene have significant financial and economic costs, with major implications for the socio-economic development of Indonesia and the attainment of short-, medium- and long-term development goals. The study highlights the links between improved sanitation and several other MDG targets, including poverty, hunger reduction, gender equality, child health, access to safe drinking water, and the quality of life of slum-dwellers.

The study demonstrates that poor sanitation affects everyone, but especially the poor and vulnerable, including children, women, the disabled and senior citizens. Hence, sanitation should receive greater attention from all levels of Indonesian government, and from development partners, the private sector and households. Decision makers should act now, and in a concerted way, to stimulate demand for improved sanitation and hygiene practices, at the same time increasing the opportunities for households to satisfy their demand.

Foreword

Indonesia, like other countries of Southeast Asia, is on a development path that is lifting large numbers of people out of poverty, and the economy is now growing at over 5% per annum. As well as economic growth, populations demand improved quality of life through improved health, housing, access to welfare services, and living environments. However, in a world of multiple government and donor priorities, some aspects of development remain neglected.

Sanitation is one such neglected aspect of development. Among the many priorities of households as well as 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.

If governments and households are to be convinced that expenditure on improving sanitation is worthwhile, stronger evidence is needed to better understand the various impacts of poor sanitation: on health, the environment, population welfare, and, ultimately, on economic indicators.

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 socio-economic aspects of sanitation. The ultimate aim of the ESI is to assist decision makers at various levels to make informed choices on sanitation policies and resource allocations.

The first major activity of the Economics of Sanitation Initiative was to conduct a 'sanitation impact' study, to examine the economic and social impacts of unimproved sanitation on the populations and economies of Southeast Asia, as well as the potential economic benefits of improving sanitation. Once these questions are answered, national stakeholders can continue the discussions about policy making and priority setting armed with a better evidence base for decision making. 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' in the broadest sense, which includes the active contribution of many people and institutions (see Acknowledgments).

Abbreviations

ALRI	Acute lower respiratory tract infection
BEST	Bina Ekonomi Sosial Terpadu, an NGO in Indonesia
BPS	Indonesian Bureau of Statistics
BOD	biochemical oxygen demand
DHS	Demographic and Health Survey
DO	dissolved oxygen
EAP	East Asia and the Pacific
EcoSan	ecological sanitation
ESI	Economics of Sanitation Initiative
GDP	gross domestic product
HRQL	Health-Related Quality of Life
ID	international dollar
JMP	Joint Monitoring Programme (WHO, UNICEF)
MDG	Millennium Development Goal
MOH	Ministry of Health
N	nitrogen
NAD	Nanggroe Aceh Darussalam Province
NGO	non-governmental organization
OECD	Organization of Economic Cooperation and Development
P	phosphorous
IDR	Indonesian rupiah
Susenas	National Socioeconomic Survey
TSS	total suspended solids
USD	United States dollar
VIP	ventilated improved pit latrine
VOSL	value of a statistical life
WHO	World Health Organization
WSP	Water and Sanitation Program

Acknowledgments

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 one year to complete and has undergone two major peer review processes.

Guy Hutton (WSP-EAP 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 teams. The study benefited from the continuous support of other WSP-EAP staff. Isabel Blackett was the task team leader until December 2007, and 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 Indonesia consisted of Lydia Napitupulu (WSP consultant, country lead), and Dedek Gunawan (WSP consultant). Guy Hutton led report drafting and finalization.

The ESI Indonesia study has been financed by the regional component of the Sustainable Sanitation for East Asia (SUSEA) Program, funded by the Swedish International Development Agency (SIDA). ESI has also received funding from the UK Department for International Development, the Danish International Development Agency, and the Dutch Ministry of Foreign Affairs. WSP and the report authors are grateful to the funding agencies for their support.

A large number of peer reviewers contributed their valuable time and ideas to the regional ESI study. Elena Strukova, Caroline van den Berg, Anjali Archarya, and Tracey Hart reviewed the methodology study before its implementation. The Indonesia study was reviewed by Foort Bustraan and Nona Pooroe Utomo (USAID / Environmental Services Program), and also benefited from peer reviews of 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 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).

Reference for citation:
Economic impacts of sanitation in Indonesia. Napitupulu L and 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 **Cambodia**. Kov P, Sok H, Roth S, Chhoeun K, 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, Hutton G. World Bank, Water and Sanitation Program. 2008.

Table of Contents

Tables

Figures

Basic country data – Indonesia, 2006

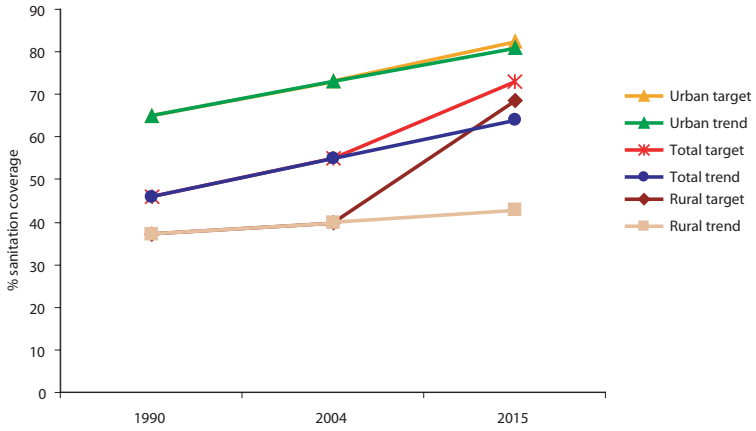
Variable	Value
Population	
Total population (million)	221.8
Rural population (%)	57.5
Urban population (%)	42.5
Annual population growth (%)	1.26
Under 5 population (% of total)	8.7
Under 5 mortality rate (deaths per 1,000)	38
Female population (% of total)	50.3
Population below poverty line (million)	39.5
Economic	
Currency name	Rupiah (IDR)
Year of cost data presented	2006
Currency exchange with USD	8,828
GDP per capita (USD)	1,420
GDP per capita (International $, adjusted for purchasing power)	3,950
Sanitation (2004)	
Improved rural (%)	40
Improved urban (%)	73
Urban sewage connection treated (%)	2

1 Introduction

Sanitation is a global concern. One of the targets of the United Nations Millennium Development Goals (MDG) is to halve – between 1990 and 2015 – the proportion of people without access to improved sanitation. Compared with other countries in Southeast Asia, in 2004 Indonesia was below average in establishing sanitation access, at 55% compared with an average of 67% for all countries in Southeast Asia[1].

Forty-five percent (45%) of the Indonesian population without improved sanitation corresponds to **one hundred million Indonesians without improved sanitation**, that is, without an easily accessible, private and safe place to urinate and defecate. According to the UNICEF/WHO Joint Monitoring Programme, progress over the 14-year period between 1990 and 2004 has been slow in Indonesia, especially in rural areas where coverage increased 3 percentage points from 37% to 40% in a 14-year period, compared with an 8 percentage point increase in urban areas. While the 9 percentage point increase in 15 years is an impressive feat in a country of Indonesia's population size and geographical spread, progress is slower than in other countries in the region of similar economic development, such as Vietnam, which recorded a 25 percentage point increase, Thailand (19 percentage point increase) and the Philippines (15 percentage point increase). Figure 1 compares trends with national target figures for rural (lower lines), urban (upper lines) and total sanitation coverage, up to 2015.

Figure 1. Sanitation coverage in Indonesia (%)



Source: http://www.wssinfo.org/

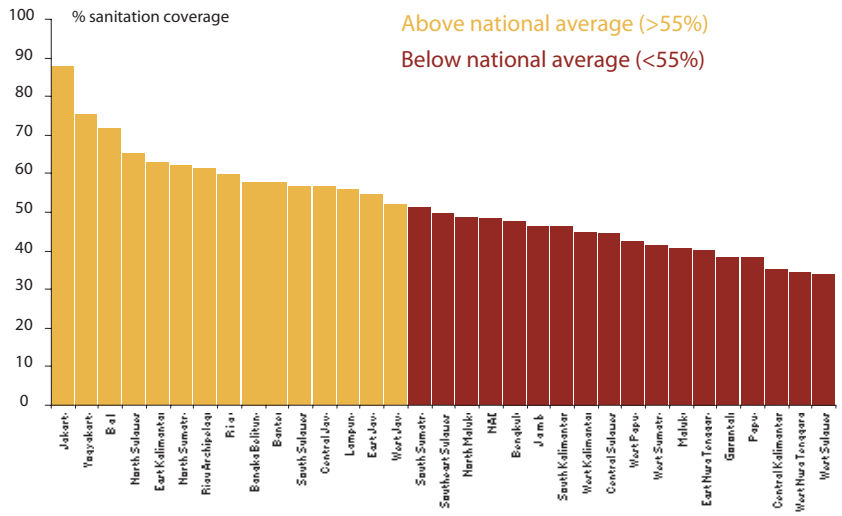
Efforts to increase sanitation coverage must also compete with population growth in Indonesia, which stands at an estimated 1.3% per annum. At this rate, an additional 2.8 million Indonesians will require improved sanitation facilities every year from now until 2015, thus adding to the 100 million people currently without improved sanitation. **Forecasts at current rate of progress suggest that Indonesia will fall short of the MDG target of 73% by 10 percentage points, equivalent to 25 million people**[2]. The Government of Indonesia (GOI) recognizes that in terms of providing adequate water supply and sanitation facilities, it is facing a "…losing battle in keeping up with the population increase"[3]. Furthermore, significant rural-urban and inter-provincial disparities exist, which sanitation improvement efforts must address. Figure 2 shows regional variations in coverage, ranging from 34% in West Sulawesi to 88% in Jakarta (see Annex Table C1 for population figures and Annex Table C2 for coverage ratios by province and rural/urban breakdown).

1 According to the UNICEF/WHO Joint Monitoring Programme, national coverage stood at 55% in 2004. Not all national surveys in Indonesia give the same figures for improved sanitation coverage. Annex Table A1 shows the sanitation coverage from four national surveys conducted between 2002 and 2006.

2 Universal Sanitation in East Asia. Mission Impossible? Water and Sanitation Program, United Nations Children's Fund, World Health Organization. 2007.

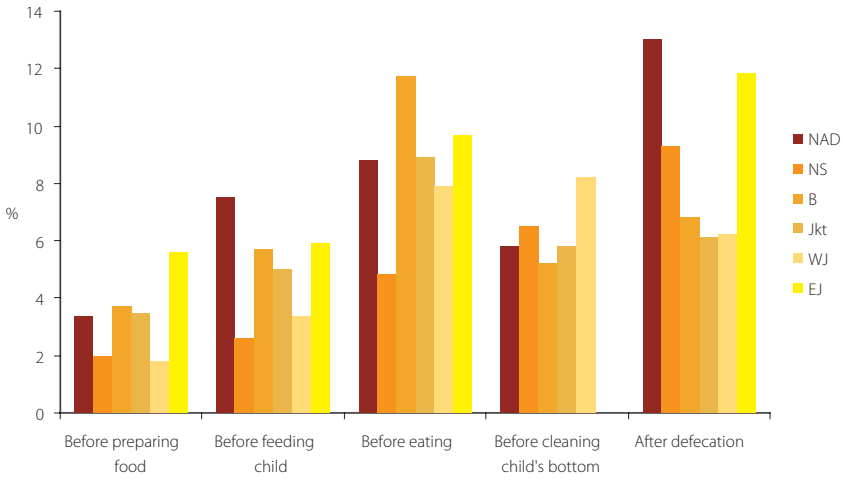
3 *National Policy: development of community-based water supply and environmental sanitation*. Bappenas, Kimpraswil, Ministry of Health, Ministry of Home Affairs, Ministry of Finance. 2003.

Figure 2. Improved sanitation coverage by province, year 2004



Hygiene practices in Indonesia are another concern. A survey conducted in six provinces in 2005 found that less than 15% of mothers cite washing hands with soap before or after five critical activities (see Figure 3). Given that poor hygiene is a major risk factor for a range of infectious diseases that have a particularly large impact on children, the low rates of improved hygiene practices are a major cause for concern.

Figure 3. Percentage of mothers citing they wash their hands with soap before or after five critical activities, by province



Key: NAD: Nanggroe Aceh Darussalam; NS: North Sumatra; B: Banten; Jkt: Jakarta; WJ: West Java; EJ: East Java. Source: USAID BHS Baseline Survey[4]

4 University of Indonesia Center for Health Research. ***Survei rumah tangga pelayanan kesehatan dasar di 30 kabupaten di 6 provinsi di Indonesia 2005.*** Final report to USAID - Indonesia Health Services Program: Jakarta. 2006.

That **sanitation is low on the list of political priorities is reflected in the low level of investment in this sub-sector in Indonesia, which is estimated at IDR 200 per household, or roughly 0.5% of the investment needed to meet the MDG target.** As well as lack of top-down investment in the sector, opportunities for attracting private sector engagement in the financing and provision of sanitation services have not been adequately exploited, especially the potential for contribution by small-scale entrepreneurs. To date, most sanitation investment has been by household self-provision. Furthermore, starting in 1990, and notably with the onset of decentralization in 1999, the mandate for provision of water and sanitation services was passed to local governments, where technical capacity to provide water and sanitation services has been inadequate.

Hence a number of pre-conditions and actions are needed to raise the profile of sanitation in government as well as in household spending. One major constraint to further investment in sanitation is a lack of knowledge of the effects of inaction, and conversely, the role improved water supply and sanitation services plays in the development process. Therefore, evidence is needed to support advocacy for increased investment in sanitation; evidence that does not focus exclusively on a single impact such as health impact, but on the full range of impacts that also include water and environmental quality, population preferences, and the various knock-on economic impacts of poor sanitation. Indeed, economic evidence can be a powerful advocacy tool, at the higher level, in motivating a range of players who influence key government decisions and sectoral resource allocations; and at the lower level, in motivating households to make the decision to invest their limited funds in an improved latrine or toilet.

Therefore, **the aim of this study is to provide decision makers in Indonesia with better evidence on the negative economic impacts of poor sanitation and hygiene**, to provide sanitation stakeholders with a better basis for arguing for increased investment and for more rational policy making in the sub-sector. The study also seeks to generate tentative estimates of the impacts that can be mitigated by investing in improved sanitation and hygiene.

2 Methods

2.1 Study approach

This study in Indonesia employs a standardized peer-reviewed methodology[5], which was also implemented in four other countries: Cambodia, Lao PDR, the Philippines and Vietnam. **The primary aim of the study is to provide national estimates of the economic impact of poor sanitation and hygiene.** Results for selected impacts are also presented by provincial level, rural/urban breakdown and specific population sub-groups such as women and children.

The study uses a modeling approach and draws almost exclusively on routine data sources such as national surveys as well as published studies. It presents the impacts in physical units and converts these into monetary equivalents using conventional economic valuation techniques. Results on economic impact are presented for a single year – 2006 – in Indonesian rupiah (IDR) and United States Dollars (USD). For those impacts where quantification in economic terms is not feasible, impacts are examined and reported descriptively. A complete listing of the equations used in calculating costs is provided in Annex A. Annex B shows the data inputs and results at national level, while Annex C shows the data inputs and results at provincial level.

2.2 Scope of sanitation

The term 'sanitation' is used to describe many different aspects of hygiene and the disposal or recycling of waste. In the international arena, the sanitation indicator adopted as part of the Millennium Development Goals (target number 10 on water supply and sanitation) focuses on the availability of a private latrine and the safe disposal of human excreta. Despite the focus of the MDG target on human excreta, the importance of other aspects of sanitation is recognized. The management of human excreta, animal excreta, solid waste, agricultural waste, toxic waste, wastewater, food, and associated hygiene practices are all included in a broader definition of sanitation. However, not all of these could be assessed in the present study. Table 1 provides an overview of which aspects of sanitation were included, with the main focus being on the human excreta aspect.

Table 1. Aspects of sanitation included in the present sanitation impact study

Included	Excluded

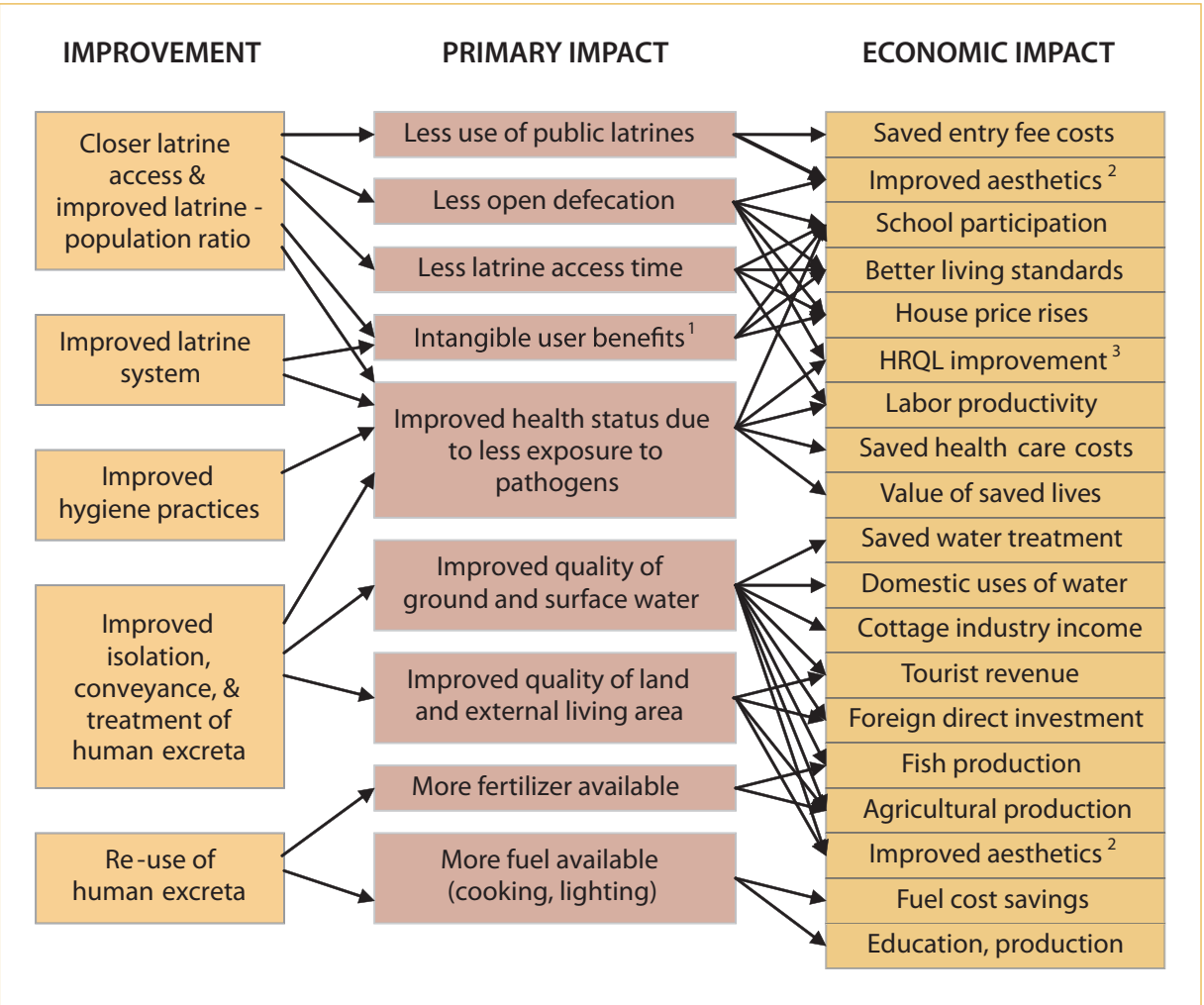
• Practices related to human excreta
  • Quality, safety, and proximity of latrine system
  • Disposal or treatment of waste and impact on the (inhabited) outdoor environment
  • Hygiene practices (hand washing with soap)
• Practices related to disposal or treatment of gray water
• Practices related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

2.3 Impacts evaluated

Poor sanitation has many actual and potential negative effects. Conversely, improved sanitation has a large number of potential economic impacts, as shown in Figure 4. The impacts of poor (and improved) sanitation are related to five main features: (1) latrine location, (2) latrine system, (3) hygiene practice related to human excreta management, (4) excreta isolation, conveyance and treatment or disposal, and (5) excreta re-use (recycling).

5 The full methodology is described in the synthesis report "Economic impacts of sanitation in Southeast Asia". Water and Sanitation Program. 2008.

Figure 4. Primary impacts and resulting economic impacts associated with improved sanitation options ("disposal of human excreta")



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

Based on this initial assessment of a long list of sanitation impacts, a shortened list was selected for evaluation in this present study. These are

- Health impacts
- Water resource impacts
- External environment impacts
- Other welfare impacts
- Tourism impacts
- Excreta re-use

Table 2 shows the financial and economic costs quantified in this study. Note that some impacts such as fish and tourism losses have multiple causes, and hence a fraction of overall losses are attributed to poor sanitation. Economic losses include additional expenditures, income, productivity or time losses, and the value of premature death associated with poor sanitation. Financial costs are distinguished from the broader economic costs, focusing on direct out-of-pocket expenses or income losses. Non-pecuniary welfare impacts were assessed but not quantified in monetary units; these along with other non-quantified impacts are listed in Annex Table A3.

Table 2. Financial and economic costs of poor sanitation measured in the study

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

2.4 Impact mitigation

From a policy viewpoint, it is important to know how much of the estimated losses resulting from poor sanitation can be averted by implementing improved sanitation options. This study estimates the potential benefits of the five *features* of sanitation improvements shown in Figure 4, plus improved sanitation for tourists, as shown in Table 3. Therefore the study provides an initial estimate of the likely gains from improving these features. These estimates are by nature fairly crude and generalized, and will be supplemented by more precise estimates of the full costs and benefits of sanitation improvements from field settings in Indonesia, available from a forthcoming study.

Table 3. Features of sanitation interventions for assessing economic gains

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

3 Results

3.1 Summary of economic impacts of poor sanitation

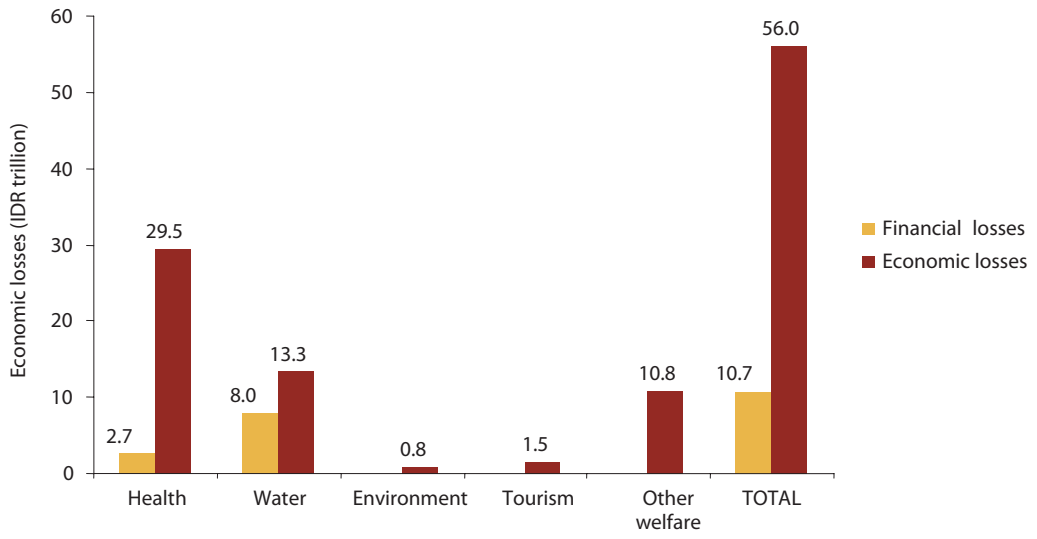
The overall economic losses from poor sanitation and hygiene amount to IDR 56 trillion (USD 6.3 billion) per year (see Table 4). This sum is equivalent to 2.3 % of GDP in 2005, amounting to approximately IDR 252,000 (USD 28.60) per person per year. To give an indication of the relative impact on the Indonesian economy, where the average price level is 36 percent of that of the United States (when prices are compared at market exchange rates), the impact in international dollars is ID 17.8 billion.

Table 4. Financial and economic losses due to poor sanitation, by impact type

Impact	Financial losses			Economic losses		
	Value (IDR billion)	Per capita (IDR thousand)	%	Value (IDR billion)	Per capita (IDR thousand)	%
Health costs	**2,719**	**12.4**	**25.3**	**29,512**	**133.3**	**52.7**
Health care costs	1,236	5.3	11.5	1,642	7.1	2.9
Productivity costs	1,033	4.4	9.6	3,090	14.1	5.5
Premature death costs	441	1.8	4.1	24,780	112.1	44.3
Water costs	**8,016**	**36.2**	**74.7**	**13,348**	**60.0**	**23.9**
Drinking water	7,089	31.8	66.0	11,379	51.2	20.3
Domestic water uses	936	4.4	8.7	1,156	5.3	2.1
Fish production	-	-	-	812	3.5	1.5
Environment	**-**	**-**	**-**	**847**	**3.5**	**1.5**
Land use	-	-	-	847	3.5	1.5
Tourism	**-**	**-**	**-**	**1,465**	**7.1**	**2.6**
Tourist loss	-	-	-	1,465	7.1	2.6
Other welfare	**-**	**-**	**-**	**10,770**	**48.6**	**19.3**
Time use	-	-	-	10,770	48.6	19.3
TOTAL	10,735	48.6	**100.0**	55,952	252.5	**100.0**

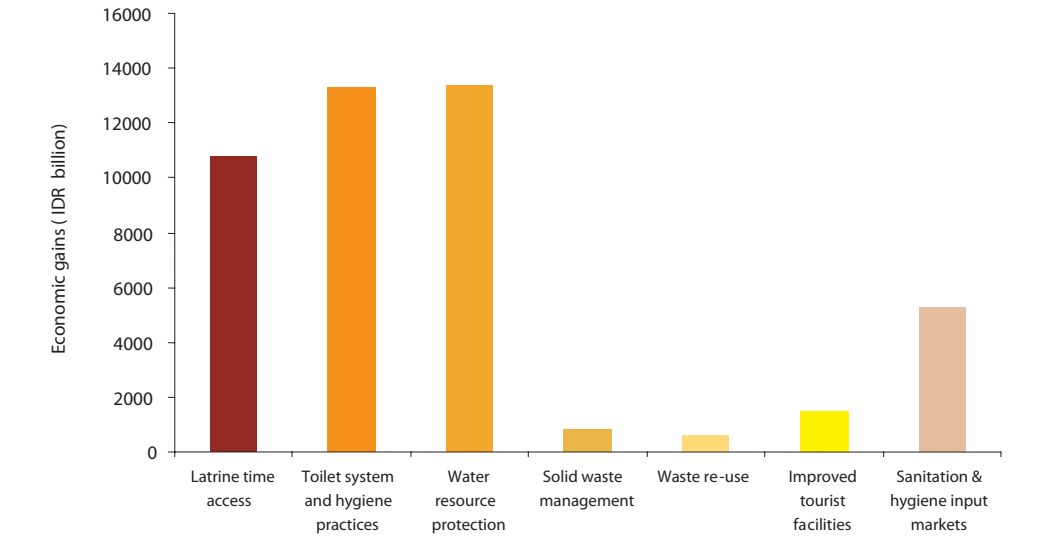
Out of the IDR 56 trillion annual economic losses, health impacts account for 53% (IDR 29.5 trillion) and water impacts 24% (IDR 13.3 trillion). The remaining 23% of economic cost is attributed to access time, tourism and loss of land use (see Figure 5). These figures exclude a whole range of other impacts which were not quantified in this study (see Annex Table B2). At IDR 275,000 (USD 31.10) annually in urban areas, per capita costs of poor sanitation and hygiene were estimated to be higher than in rural areas at IDR 224,000 (USD 25.40); however, significantly more people still do not have access to improved sanitation in rural areas. Financial costs – reflecting estimates of actual expenditures or income losses due to poor sanitation and hygiene – amount to IDR 10.6 trillion (USD 1.2 billion) annually, or 19% of economic losses – made up of water and health impacts.

Figure 5. Financial and economic losses due to poor sanitation, by impact type (IDR trillion)



By improving sanitation and hygiene, the majority of negative impacts can be averted (see Figure 6). Closer latrines reduce time losses valued at IDR 10.6 trillion (USD 1.2 billion), while improved toilet systems and hygiene practices bring health benefits worth at least IDR 13.2 trillion (USD 1.5 billion). Water resource protection measures due to improved management of human excreta also lead to potential savings of IDR 13.2 trillion (USD 1.5 billion), mainly by reducing the costs associated with access to safe drinking water. Investment in improved sanitation and the re-use of human excreta can lead to sanitation markets of at least IDR 5.3 trillion (USD 600 million) per annum. Improved sanitation for tourist locations can lead to annual economic gains of at least IDR 1.5 trillion (USD 166 million).

Figure 6. Economic gains from universal coverage of improved sanitation and hygiene, by impact type (IDR billion)



In conclusion, protecting water resources, averting health impacts and reducing access time are the three major potential benefits of a sanitation program, as quantified in this study. Positive impacts on tourism, employment from sanitation programs, and waste re-use are also potentially important benefits from sanitation programs. Non-quantified intangible benefits such as comfort, privacy and security, especially for women and the elderly, are also likely to bring major welfare improvements for populations receiving improved sanitation. However, further field studies collecting primary information are needed to actually show these benefits in an Indonesian context.

3.2 Health impacts

3.2.1 Burden of disease

The financial and economic health costs assessed in this study include (1) spending on health care, (2) loss of income or production associated with disease, and (3) the value associated with premature loss of life.

Poor sanitation and hygiene cause significant burden of disease in Indonesia through illness and premature death. Given the large number of diseases and health effects due to poor sanitation and hygiene (see Annex Table B3), this study selected key health impacts based on their epidemiological and economic importance, and on the availability of data from national statistics and research studies. Table 5 shows the estimated number of episodes and deaths attributed to poor sanitation for the selected diseases: diarrheal diseases, helminthes, scabies, trachoma, hepatitis A, hepatitis E, malnutrition and diseases related to malnutrition. Eighty-nine million cases of diarrhea were attributed to poor sanitation and hygiene, estimated using data from the national DHS, which collected diarrheal incidence rates for the under five population (2.5 cases per child per year). Twenty-eight million cases of scabies are estimated to be attributed to poor hygiene practices. In addition, from the national health information system, three million malnourished children, one million cases of helminthes, and a further one million disease cases related to malnutrition, are attributed to poor sanitation and hygiene. However, these figures – especially those from routine government sources – are likely to be heavily underestimated, due to the majority of disease cases not seeking health care from a public service provider in Indonesia. Other studies suggest significantly higher rates of disease than those reported by government systems. For example, in East Asia helminthes are cited to have prevalence rates of 36% (roundworm), 28% (whipworm) and 26% (hookworm)[6], which would lead to significantly more than one million cases. Three million malnourished children may also be a significant underestimate, in a country where it is estimated that 28% of children under five – or 5.4 million – are severely or moderately underweight.

The total number of deaths attributed to poor sanitation and hygiene exceeds fifty thousand, of which 24,000 are accounted for by direct diseases (mainly diarrhea) and 26,000 by indirect diseases related to malnutrition. These latter deaths include only children under five and therefore underestimate the total deaths in all age groups.

6 Hotez P, Bundy D, Beegle K, et al. Helminth Infections: Soil-Transmitted Helminth Infections and Schistosomiasis. Chapter 24 in ***Disease Control Priorities in Developing Countries***. 2006. Jamison D, Breman J, Measham A, Alleyne G, Claeson M, Evans D, Jha P, Mills A and Musgrove P, Editors: 2nd Edition. New York: Oxford University Press.

Table 5. Estimated number of annual cases and deaths attributed to poor sanitation, 2006

Disease	Morbidity (cases)	Mortality (deaths)
Direct diseases		
Diarrheal disease	89,417,461	22,880
Helminthes	1,054,048	56
Scabies	28,659,082	583
Trachoma	174,079	0
Hepatitis A	715,330	702
Hepatitis E	23,770	21
Sub-total	*120,043,770*	*24,242*
Indirect diseases related to malnutrition among children under five years		
Malnutrition	3,073,220	-[1]
ALRI	1,066,935	8,049
Malaria	87,818	1,887
Measles	0	3,528
Other[2]	-[1]	11,282
Protein energy malnutrition[2]	-[1]	1,144
Sub-total	*4,227,973*	*25890*
Total	**124,271,743**	**50,132**

[1] Not available
[2] Not included in economic losses in this study. These consist, among others, of TB, other childhood cluster diseases, meningitis, hepatitis, dengue fever, and residual deaths (not assigned to other causes).

3.2.2 Health care costs

To estimate health care costs, the study compiled information on disease rates, treatment-seeking rates, treatment practices, and unit costs. Disease incidence and treatment seeking rates were estimated for each province (see Annex Tables C3 and C4). According to the national socio-economic survey (Susenas), two-thirds of Indonesians self treat or take no treatment when sick, while the majority of those who seek care do so at a formal caregiver (Annex Table B4). To estimate the costs of treatment seeking, standard health care unit costs were applied country-wide, based on the available costing studies conducted in Indonesia (Annex Table B5). Table 6 shows the marginal and full costs of treatment as well as the patient transport costs used in the study. For example, a diarrhea case seeking outpatient care at a government or private formal facility would have a marginal cost of IDR 34,429, and including fixed costs, the figure would amount to IDR 48,554. In addition, transport costs would cost an average IDR 3,973 per patient.

Table 6. Unit health care costs used in the study (IDR, 2006)

Provider and disease	Marginal cost per patient	Full unit cost per patient	Non-medical cost (transport)
Formal outpatient care	34,429	48,554	3,973
Formal inpatient care (per day)	50,320	71,507	8,033
Informal outpatient care	16,773	24,277	3,973
Malnutrition care (per case)	164,201	229,528	3,973
Self treatment[1]	4,855 - 15,008	4,855 - 15,008	0

Source: Annex Table B5. [1] Range reflects costs of treatment for different diseases.

The total health care costs amount to IDR 1.6 trillion (USD 186 million), of which IDR 1.2 trillion (USD 140 million) is direct marginal expenditure made by patients or the health facilities on medical care or transport. Diseases with the greatest financial and economic impact are skin diseases (due to high treatment seeking), malnutrition (due to higher unit costs) and diarrheal disease (due to high numbers). Public clinics account for 49% of economic cost, or IDR 803 billion (USD 91 million), followed by private clinics at 36%, self-treatment at 10% and transport costs at 5%. Hence a significant proportion of the economic costs would be saved to patients and to government budgets if sanitation and hygiene-related diseases were prevented.

Table 7. Total health care costs by disease (IDR billion)

Disease	Financial costs	Economic costs					% costs
		Public clinics	Private clinics	Transport	Self-treatment	Total	
Diarrheal diseases	387.5	195.1	218.1	50.3	43.3	506.7	31%
Helminthes	30.0	16.8	19.4	1.8	2.6	39.7	2%
Skin diseases	534.1	289.6	324.9	23.0	72.4	708.9	43%
Trachoma	6.2	3.5	4.4	0.0	0.9	8.8	1%
Hepatitis A	15.9	8.8	9.7	0.9	2.6	21.2	1%
Hepatitis E	0.9	0.0	0.0	0.0	0.0	0.9	0%
Malnutrition, indirect	25.6	13.2	15.0	2.6	3.5	33.5	2%
Malnutrition, direct	240.1	277.2	0.0	0.0	45.9	323.1	20%
Total	1,239.5	803.3	590.6	78.6	170.4	1,643.8	**100%**

3.2.3 Health-related productivity costs

Disease takes people away from their occupations and daily activities, and regular sickness-related absence from school affects the ability of children to keep up with the curriculum and complete their education. Hence the time lost from these activities has a value. Financial costs were estimated as immediate income losses for adults not paid their wage or earning an income from time lost due to sickness[7]. Economic costs were estimated as the time lost from daily activities, valued for adults at 30% of the average compensation to employees of IDR 12,183 (USD 1.38) per hour, giving IDR 3,655 (USD 0.41) as the national average value of lost time (see Annex Table C5 for provincial values[8], as well as other sources of time value including GDP per capita, minimum wage and average wage). Child time was valued at half that of adult time at IDR 1,827 (USD 0.21) – to account for the time taken off school or other productive activities. Time off daily activities varied from two to ten days depending on the severity of the disease, and whether treated or not.

Table 8 shows total productivity losses of roughly IDR 3 trillion (USD 350 million) per annum, two-thirds of which is accounted for by adults. Eighty-four percent of economic costs are accounted for by diarrheal diseases, and 65% represent losses to the adult population. Financial costs associated with income loss for adults are in the order of IDR 1 trillion (USD 117 million) per annum.

7 In 2005, 61% of all adults aged over 15 were in some kind of employment: salaried position (27%), self employed without employees (18%), self employed with employees (25%), casual workers (10%), and unpaid workers (20%).

8 Compensation of employees per capita was calculated at provincial level by multiplying national compensation of employees by the ratio of GDP per capita at the provincial to national GDP per capita, and dividing by the total full-time equivalent workforce.

Table 8. Total productivity costs (IDR billion)

Disease	Financial costs	Economic costs, by age group			
		0-4	5-14	15+	Total
Diarrheal diseases	823.7	704.5	286.0	1,606.7	2,597.2
Helminthes	7.1	0.9	0.9	14.1	15.9
Skin diseases	192.5	15.0	33.5	374.3	422.9
Trachoma	1.8	0.0	0.0	4.4	4.4
Hepatitis A	9.7	0.9	1.8	18.5	21.2
Hepatitis E	0.0	0.0	0.0	0.9	0.9
Malnutrition, indirect	0.0	30.0	0.0	0.0	30.0
Total	**1,035.5**	**752.1**	**322.2**	**2,019.0**	**3,093.3**

3.2.4 Costs of premature death

Premature death affects society in a number of ways. The most tangible economic impact is the loss of a member of the workforce, which has implications for economic outputs and wages generated now and in the future. One method used in cost-benefit analysis is to approximate the value of human life using the estimated future discounted income stream from a productive person, termed the 'human capital approach'. Given that this technique gives more conservative (lower) estimates of the value of human life compared with alternative methods commonly applied, such as value-of-a-statistical-life (VOSL), the human capital approach was used in this study. As an approximate average wage, or value of time, the average annual compensation to employees of IDR 24.5 million (USD 2,775) was applied. This gives an equivalent value of life of IDR 540 million (USD 61,278) for those dying as productive adults (those over 15 years of age, with a median age of 40 years old); IDR 1 billion (USD 115,387) for those dying between the ages of 5 and 14 (median age of 10 years old); and IDR 860 million (USD 97,760) for the death of a child under five (median age of 2.5 years old).

These values reflect an economic cost for a premature death. To estimate the financial cost of premature death – to reflect short-term direct income loss – it is conservatively assumed that a household loses the equivalent of one year of income, or IDR 24.5 million (USD 2,775). These figures all reflect national average. Provincial value of life figures are provided in Annex Table C6. In sensitivity analysis, the VOSL method is used. Due to the absence of studies on VOSL in Indonesia, an average VOSL of USD 2 million is transferred from OECD country studies. The transfer is made at an income elasticity of 0.6, and adjusted by the difference in GDP per capita between these countries and Indonesia. The resulting economic value for premature death valued using VOSL is IDR 2.1 billion (USD 240,341).

Table 9 presents the total costs of premature death. Of a total economic cost of IDR 25 trillion, the majority (95%) is attributed to deaths in the 0-4 year old age group – but this proportion is higher because deaths in this age group have been more comprehensively assessed. Financial costs total IDR 440 billion (USD 50 million). Economic and financial costs would be higher if the 'other' category of indirect deaths had been included (see footnote to Table 5).

Table 9. Total costs of premature death (IDR billion)

Disease	Financial costs	Economic costs, by age group			
		0-4	5-14	15+	Total
Diarrheal diseases	432.6	13,807.0	582.6	485.5	14,875.2
Helminthes	0.0	0.0	0.0	0.0	0.0
Skin diseases	8.8	26.5	61.8	105.9	194.2
Trachoma	0.0	0.0	0.0	0.0	0.0
Hepatitis A	0.0	8.8	26.5	44.1	79.5
Hepatitis E	0.0	0.0	0.0	0.0	8.8
Malnutrition, indirect	0.0	9,613.7	0.0	0.0	9,613.7
Total	**440.2**	**23,464.8**	**670.9**	**644.4**	**24,780.2**

3.2.5 Summary of health-related costs

Figure 7 summarizes the estimated economic cost of the health impacts of poor sanitation and hygiene in Indonesia (Annex Table A5 provides the figures). The economic cost is estimated at IDR 29.6 trillion (USD 3.35 billion) per year, with the majority – 84% – accounted for by premature death.

Figure 7. Health-related costs of poor sanitation and hygiene (IDR billion)

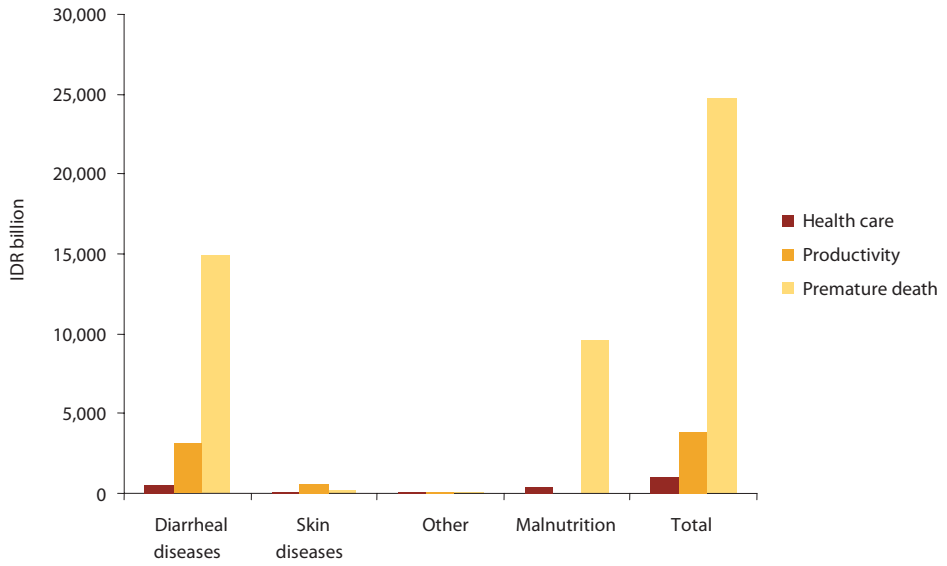
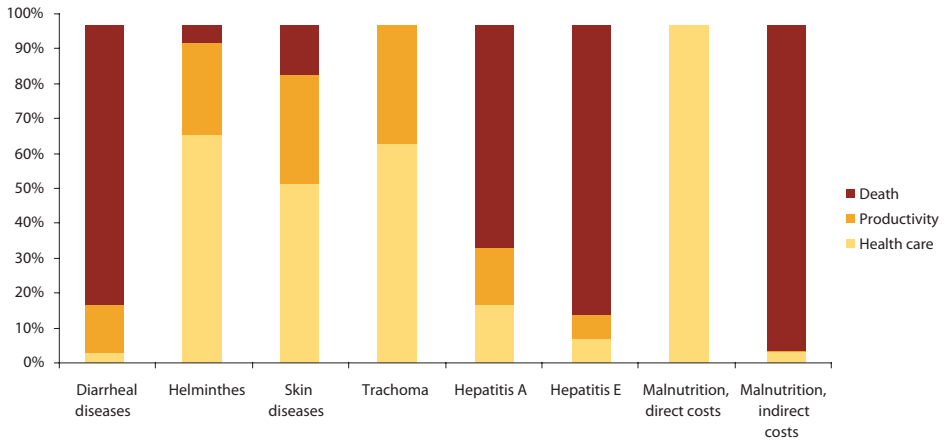


Figure 8 shows the contribution of various costs to overall cost, by disease. For helminthes, skin diseases, trachoma and malnutrition, the losses stem mostly from the cost of health care. For diarrheal disease, hepatitis and indirect diseases of malnutrition, losses from premature death are the most significant component of cost.

Figure 8. Contribution of various costs to total cost, by disease



3.3 Water resource impacts

Indonesia is well-endowed with water resources, with an average surface water volume of 15,500 m^3 per person per year. Major rivers include the Kali Brantas and Bengawan Solo rivers in East Java, the Cenranae river in South Sulawesi, and the Barito river in Central Kalimantan (see Annex Table C7). Major lakes include Air Siku and Kolong Kac in South Sumatra and Palaguna lake in South Sulawesi (see Annex Table C8). However, water availability is highly variable between regions and seasons, with some rivers drying up during the dry season. On Java, the average available surface water is one tenth the national average due to high population density.

The impact of pollution on the economic value of water resources is determined by three main factors: the extent of water resources, the release of polluting substances in water resources, and the actual or potential uses of water. At the national level, currently about 93% of freshwater resources are withdrawn for irrigation, 6% for domestic activities and 1% for industrial use[9]. For some of these activities, such as for drinking, good quality water is important; while for other uses, such as for agricultural and some industrial uses, water quality standards are not so strict.

3.3.1 Water pollution from poor sanitation

Domestic sources contribute significantly to water pollution in Indonesia, where the majority of households do not have 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 originate from households, industry, agriculture (fertilizers, pesticides, animal waste), erosion, and salinity intrusion from coastal areas.

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. Table 10 shows the proportion of the total population with sanitation options that discharge directly or indirectly to ground or surface water. The total effluent of human excreta to water bodies is then estimated by combining population size by province (Annex Table C1), access to different types of sanitation facilities (Annex Table C2), the proportion of sewage released into water bodies (Table 10, or Annex Table C9 for provincial breakdown), and average human waste production per year[10].

Table 10. Proportion of rural, urban and total households with untreated sewage discharged to water bodies

Location	Sewage discharged to water body	Open defecation in water courses[1]	Septic tank effluents to groundwater[2]	Pit latrine effluents to groundwater[3]	Total
Rural	27.6	10.7	6.1	8.9	53.2
Urban	28.6	3.1	15.6	4.9	52.2
Total	**28.0**	**7.4**	**10.2**	**7.2**	**52.8**

[1] One-quarter of total open defecation
[2] 50% of septic tanks
[3] 50% of unimproved pit latrines

Based on the above data and assumptions, the total release of polluting substances to inland water bodies in Indonesia is estimated at 6.4 million tones of feces annually, 64 million m^3 of urine, and 854 million m^3 of gray water (Table 11). This translates as approximately 2.1 million tones of biochemical oxygen demand and 385,000 tons of nitrogen compounds per year. A provincial distribution is shown in Annex Table C10. In Jakarta alone, roughly 0.3 million tons of feces and 2 million m^3 of urine are estimated to be released in into inland water bodies.

9 *Water pricing and valuation in Indonesia: case study of the Brantas River Basin.* C Rodgers and P Hellegers. International Food Policy Research Institute *Discussion Paper 141*.Washington, DC. 2005.
10 Equal to 0.15 kg of feces, 1.5 liters of urine and 200 liter of gray water per person per day.

Table 11. Total release of domestic human waste to water bodies

Province	Total release			Polluting substances (thousand tons)				
	Feces (thousand kg)	Urine (thousand m3)	Gray (million m3)	BOD	N	P	TSS	Coliform count (10^15)
Daily								
National	17,565	176	2,340	6	1	0	8	12
Jakarta	714	7	95	0	0	0	0	1
Annually								
National	6,411,223	64,059	854,115	2,137	385	98	2,906	4,545
Jakarta	260,731	2,607	34,764	87	16	4	118	185

Source: Authors' estimate

Other sources of water pollution are industrial and agricultural activities. However as with domestic wastes, there is no existing national level estimate. Based on authors' estimates using available studies on industrial waste in Jakarta (Annex Table C11), approximations of animal waste, and other studies from the Asia region, the proportion of biochemical oxygen demand from domestic, agricultural and industrial sources is estimated (Annex Table C12). Nationally, an estimated 35% of BOD is released from domestic sources (varying 3% to 69% across provinces), compared with 57% from industry and 9% from agriculture. There is a wide variation in these estimates at the provincial level.

3.3.2 Water quality indicators

Water quality monitoring in Indonesia is mainly conducted by the government, at national, provincial and local levels. Some major government monitoring activities include (1) the Clean River Program (PROKASIH), which measures water quality in the most heavily polluted rivers, including industrial wastewater discharge; (2) the Clean City Award Program (ADIPURA), which includes water quality as one of the evaluated categories; and (3) a national government-supported program monitoring one river in each province since 2002. The Ministry of Environment compiles river water monitoring results from several provinces and publishes them in the annual 'State of the Environment' report. Selected river quality indicators from this report are presented in Annex Table C13. In addition to government activities, water companies also conduct water quality monitoring on their sources of water supply.

Different organizations measure different water quality indicators. Parameters routinely recorded are temperature, pH, conductivity, turbidity, biochemical oxygen demand, dissolved oxygen and nutrients (ammonia and orthophosphate). Indicator monitoring is done mainly for regulatory enforcement at the provincial level. More recently, the general public has been able to access several indicators updated daily via the website of the river management agency. Although monitoring is conducted at many sites throughout the country, results are not widely disseminated and the available data are indicative (e.g. the low and high values) rather than complete. Second, when interpreting the results it should be borne in mind that the water quality monitoring schedule is somewhat erratic and produces some results which do not appear robust when cross-temporal or cross-site comparisons are made.

Table 12 presents a summary of the pollution levels of selected rivers. Annex Table C13 provides the data supporting these assessments, covering pH, dissolved oxygen, BOD, dissolved solids, and suspended solids. Given the large volumes of pollution load presented in section 3.3.1, it is not surprising that the quality of river water is poor. Most BOD readings are above the national standard of 2 mg/l, while at downstream locations dissolved oxygen levels are routinely below 5 mg/l (an approximate threshold below which compromises the ability of water to support fish). For 30 provinces, all rivers at some time do not fulfill the Class I quality standard as a source of raw water for drinking. In 2005 only three rivers fulfilled the Class I criteria at locations upstream. Similarly, for locations mid- and downstream, only three rivers were able, at a specific point in time (not all the time), to fulfill the Class II criteria (water quality suitable for other uses such as recreation and fish farming/aquaculture). Even rivers in low density areas such as Papua have mildly polluted water and do not meet the required drinking water standard.

Table 12. Quality of major rivers based on national standards, 2005

Province	River	Pollution level by location[1]	
		Upstream	Mid- or downstream
NAD	Krueng Aceh	Mild to medium	Mild to medium
North Sumatra	Deli	Mild to medium	Mild to medium
West Sumatra	Batang Agam	Satisfactory to mild	Mild
R i a u	Kampar	Mild to heavy	Mild to medium
J a m b i	Batang Hari	Mild to medium	Mild to medium
South Sumatra	Musi	Mild to medium	Mild to medium
Bengkulu	Air Bengkulu	Mild to medium	Mild
Lampung	Way Sekampung	Medium	Mild to medium
Bangka Belitung	Rangkui	Mild to heavy	Mild to heavy
Jakarta	Kali Angke	Mild to heavy	Mild to medium
West Java and Jakarta	Ciliwung	Mild to heavy	Medium to heavy
West Java	Citarum	Mild to heavy	Medium to heavy
Central Java - Yogyakarta	Progo	Satisfactory to mild	Mild to heavy
East Java	Brantas	Mild to medium	Satisfactory to mild
West Java - Banten	Cisadane	Mild to heavy	Mild to medium
B a l i	Tukad Badung	Mild	Mild
West Nusa Tenggara	Jangkok	Mild to medium	Medium
East Nusa Tenggara	Kali Dendeng	Mild	Satisfactory to mild
West Kalimantan	Kapuas	Satisfactory to mild	Mild to heavy
Central Kalimantan	Kahayan	Heavy	Mild to heavy
South Kalimantan	Martapura	Mild to heavy	Medium
East Kalimantan	Mahakam	Mild	Mild to medium
North Sulawesi	Tondano	Mild	Mild
Central Sulawesi	Palu	Mild to medium	Mild to medium
South Sulawesi	Tallo	Mild	Mild to heavy
South Sulawesi	Jeneberang	Mild	Mild to heavy
Southeast Sulawesi	Konaweha	Mild	Mild
North Maluku	Tabobo	Mild	Satisfactory to mild
Papua	Anafere	Mild	Medium

Source: Indonesia State of the Environment, 2005

[1] Water quality evaluated based on Government Regulation No 82/2001 on Water Quality Management and Water Pollution Control. Upstream river quality evaluated based on Class I criteria (suitability as source of raw drinking water); mid- and downstream quality based on Class II criteria (suitability for water-based recreation activities, aquaculture, husbandry, plant watering and other uses).

It is noteworthy that while rivers may exhibit a higher capacity to assimilate waste during the rainy season, water quality indicators are not necessarily better. For example, monitoring at the Brantas River Basin in East Java showed that during the rainy season, suspended solid loads rise to 70-500 mg/l compared to 20-150 mg/l in dry season, above the Indonesian standard of 50 mg/l. Furthermore, BOD at Brantas river ranges from 5-12 mg/l during the dry season, and from 6-15 mg/l during the wet season, which is significantly higher than the Indonesian standard of 2 mg/l. One of the most polluted river sections exhibited BOD values ranging from 10 to 20 mg/l .

3.3.3 Drinking water

Due to the many pollutants released into water in Indonesia, leading to poor quality surface water, few surface water sources are safe to drink from. This leads to households switching to water sources that are less convenient to access, more costly to access, or less safe, or all three. Annex Table B7 shows selected drinking water quality standards in Indonesia.

As a consequence of poor quality surface water or, equally, concerns about the quality of groundwater, many households in Indonesia choose to consume treated water from water treatment plants (18%), bottled water (4%), and/or they treat water themselves (at least 7 in 10 households). Many households have little choice but to continue to consume unsafe water, such as from an unprotected well or spring (14%), or surface water such as rivers (3%). Table 13 presents access to various drinking water sources, and definitions of 'improved' versus 'unimproved' (Annex Table C14 presents drinking water sources by province and rural/urban area).

Table 13. Access to various drinking water sources

Source	Rural	Urban	Total
1. Piped from plant	9.03	30.80	18.34
2. Ground water (tubewell or borehole)	9.23	19.47	13.61
3. Protected well (dug well)	38.15	29.98	34.66
4. Protected spring	12.85	3.14	8.70
5. Rainwater	3.41	1.35	2.53
6. Packaged water	1.02	8.95	4.41
7. Unprotected well	14.26	4.77	10.20
8. Unprotected spring	6.89	0.60	4.20
9. Rivers	4.78	0.61	3.00
10. Others	0.38	0.33	0.36
Total	100.00	100.00	100.00
JMP definition			
Improved (1,2,3,4,5)	72.67	84.74	77.83
Unimproved (6,7,8,9,10)	27.33	15.26	22.17
'Safe' water (includes packaged)			
Improved (1,2,3,4,5,6)	73.69	93.69	82.24
Unimproved (7,8,9,10)	26.31	6.31	17.76

Source: Susenas, 2006. See Annex Table C14 for provincial breakdown.

In 2006, 39% of urban households and 23% of rural households obtained their drinking water from a source that is located less than 10 meters from the nearest septic tank or other waste disposal site, where the risk of contamination is relatively high. In Jakarta, more than 60% of wells sampled in 2004 were contaminated with E. coli in excess of the regulated drinking water level, despite the majority of these being classified as protected wells. Furthermore, in 2006 the Jakarta Environmental Monitoring Agency (BPLHD Jakarta) estimated that 80% of deep wells were contaminated with E. coli. Hence the actual access to improved drinking water sources may be different from the estimates provided in Table 13.

Table 14 shows the proportion of households that pay for their drinking water compared with those that obtain their drinking water free of charge, by water source. According to the Susenas survey, 78% of households obtain their water nominally free of charge; but in fact there may be capital, maintenance or access costs (especially for piped

water or well water) that are paid for by community groups, government agencies or other organizations. Some households purchase water that has been accessed from surface or ground sources but not treated.

Table 14. Households purchasing or accessing free drinking water, by source

Source	Purchased (%)	Free (%)	Total (%)
Packaged	100.0	0.0	100.0
Piped from plant	69.7	30.3	100.0
Groundwater (tubewell or borehole)	11.5	88.5	100.0
Well (dug well)	3.8	96.2	100.0
Spring	9.4	90.6	100.0
River	2.3	97.7	100.0
Rainwater	5.5	94.5	100.0
Other	37.4	62.6	100.0
Total	**21.6**	**78.4**	**100.0**

Source: Susenas, 2006

Due to lack of nationally representative data on the proportion of households that treat their drinking water themselves, available local studies and interviews were used. The study assumes that 90% of all households treat their water, where their main drinking water source is not package/bottled water. In the less-developed and poorer provinces of West Nusa Tenggara, East Nusa Tenggara, West Papua and Papua, it is assumed that 70% of households treat their drinking water. The majority – over 95% – of household treatment, is done by boiling, as shown in a 6-province study.

Unit cost information for various water sources was gathered from several sources:

- Water piped from treatment plant: the average price for non-commercial customers in 2004 was IDR 1,500 (USD 0.17) per m^3, varying by province from IDR 700 (USD 0.08) per m^3 to IDR 2,400 (USD 0.27) per m^3, inflated to reflect 2006 prices. Financial cost was estimated to be 80% of economic cost, given that water companies are subsidized (80% reflects the average level of cost recovery for water companies).
- Water piped from other sources: assumed to cost IDR 21,200 (USD 2.4) per m^3. Financial cost equals economic cost. It is assumed that households choose piped water for two reasons: quality concerns and convenience. Quality concerns (related to poor sanitation) are attributed 50% of the piped water costs.
- Other purchased water: IDR 47,700 (USD 5.4) per m^3 from water vendors selling by the jerry can, and IDR 326,600 (USD 37) per m^3 for packaged water based on an average of small sized bottled water and refillable 19-liter containers (locally called a 'galon'). Financial cost is equal to economic cost.
- Cost of household water treatment (boiling): the study uses an economic cost of IDR 2,000 (USD 0.21) to boil a liter of water, representing a weighted average of the economic cost of kerosene[11] and an opportunity cost for firewood collection (the two main fuel sources for boiling water). The financial cost is calculated using the subsidized kerosene prices, which reflects the amount households actually pay[12].
- Hauled water: nationally, 64% of households hauling their water require 5 minutes or less daily to obtain their water; 29% require 5-29 minutes; 5% require 30-59 minutes, and 3% require more than one hour. Part of the time costs, valued at average compensation to employees, are allocated to poor water quality, as households have to travel further to access adequately clean water. This is only an economic cost, with no financial cost.

11 The financial cost of boiling water using kerosene (***Action research on point of use drinking water treatment alternatives as appropriate for underprivileged households in Jakarta***. M Weimer. Environmental Services Program: Jakarta. 2006) was adjusted by the government subsidy on kerosene to estimate the full economic cost.

12 The subsidy provided by the government is not included as financial cost given that the costs are not a direct financial contribution by the government, but rather the lower sales volume of oil on the international market.

The total costs of accessing cleaner drinking water due to water pollution are adjusted to reflect the contribution of poor sanitation to overall water pollution, using the proportions by province shown in Annex Table C14.

Table 15 shows the total costs attributed to poor sanitation of accessing drinking water, including only the daily needs per capita for drinking water. The largest cost component is for drinking water treatment, since most Indonesians boil their water (even piped water from formal treatment plants are not directly potable). The financial cost is IDR 7.1 trillion (USD 803 million) per year, while the economic cost is IDR 12 trillion (USD 1,364) per year. The majority of costs – 85% – are attributed to household water treatment. Since most households use kerosene as cooking fuel, the economic cost is higher than the financial cost to households because the price of kerosene is heavily subsidized by the government.

Table 15. Drinking water access costs (IDR billion)

Water source	Financial		Economic	
	Total	%	Total	%
Purchased piped water	**132**	**1.8**	**203**	**1.7**
Rural	62	0.9	97	0.8
Urban	62	0.9	106	0.9
Purchased non-piped water	**945**	**13.3**	**971**	**8.1**
Rural	450	6.4	468	3.9
Urban	494	6.9	503	4.2
Household water treatment	**6,012**	**84.9**	**10,196**	**84.7**
Rural	3,461	48.9	5,835	48.5
Urban	2,551	36.0	4,361	36.2
Hauled water	**0**	**0**	**671**	**5.6**
Rural	0	0	494	4.1
Urban	0	0	177	1.5
Total	**7,089**	**100.0**	**12,041**	**100.0**
Rural	3,973	56.0	6,895	57.3
Urban	3,107	44.0	5,156	42.8

3.3.4 Other domestic uses of water

In addition to the uses of surface and groundwater sources for drinking, water is a resource for many other human and nonhuman activities. While it is not possible to conduct an exhaustive analysis of all the uses of water, this study assessed the relevance of non-commercial household (domestic) activities, such as the use of water for cooking, washing, and bathing.

Table 16 shows the costs attributed to poor sanitation as a result of accessing water from improved water sources. The estimated economic impact amounts to IDR 1.2 trillion (USD 131 million) per year. Nearly 90% of these costs are accounted for by households that purchase piped water. Although the same strict requirements for water quality do not apply as for drinking water, households may still walk further for improved water and willingly pay companies to deliver or pipe water for non-drinking domestic uses.

Table 16. Water access costs for other domestic uses (IDR billion)

Water source	Financial		Economic	
	Total	%	Total	%
Purchased piped water	**932**	**100.0**	**1,021**	**88.1**
Rural	263	28.2	310	30.4
Urban	669	71.8	712	69.4
Hauled water	**0**	**0.0**	**139**	**11.9**
Rural	0	0.0	97	69.8
Urban	0	0.0	41	30.2
Total	**932**	**100.0**	**1,160**	**100.0**
Rural	263	28.2	406	35.0
Urban	669	71.8	753	65.0

3.3.5 Fish production

The fisheries sub-sector in Indonesia employs more than 4.5 million people (4.7% of the workforce) in both wild capture fisheries and aquaculture. In 2005, fisheries contributed USD 6.8 billion to the national product, equivalent to 2.2% of GDP. In 2005, fresh fish and shrimp exports totaled USD 1.5 billion, or about 2% of all exports .

Given the lack of empirical evidence linking water quality and fish production in Southeast Asia, this study used innovative methods to examine the likely effect of sewage on fish production. While the impact of micro-bacteria in surface water affects both fish health and the health of the Indonesian people who live off fish, the lack of data on these makes it difficult to evaluate quantitatively. A second link is examined, which is the impact of BOD from sewage and wastewater on dissolved oxygen levels in rivers, lakes and ponds and hence fish reproduction and survival. The methodology used is described in full in the 4-country regional report (see Acknowledgments for citation).

It is estimated that the negative impact of poor sanitation on the dissolved oxygen content of freshwater in Indonesia causes a loss to fish production equivalent to IDR 812 billion (USD 92 million) per annum, of which 17% is accounted for by South Sumatra, 15% by West Kalimantan and 12% by South Kalimantan (Annex Table C15 provides the full provincial breakdown).

3.3.6 Summary of water-related costs

Table 21 shows the total costs from the three evaluated impacts of water pollution in Indonesia. The majority of financial and economic losses – over 85% – are accounted for by drinking water quality impact. Fifty-eight percent of the costs are accounted for by rural areas and 42% by urban areas. These costs are an underestimate of the total water-related costs of poor sanitation, as a number of other potential impacts were not evaluated (see Annex Table B2).

Table 17. Summary of total costs due to polluted water sources (IDR billion)

Impact	Location	Financial		Economic	
		Total	%	Total	%
Drinking water	Rural	3,973	49.6	6,895	49.2
	Urban	3,107	38.8	5,156	36.8
	Total	**7,089**	**88.4**	**12,041**	**85.9**
Fish production	Rural	0	0	812	5.8
	Urban	0	0	0	0
	Total	**0**	**0**	**812**	**5.8**
Domestic water uses	Rural	265	3.3	406	2.9
	Urban	671	8.3	750	5.4
	Total	**936**	**11.6**	**1,156**	**8.3**
Total	Rural	4,237	52.9	8,113	57.9
	Urban	3,778	47.1	5,906	42.1
	Total	**8,016**	**100**	**14,019**	**100**

3.4 Environment

3.4.1 Aesthetics

Aesthetics is not strongly related to productivity or income. Economic studies do not usually quantify aesthetics, such as smell and sight, in economic terms. 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 hence not the broader environment where people spend their time, such as rural paths and roads, city streets, market places, fields, and so on. In Indonesia, the housing module in Susenas collects information on the type of environmental pollution suffered by households, covering different sources of smoke, odor and noise. The Susenas 2004 survey found that more than 10 million people are exposed to open sewers, more than 43 million people exposed to open defecation, and more than 8 million people exposed to open dumping of solid waste (Table 18). Although difficult to quantify in monetary terms, the impact of exposure to sub-standard practices of waste disposal may impact directly on consumption and production activities of households, yielding lower level of welfare and quality of life. The real condition of reduced quality of life can be reflected by one example, where in 2005 residents living close to an open dumping site Bantargebang in Bekasi were awarded IDR 50,000 (USD 5.70) per month per household as compensation for the smell they have to endure ('smell compensation') .

Table 18. Households exposed to sub-standard practices of waste disposal

Location	Improved sanitation (%)		Exposed population (million)		
	Enclosed defecation sites	Solid waste collected	Exposed to open sewers	Exposed to open defecation sites	Exposed to open dumping of solid waste
Rural	72%	1%	3.78	35.97	3.47
Urban	92%	41%	6.90	7.87	5.33
Total	**80%**	**18%**	**10.68**	**43.84**	**8.80**

Source: Susenas, 2004.

3.4.2 Land quality

Land that is used for improper, unofficial disposal of solid waste and open defecation will be unusable for other more productive uses, and hence will cause an economic loss to society. Collection rates of solid waste are low, especially in poor urban and rural areas in Indonesia. Even when collected, about 90% of the waste is disposed of illegally, through open dumping practices without proper environmental considerations. The majority of cities (85 small cities and 53% of medium-sized cities) implement open dumping; only a small proportion of solid waste is recycled or properly disposed in controlled dumping sites or sanitary landfills. Hence the price of land close to solid waste disposal areas can be highly depressed, as in the case of Bantargebang in the city of Bekasi, Banten Province, where the average price of land close to the disposal site (IDR 20,000 to IDR 30,000 per m^2) was about 10% of the average price in northern Bekasi (IDR 300,000 per m^2).

Table 17 shows that the total economic loss is estimated at IDR 245 billion (USD 27.8 million) due to open defecation practices, and IDR 604 billion (USD 68.5 million) due to poor solid waste disposal practices (see Annex Table C17 for provincial and rural/urban breakdown).

Table 19. Economic loss due to degraded and unavailable land

Location	Land mass (m^2 million)		Average land value (IDR/m^2)	Total land value loss (IDR. billion)	
	Human waste	Solid waste		Human waste	Solid waste
Rural	41.5	20.9	2470-10,000	- [1]	137.7
Urban	7.9	29.5	5030-20,040	245.5	466.7
Total	**49.5**	**50.4**		**245.5**	**604.4**

[1] Not calculated

3.5 Other welfare impacts

Difficulties in quantification aside, no studies at the national level provide information on what is classified in the present study as "other welfare" impacts of poor sanitation. The type of sanitation facility a household has will have a range of impacts on population welfare. An important but difficult to quantify aspect is the welfare impact on individuals and families that use a sub-standard, uncomfortable latrine or 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 welfare losses using conventional economic techniques. More tangible impacts of using sub-standard latrines or having no facilities are time impacts due to journeying time or waiting due to insufficient shared or public latrines per head of population, as well as life decisions such as schooling or choice of employment, which may be linked to the presence of sub-standard latrines or absence of latrines in schools and workplaces.

3.5.1 Access time

Welfare loss from increased access time arising from having to use unimproved sanitation can be due to journey time for open defecation or waiting time for shared latrines. Table 20 presents the population experiencing sub-optimal access (Annex Table C19 presents the provincial and rural/urban breakdown). For 75% of households, comprising households using private toilets, and a proportion of those using shared and common latrines (50%) and those practicing open defecation (25%), access time is already minimized. The remaining population – 10% using shared and 15% practicing open defecation, equaling 25% of households – are assumed to experience sub-optimal access time. For these households, open defecation is assumed to require 15 minutes per day extra to find a secluded spot for defecation, while for shared latrines the extra time queuing varies from 15 minutes in rural areas to 30 minutes in urban areas. Access time is relatively high because in urban areas in Indonesia access time can be

longer because toilets are shared with many people, and because it is common for people to wash themselves while in the latrines, thus prolonging queuing time. For example, in the public toilets being built by BEST in urban areas of Banten Province, the 6-7 latrines are shared by 100 families. Assuming 4 people per family, that makes a ratio of 57 people per latrine. In other towns, dormitories catering to blue collar workers were found to provide only 2 latrines for 20-40 people, who often have to queue for more than half an hour to use the latrine. Hence, queuing is one of the main complaints regarding shared public latrines.

The 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. The time value of children was assumed to be half the value of adult time.

Table 20. Toilet access, by geographical location sub-type (by region)

Location	Population with access time already minimized (%)	Population experiencing sub-optimal access		Average time access per day for those with sub-optimal access	
		Shared latrines (%)	Open defecation (%)	Shared latrines (hrs)	Open defecation (hrs)
Rural	68.78	10.08	21.14	0.25	0.25
Urban	83.90	9.83	6.29	0.50	0.25
Total	**75.27**	**9.98**	**14.75**	**0.25-0.50**	**0.25**

Source: Authors' estimate

Latrine access time also makes up an important component of the cost of unimproved sanitation. Fifty-five million people experience sub-standard access time daily, with more than 4 billion hours of access time needed annually (Table 21). Annual economic losses are estimated at IDR 10.8 trillion, or USD 1.22 billion (Annex Table C19 presents provincial and rural/urban breakdowns).

Table 21. Time used and costs of accessing shared latrine or open defecation site

Establishment	Time spent accessing facility (million hours)		Economic cost (IDR billion)	
	Shared latrines	Open defecation	Total	%
Rural	781	1,613	6,261	58%
Urban	1,301	413	4,512	42%
Total	**2,083**	**2,026**	**10,773**	**100%**

3.5.2 Intangible aspects

With high levels of unimproved sanitation in Indonesia, welfare losses due to a number of 'intangible' aspects of poor sanitation could provide important arguments for sanitation programs. However, to date no studies examining these aspects in Indonesia have come to light.

- Comfort & acceptability– the ease 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; not being limited to toilet-going in the hours of darkness; or being seen walking to access toilet facilities, especially women.
- Security – the location of the latrine within or near to the home means that excursions to the outdoors do not need to be made for toilet-going needs, in particular at night, when there may be dangers (theft, attack, rape, and injuries sustained from snakes or other dangerous animals).
- Conflict – on-plot sanitation can avoid conflict with neighbors or the community, where tensions exist concerning shared facilities, or fields and rivers for open defecation.

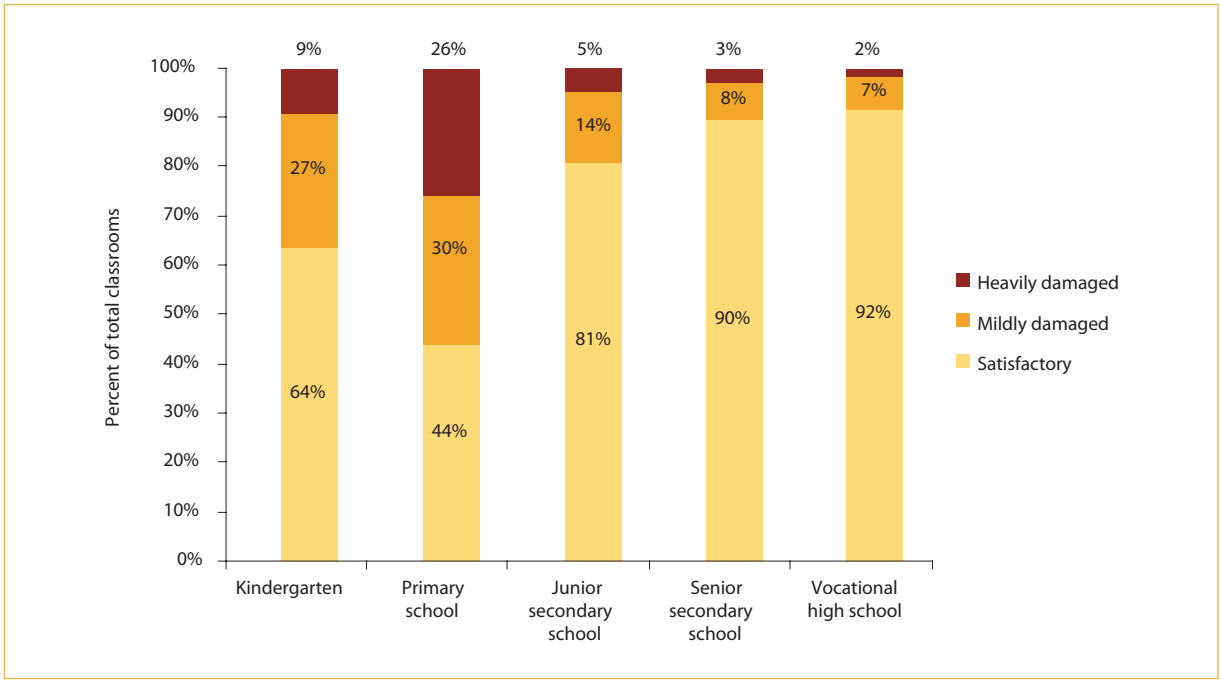
- Status and prestige – when visitors come to the house, it gives prestige to the household to be able to offer their guests a clean and convenient toilet to use. Families may hold more social events at their house if they have a clean latrine.

3.5.3 Impact on life decisions and behavior

Running water supply and sanitary latrines in schools are rare in most of the developing world. 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 enrollment and attendance, especially for girls. Good latrine access at the workplace has implications for female participation in traditionally male-dominated employment areas. Furthermore, sanitary and adequate latrines in schools and at workplaces not only affect participation rates but improve the welfare of all pupils and employees using them.

Given the complex web of causative factors and eventual life decisions, and the many factors determining absenteeism from school or the workplace, it is difficult to quantify the exact relationship between poor sanitation conditions, education and work decisions, and eventual economic outcomes. In terms of education, the poor quality of education is still a challenge, including poor quality of infrastructure. Official reports have in recent years provided snapshots of the condition of classrooms and other school facilities in Indonesia (Figure 9). Available data suggest that a significant number of kindergarten and primary classrooms are not in an acceptable condition (>35%), while a lower proportion of secondary school classrooms are in a damaged state (<20%). At the primary school level, less than half of all classrooms are in satisfactory condition, and about a quarter are badly damaged. If classrooms are damaged, it is probable that water and sanitation facilities at these schools are in a similar or worse condition. Indeed, it is highly likely that the toilet condition in the majority of schools is significantly worse than the classroom condition.

Figure 9. Classroom condition, 2005-06



Source: Ministry of Education Summary Data 2005/06

There are no data on toilet or clean water access at schools in Indonesia. Some anecdotal information is available, such as the report of consultants on the Indonesia School Improvement Grants Program (SIGP) who, visiting potential grantee schools in Pandeglang (West Java), observed that in almost all schools, toilets and washrooms were out of order. Those which were still working were inadequate in number to cater for the number of students using them. On average there were 2 toilets per school. Lack of clean water access was also observed, with students at many schools being forced to use streams or fish ponds near the school for toilet needs, posing particular problems during the rainy season.

In spite of poor classroom conditions, however, official statistics show primary school enrollment rates in Indonesia to be relatively high, with no difference in enrollment between boys and girls (93% for both girls and boys in 2005). A higher proportion of boys complete primary school, however, and there is higher drop out rate for girls than for boys. On the other hand, despite relatively better quality of classrooms and facilities, enrolment rates at junior (65%) and senior secondary (42%) school are significantly lower than at primary school. This drop-out can be attributed to various contributing factors; but note that, at these older ages, toilet availability and condition become relatively more important for children, especially girls.

A survey in 1999 indicated sickness, having to work/earn money, having to help with household chores, and having been punished as the main reasons for missing schools days. The reasons for dropping out or not attending school include parents' low income, student laziness, having to work, having had enough education, and the school being too far away. The condition of school facilities was not cited among the main reasons for missing school days or dropping out of school, although poor water and sanitation is unlikely to have been provided as a response option in school surveys.

Lack of data is also encountered in terms of work participation, and this study did not explore this issue further.

3.6 Tourism impacts

Tourism is a key sector in Indonesia, providing IDR 39.7 trillion (USD 4.5 billion) in revenue in 2006, an important source of local government tax income, as well as jobs for 6.1 million Indonesians (7% of total jobs). In 2006, almost 5 million foreign visitors traveled to Indonesia, 57% for holidays, 38% for business, and 5% for other purposes. The tourist industry is expected to grow by 3.6% in 2007, increasing to 6.4% per annum from 2008 to 2015.

The number of tourists choosing Indonesia for their holidays is related, among other things, to the general sanitary conditions of the country, such as the quality of water resources; quality of outdoor environment (smell, sightliness); food safety (hygiene in food preparation); general availability of toilets offering comfort and privacy in hotels, restaurants, and bus stations; and the related health risks of all the above. Better sanitary conditions will attract 'high-value' tourists, that is, those who are willing to pay more for their holiday. Currently, foreign tourists spend on average IDR 882,800 (USD 100) per day, and stay on average 9 days, giving an average revenue per tourist visit of IDR 7.9 million (USD 900).

Economic losses are reflected by the gap between current tourist revenues and the tourist revenues that would be possible at significantly higher tourist visit numbers, such as those experienced by neighboring countries with higher visit rates. The current hotel occupancy rate of 45% is low, and is assumed, therefore, in the mid-term, to grow to 80%. The analysis conservatively assumes constant hotel capacity over the same time period. Assuming that 5% of these revenue gains are attributable to improved sanitation, present poor sanitation conditions are estimated to contribute IDR 1,465 billion (USD 166 million) in losses annually (Annex Table C20 provides provincial breakdown).

3.7 Sanitation Markets

In addition to averted losses, improved sanitation and hygiene means a shift in demand for hygiene-related products such as latrines, soap and toilet paper. Improved toilet systems leads to an increase in demand for construction materials, and improved treatment and disposal leads to increased demand for sludge removal services.

Table 22 shows the potential market size for sanitation inputs for the construction of latrines. The analysis assumes sanitation improvement in some 2.1 million rural households and 170,000 urban households annually to meet the MDG target in 2015, with the majority constructing latrines with septic tanks (soak pits). Using these assumptions, the value of demand for materials is worth at least IDR 2.4 trillion (USD 274 million) annually.

Table 22. Sanitation input market values, construction (IDR billion)

Areas receiving improvement	Simple pit latrine	VIP	Septic tank	Simple EcoSan	Piped sewer connection	Total
Coverage received (% of total)						
Rural households (of 2.1 million/year)	20%	10%	60%	5%	5%	100%
Urban households (of 170,000/year)	5%	10%	75%	5%	5%	100%
Value (IDR billion)						
Rural	155.4	173.0	1,277.4	21.2	21.2	1,650.8
Urban	15.9	60.9	678.0	7.9	7.9	768.0
Total	**171.3**	**233.9**	**1,955.4**	**29.1**	**29.1**	**2,418.9**

Improvement in hygiene means an increase in the use of hygienic products, including soap and toilet paper. An increase of 40% in the use of soap by rural households and 20% by urban households results in an increase in demand for soap worth IDR 630 billion (USD 71 million) annually (Table 23). A 25% increase in households using toilet paper could yield an additional IDR 313 billion (USD 24 million) demand for toilet paper annually. Proper handling of pits and septic tanks requires sludge to be removed at least every two years; leading to market growth of IDR 2 trillion (USD 227 million) per year in sludge removal services.

Table 23. Sanitation input market values, hygiene products and improved treatment

Areas receiving improvement	Soap	Toilet paper	Sludge removal	Total
Coverage				
% rural households	40%	0%	25%	65%
% urban households	20%	25%	25%	75%
Value (IDR billion)				
Rural	459.1	0.0	538.5	997.6
Urban	167.7	211.9	1,465.4	1,853.9
Total	**626.8**	**211.9**	**2,004.0**	**2,842.6**

In addition to expanding the market for sanitation inputs, improved sanitation includes re-use of waste. The reuse of human waste for fertilizer or biogas production cannot be assumed to be population-wide, given cultural attitudes towards handling and re-use of human waste, and low practical feasibility in many locations. Success often depends on local perceptions of the expected returns on re-using of human waste, whether it be for biogas or fertilizer. The

number of establishments or households using human fecal waste for fertilizer is not yet significant in Indonesia. Fecal waste processing has so far largely focused on using animal waste, with the Ministry of Agriculture promoting small-scale biogas processing. The Ministry of Agriculture has estimated that a biogas digester using excreta from livestock can yield the equivalent of 2.5 liters of kerosene per day, valued at USD 1.42 per day or USD 517 annually.

In terms of processing human fecal waste into biogas, information was obtained from the Bina Ekonomi Sosial Terpadu (BEST) organization, which has been working with communities and other stakeholders to construct sanitation facilities in urban communities. Each of the facilities serves about 100 households (350 to 500 people). Some of these facilities are fitted with a system for generating biogas. Human waste from a facility used by 100 households can generate enough biogas to power 3 stoves for 24 hours. The stoves are located on site; some are used by households for daily cooking, and some are allotted to small scale food vendors. Based on these parameters, this study conservatively estimates that each stove runs continuously for 12 hours per day, and that each hour of cooking is equivalent to the use of one liter of kerosene at the cost of IDR 5,000 (USD 0.57). In total, each stove can yield USD 6.80 worth of cooking energy per day per stove, or IDR 68 million (USD 7,442) per year for three stoves. If we assume that all households sharing the sanitation facilities have equal access to the stoves, the estimated benefit for 100 households is IDR 650,000 (USD 74) annually per household. Assuming 198,000 rural households and 710,000 urban households adopt biogas, the potential value of waste conversion into biogas is at least IDR 132 billion (USD 15 million) per year in rural areas and IDR 467 billion (USD 53 million) in urban areas, totaling IDR 600 billion (USD 67 million) annually.

4 Recommendations

Recommendation 1. Give greater priority to investments in sanitation and hygiene promotion
Economic losses due to poor sanitation and hygiene of IDR 56 trillion are considerable, totaling 2.3% of national GDP. Hence the developmental benefits of investing in improved sanitation are potentially huge, leading to averted costs of IDR 40 trillion. These investments will also mitigate a number of other impacts not quantified in this study, as well as generating further benefits through excreta re-use and sanitation input market value. Improving sanitation also contributes to the attainment of other development targets, including some of the key MDGs. With at least one third of the Indonesian households without improved sanitation, it is evident that more investments are needed in this sector.

Recommendation 2. Target investments to rural areas as well as to urban slums
Losses are incurred in both rural and urban populations where sanitation is unimproved, thus justifying balanced investment to both unserved rural and urban areas, and targeting of subsidies to the most deserving populations.

Per capita losses were marginally higher in urban areas, while a larger proportion of the unserved population resides in rural areas. Sanitation programs should in particular target families with young children, as this population group is more vulnerable to health impacts of unimproved sanitation. Rural areas where households practice subsistence farming and have limited cash income and spending power will need motivation to reach the first rung of the sanitation ladder.

Another priority is supporting sanitation development in poor urban areas where land or house ownership is low and households cannot easily improve sanitation individually but need a community response. These areas have high population densities and are more exposed to the negative impacts of poor sanitation. In such confined spaces, human excreta that is not properly disposed or treated will pollute water resources, drains, rivers and canals and increase health risks among the people living in the vicinity.

Recommendation 3. Strengthen promotion and information campaigns to improve personal hygiene practices, focusing on hand washing with soap
The study showed that hand washing with soap can lead to substantial economic benefits in the form of lower disease incidence and averted health costs, particularly from reduced incidence of diarrheal and infectious skin diseases, and the implications for nutritional status in infants and children. The documented low levels of improved hygiene practices, the relatively low per capita costs of hygiene promotion and the associated benefits, justify greater attention by public policy makers and the private sector to improving hygiene practices and availability of hygiene products. As well as stand-alone hand washing with soap campaigns, hygiene promotion can be efficiently built into all water and sanitation programs and other health campaigns, to reach a greater audience and at lower unit cost.

Recommendation 4. Further evaluate available sanitation technology and program options for improving sanitation in Indonesia
The estimated national economic benefits from improving sanitation will provide useful information for sanitation advocacy and policy making, but sanitation program selection needs to be made based on more precise information on the costs and benefits of specific sanitation options. The various public/private and financial/economic costs and benefits need to be better understood in specific contexts to inform policy making, program design, community engagement and financing options. Future work conducted under the Economics of Sanitation Initiative will help fill the information gap.

Annexes

Annex A: Algorithms

A1. 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

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

User preference losses of poor sanitation and hygiene

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

Tourism losses from poor sanitation

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

A2. 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

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

A3. 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 (excl. 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

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

A4. Land costs

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

A5. User preference costs 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

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

A6. 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

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

A7. Variable definition summary

Tables A1 to A3 present the subscripts, variables and parameters used in the algorithms in Sections A1 to A6 above.

Table A1. Subscripts used in algorithms

Code	Description	Elements[1]
a	Age group	Less than one year, 1-4 years, 5-14 years, 15-65 years, over 65
i	Disease types	Diarrhea, cholera, typhoid, malnutrition-related diseases, etc
h	Health care provider	Public hospital, private hospital, informal care, self-treatment
m	Treatment method	Piped water, non-piped water, home-treated water, hauled water

Table A2. Variables used in algorithms

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	User preference 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 (USD)
ewomen	Number of women in paid employment

Symbol	Description
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*
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 unusable 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 A3. Parameters used in algorithms

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 the fish production at the current DO level to fish production at the optimal DO level
ϕ	Proportion of schools with inadequate sanitation facilities
η	Proportion of work places with inadequate sanitation facilities
μ	Proportion of diseases related to poor 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 B: National Data Inputs and Results

Table B1. Comparison of sanitation coverage (%) measured in national surveys in Indonesia

Survey	Improved sanitation (%)				Unimproved sanitation (%)				
	Private toilet with septic tank	Private toilet without septic tank	Pit latrine	Total	Public toilet	Pit latrine	Open defecation	Other	Total
National Demographic and Health Survey 2002-2003									
Rural	27	10	8	45	6	8	34	7	55
Urban	65	9	2	75	9	2	12	3	25
Total	44	10	5	59	8	5	24	5	42
National Socio-Economic Survey 2004									
Rural	26	-	17	45	-	17	40	3	55
Urban	66	-	8	74	-	8	17	1	26
Total	43	-	12	55	-	12	31	2	45
National Inter-Censal Survey 2005									
Rural	29	16	6	52	11	6	26	5	48
Urban	64	12	1	77	13	1	8	1	23
Total	44	14	4	63	12	4	18	3	37
National Socio-Economic Survey 2006									
Rural	24	-	18	42	-	18	37	3	58
Urban	62	-	10	72	-	10	17	1	28
Total	41	-	14	55	-	14	29	2	45

Source: Statistics Indonesia (BPS)

Table B2. Impacts of poor sanitation not quantified in this study

Impact	Excluded items	Link with poor sanitation
1. Health	Quality of life	Sanitation-related diseases cause pain and suffering beyond the measurable economic effects. Disability-adjusted life-years (DALY), which attempt to capture quality of life loss, indicate that sanitation-related diseases contribute significantly to national disease burden estimates
	Informal treatment-seeking and home treatment	This study excludes the large proportion of disease cases – especially for mild diseases – that are not reported in official statistics, that are treated at home or by an informal care giver. These costs are largely unknown, but potentially significant
	Other sanitation-related diseases	The following disease and health conditions have been excluded: 1. Helminthes and skin diseases (Cambodia, Philippines) 2. Malnutrition and the costs of supplemental feeding 3. Reproductive tract infections for women bathing in dirty water 4. Dehydration resulting from low water consumption from lack of access to private latrines (especially women) 5. Specific health problems suffered by those working closely with waste products (sanitation workers, dump scavengers) 6. Health impacts due to flooding (physical, psychological) 7. Impact on education of childhood malnutrition 8. Unreported food poisoning due to contaminated fish products 9. Animal and insect vectors of disease (e.g. rodents, mosquitoes) 10. Avian influenza
2. Water resources	Household water use	Household time spent treating drinking water, including boiling, maintaining rain water collection systems, replacing filters, etc.
	Fish production	The study excluded the following: 1. Non-recorded marketed freshwater fish 2. Farmed freshwater fish (Indonesia) 3. Marine fish 4. Subsistence fishing losses 5. Nutrient losses from lower fish catch and effect on spending
	Water management	Economic losses associated with flooding from lack of drainage
	Irrigation	Polluted surface water may lead to extraction of scarce groundwater; or use of polluted water for irrigation has implications for agricultural productivity and human health
	Other welfare impacts	1. 'Non-use' value of clean water resources such as 'existence' and 'bequest' values 2. Wildlife use of water resources
3. External environment	Aesthetics	Welfare loss from population exposure to open sewers / defecation
4. Other welfare	Intangible impacts	Welfare loss from lack of comfort, privacy, security, and convenience of unimproved sanitation; effects on status & prestige
	Time loss	Access time for urination in private place, especially women Access time for daytime defecation (when away from household)
	Life decisions and absence from daily activities	Poor sanitation in schools and the workplace affect attendance and drop-out rates, especially of girls and women
5. Other	Foreign direct investment	Companies selecting investment locations may be influenced by, among other factors, the sanitation situation in a country; tangible secondary evidence is, however, very limited.
	Macroeconomic impact	Overall impact on GDP and economic growth of the diverse micro-economic impacts of poor sanitation

Table B3. 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-person
Vibrio cholera	Bacterium	Fecal-oral	Water, food
Escherichia Coli	Bacterium	Fecal-oral	Food, water + person-person
Amebiasis (amebic dysentery)	Protozoa [1]	Fecal-oral	Person-person, food, water, animal feces
Giardiasis	Protozoa [1]	Fecal-oral	Person-person, water (animals)
Salmonellosis	Bacterium	Fecal-oral	Food
Shigellosis	Bacterium	Fecal-oral	Person-person +food, water
Campylobacter Enteritis	Bacterium	Fecal-oral	Food, animal feces
Helicobacter pylori	Bacterium	Fecal-oral	Person-person + food, water
Protozoa			
Other viruses [2]	Virus	Fecal-oral	Person-person, food, water
Malnutrition	Caused by diarrheal disease and helminthes		
Helminthes (worms)			
Intestinal nematodes [3]	Roundworm	Fecal-oral	Person-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-person + raw fish
Eye diseases			
Trachoma	Bacterium	Fecal-eye	Person-person, via flies, fomites, coughing
Adenoviruses (conjunctivitis)	Protozoa [1]	Fecal-eye	Person-person
Skin diseases			
Ringworm (Tinea)	Fungus (Ectoparasite)	Touch	Person-person
Scabies	Fungus (Ectoparasite)	Touch	Person-person, sharing bed and clothing
Other diseases			
Hepatitis A	Virus	Fecal-oral	Person-person, food, shellfish, water
Hepatitis E	Virus	Fecal-oral	Water
Poliomyelitis	Virus	Fecal-oral, oral-oral	Person-person
Leptospirosis	Bacterium	Animal urine-oral	Water and soil - swamps, rice fields, mud

Sources: World Health Organization http://www.who.int/water_sanitation_health/en/ and Hunter's Tropical Medicine and Emerging Infectious Diseases. Strickland GT. Eighth Edition ed. 2000. W.B. Saunders Company. 1192 pages

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), calicivirus (gastrointestinal infections), norwalk viruses (gastrointestinal infections), reovirus (respiratory and gastrointestinal infections)

[3] Intestinal nematodes include ascariasis (roundworm - soil), trichuriasis trichiura (whipworm), ancylostoma duodenale / Necator americanus (hookworm), and intestinal Capillariasis (raw freshwater fish).

Table B4. Outpatients seeking treatment by provider type, all diseases

Location	Public hospital	Private hospital	Private practice	Govern-ment health center	Para-medic	Tradit-ional healer	Mid-wife	Other	Total
Rural	6.2	2.5	17.1	42.7	23.6	2.3	0.7	4.8	100.0
Urban	10.1	6.5	30.8	34.6	11.9	1.8	0.5	3.8	100.0
Total	**8.0**	**4.3**	**23.1**	**39.2**	**18.5**	**2.1**	**0.6**	**4.3**	**100.0**

Source: Susenas 2006

Table B5. Disease treatment cost studies

Study (study year)	Health service level or type	Currency	Unit costs		
			Low	Mid	High
Diarrheal diseases					
Simanjuntak et al (2001) Outpatient visits, North Jakarta	Primary (public)	IDR	4,414		17,656
		USD	0.50		2.00
	Primary (private)	IDR	8,828		88,280
		USD	1.00		10.00
Karyana (2003) Outpatient visits, Tugu Selatan Primary (public health center)	Informal health care	IDR		5,000	
		USD		0.57	
	Self treatment	IDR	250	1,620	10,000
		USD	0.03	0.18	1.13
	Transport cost	IDR	500	3,000	8,000
		USD	0.06	0.34	0.91
		IDR	24,060	36,375	56,970
		USD	2.73	4.12	6.45
Soeharno (2001) Outpatient visits Sidoarjo, East Java Primary (public health center)	Medicine	IDR	25,116	43,933	76,752
		USD	2.85	4.98	8.69
	ORS, 2 days	IDR		593	1,281
		USD		0.07	0.15
	ORS, 5 days	IDR		1,443	
		USD		0.16	
	Antibiotics	IDR		1,463	
		USD		0.17	
Supomo (2001) Outpatient visits Sidoarjo, Central Java Primary (public health center)	Patient cost diarrhea	IDR		644	1,085
		USD		0.07	0.12
	Patient cost pneumonia	IDR		527	802
		USD		0.06	0.09
	Full treatment cost diarrhea	IDR		5,661	38,208
		USD		0.64	4.33
	Full treatment cost pneumonia	IDR		5,275	35,354
		USD		0.60	4.00
Surahman (2001) Inpatient cost (private hospital)	Total out of pocket cost	IDR		4,204,852	
		USD		476.31	
Sofyan (2004) Outpatient cost, Serang, Banten Primary (public health center)		IDR	8,516		15,315
		USD	0.96		1.73
Ermawati, 2005 (2004) Inpatient cost, Tangerang, Banten (public hospital)	Severe (with complications)	IDR	827,195	1,288,158	1,827,038
		USD	93.70	145.92	206.96
	Non-severe (with/out complications)	IDR	454,401	454,401	800,344
		USD	51.47	51.47	90.66

Study (study year)	Health service level or type	Currency	Unit costs		
			Low	Mid	High
Typhoid					
Wahyuni, 2004 (2004) Inpatient cost, Jakarta (public hospital)	With complications	IDR	1,522,148	3,281,210	7,033,503
		USD	172.42	371.68	796.73
	No complications	IDR	1,041,560	1,736,953	3,439,027
		USD	117.98	196.75	389.56
Hadiwiardjo, 2006 (2006) Outpatient cost, Tangerang, Banten (public health center)		IDR		94,377	129,864
		USD		10.69	14.71
Tuberculosis					
Baroroh, 2004 (2004) Purbalingga, West Java (public health center)	Government subsidy	IDR		499,526	
		USD		56.58	
	Patient out of pocket cost	IDR		77,540	
		USD		8.78	
Malaria					
Yanuar, 2004 (2003) Sungailiat, Bangka (public hospital)	Outpatient	IDR	3,500	28,310	120,000
		USD	0.40	3.21	13.59
	Inpatient	IDR	93,500	351,985	1,438,000
		USD	10.59	39.87	162.89
	Self treatment	IDR	1,000	2,510	11,800
		USD	0.11	0.28	1.34
	Traditional treatment	IDR	1,500	2,350	4,000
		USD	0.17	0.27	0.45
	Other out of pocket costs	IDR	12,500	97,355	289,000
		USD	1.42	11.03	32.74
Cost comparison Inpatient Sukabumi, West Java Primary (public health center)	Full cost	IDR		4,459	
		USD		0.51	
	Patient tariff	IDR		2,000	
		USD		0.23	
Hartono (2000) Inpatient cost Jakarta (type C low, type B high)	Public hospital	IDR	208,039		444,336
		USD	23.57		50.33
	Private hospital	IDR	1,020,651		1,366,212
		USD	115.62		154.76
Malnutrition					
Friedman et al (2004) Outpatient cost Various (public health centers supplemental feeding)	Marginal cost	IDR	175,455	204,843	219,108
		USD	19.87	23.20	24.82
	Total (full cost)	IDR	183,264	207,521	221,882
		USD	20.76	23.51	25.13
	Therapeutic feeding				
	Marginal cost	IDR	188,868	241,240	402,774
		USD	21.39	27.33	45.62
	Total (full cost)	IDR	191,452	257,049	408,234
		USD	21.69	29.12	46.24
	Vitamin A supplement				
	Marginal cost	IDR	710	1,450	1,948
		USD	0.08	0.16	0.22
	Total (full cost)	IDR	1,317	2,057	2,513
		USD	0.15	0.23	0.28

Table B6. Total health-related costs (IDR billion)

Disease	Total financial costs				Total economic costs			
	Health care	Prod-uctivity	Premature death	Total	Health care	Prod-uctivity	Premature death	Total
Diarrheal diseases	388	821	433	1,642	503	2,595	14,875	17,983
Helminths	26	9	0	35	44	18	0	62
Skin diseases	530	194	9	733	706	424	194	1,333
Trachoma	9	0	0	9	9	9	0	18
Hepatitis A	18	9	0	26	18	18	79	124
Hepatitis E	1	0	0	0	0	0	9	9
Malnutrition, direct	238	0	0	238	327	26	9,614	9,967
Malnutrition, indirect	26	0	0	26	35	0	0	35
Total	1,236	1,033	441	2,719	1,642	3,090	24,780	29,512

Table B7. Selected drinking water quality standards in Indonesia

Indicator	Unit	Indonesia standard
pH value	Unit	6-9
Suspended solids	Mg/L	50
Total dissolved solids	Mg/L	1000
Dissolved oxygen	Mg/L	6
Biological oxygen demand	Mg/L	2
COD	Mg/L	10
Phosphate	mg/L	0.2
NO_3	mg/L	10
NH_3-N	mg/L	0.5
Arsenic	mg/L	0.05
Cobalt	mg/L	0.2
Barium	mg/L	1
Boron	mg/L	1
Selenium	mg/L	0.01
Cadmium	mg/L	0.01
Chrome (IV)	mg/L	0.05
Copper	mg/L	0.02
Iron	mg/L	0.3

Source: Government Regulation No 82/2001

Annex C: Provincial Data Inputs and Results

Table C1. Population size by province and region in Indonesia, 2006

Province	Population			Households	
	Rural	Urban	Total	Average size (2005)	Total
Sumatra					
NAD	3,028,642	1,023,912	4,052,553	3.8	1,055,058
North Sumatra	6,832,531	5,786,468	12,618,998	4.3	2,962,612
West Sumatra	3,247,684	1,386,478	4,634,161	4.0	1,151,036
Riau	3,021,262	1,743,415	4,764,677	3.9	1,236,319
Jambi	1,954,587	729,883	2,684,470	3.9	693,092
South Sumatra	4,588,790	2,314,275	6,903,065	3.9	1,763,500
Bengkulu	1,122,646	446,148	1,568,794	3.8	411,678
Lampung	5,701,178	1,513,202	7,214,380	3.9	1,832,252
Bangka Belitung	635,011	440,270	1,075,281	4.0	265,636
Riau Archipelago	275,917	1,062,546	1,338,463	3.9	347,299
Java-Bali					
Jakarta	0	8,966,706	8,966,706	3.5	2,529,972
West Java	19,203,877	20,443,459	39,647,335	3.3	12,029,882
Central Java	19,132,359	12,999,103	32,131,462	3.7	8,705,992
Yogyakarta	1,385,132	2,004,996	3,390,128	3.2	1,052,353
East Java	21,656,344	14,950,066	36,606,411	3.5	10,602,134
Banten	4,359,731	4,867,719	9,227,450	3.7	2,481,957
Bali	1,692,353	1,740,619	3,432,972	3.7	921,483
Nusa Tenggara					
West Nusa Tenggara	2,731,237	1,489,160	4,220,397	3.3	1,262,645
East Nusa Tenggara	3,677,128	679,875	4,357,003	4.6	942,879
Kalimantan					
West Kalimantan	2,966,742	1,092,898	4,059,639	4.1	980,675
Central Kalimantan	1,369,853	557,111	1,926,964	3.6	541,895
South Kalimantan	2,072,930	1,274,374	3,347,305	3.6	918,978
East Kalimantan	1,279,230	1,658,451	2,937,680	3.7	783,433
Sulawesi					
North Sulawesi	1,350,493	804,897	2,155,390	3.4	632,735
Central Sulawesi	1,856,156	463,240	2,319,396	4.0	582,941
South Sulawesi	5,295,299	2,286,499	7,581,797	4.1	1,829,339
Southeast Sulawesi	1,566,367	436,311	2,002,678	4.1	488,319
Gorontalo	696,586	245,232	941,818	3.4	274,752
West Sulawesi	783,258	195,477	978,736	4.1	236,150
Maluku and Papua					
Maluku	906,338	365,226	1,271,564	5.0	256,632
North Maluku	678,544	220,098	898,642	5.5	163,528
West Papua	485,518	171,448	656,965	3.6	184,936
Papua	1,416,045	500,039	1,916,084	3.6	539,379
National	**126,969,767**	**94,859,597**	**221,829,364**	**3.7**	**60,661,472**

Source: Authors' projection for 2006, based on 2005 Intercensal Survey (Statistics Indonesia), adjusted by average population growth 2000-2005 by province from Indonesia Yearly Statistics (Statistics Indonesia) 2005/2006.

Table C2. Sanitation coverage by province and rural/urban grouping

Province	Location	Improved sanitation %			Unimproved sanitation %				All %
		Septic tank	Pit latrine	Total	Water body garden, field, beach	Pit latrine	Other	Total	
NAD	Rural	24.8	15.5	40.3	39.4	15.5	4.7	59.7	100.0
	Urban	68.5	9.4	78.0	11.6	9.4	1.0	22.1	100.0
	Total	34.3	14.2	48.5	33.4	14.2	3.9	51.5	100.0
North Sumatra	Rural	28.5	18.9	47.4	27.4	18.9	6.2	52.6	100.0
	Urban	71.5	9.3	80.8	7.5	9.3	2.4	19.2	100.0
	Total	47.2	14.7	62.0	18.8	14.7	4.5	38.0	100.0
West Sumatra	Rural	19.7	8.7	28.4	59.6	8.7	3.3	71.6	100.0
	Urban	63.7	7.2	70.9	20.0	7.2	1.9	29.1	100.0
	Total	33.4	8.2	41.6	47.3	8.2	2.9	58.4	100.0
Riau	Rural	1.1	35.5	36.6	24.1	35.5	3.8	63.4	100.0
	Urban	70.9	11.7	82.6	5.5	11.7	0.2	17.4	100.0
	Total	36.0	23.6	59.6	14.8	23.6	2.0	40.4	100.0
Jambi	Rural	19.5	16.6	36.1	45.1	16.6	2.2	63.9	100.0
	Urban	65.4	8.6	74.1	16.2	8.6	1.1	25.9	100.0
	Total	32.0	14.5	46.4	37.2	14.5	1.9	53.6	100.0
South Sumatra	Rural	18.0	20.7	38.7	38.9	20.7	1.8	61.3	100.0
	Urban	64.9	12.3	77.2	9.8	12.3	0.7	22.8	100.0
	Total	33.2	18.0	51.1	29.5	18.0	1.4	48.9	100.0
Bengkulu	Rural	16.4	22.0	38.4	36.4	22.0	3.2	61.6	100.0
	Urban	56.2	16.1	72.3	5.2	16.1	6.3	27.7	100.0
	Total	27.1	20.4	47.5	28.0	20.4	4.1	52.5	100.0
Lampung	Rural	20.6	31.2	51.7	16.0	31.2	1.1	48.3	100.0
	Urban	56.6	15.0	71.6	11.5	15.0	1.9	28.4	100.0
	Total	28.1	27.8	55.9	15.1	27.8	1.3	44.1	100.0
Bangka Belitung	Rural	37.1	8.7	45.9	37.6	8.7	7.9	54.2	100.0
	Urban	65.4	10.4	75.8	10.5	10.4	3.4	24.2	100.0
	Total	48.6	9.4	58.0	26.6	9.4	6.1	42.0	100.0
Riau Archipelago	Rural	16.2	9.1	25.3	62.0	9.1	3.6	74.7	100.0
	Urban	53.8	16.1	69.9	13.4	16.1	0.5	30.1	100.0
	Total	46.4	14.8	61.2	23.0	14.8	1.1	38.8	100.0
Jakarta	Total	82.3	5.7	88.0	5.9	5.7	0.3	12.0	100.0
West Java	Rural	28.1	11.2	39.2	47.9	11.2	1.7	60.8	100.0
	Urban	56.6	7.4	64.0	27.2	7.4	1.4	36.0	100.0
	Total	42.6	9.2	51.8	37.4	9.2	1.6	48.2	100.0
Central Java	Rural	30.2	17.5	47.7	33.4	17.5	1.4	52.3	100.0
	Urban	61.9	7.4	69.2	22.7	7.4	0.8	30.8	100.0
	Total	43.1	13.4	56.5	29.0	13.4	1.1	43.5	100.0
Yogyakarta	Rural	32.3	29.9	62.1	6.4	29.9	1.6	37.9	100.0
	Urban	79.5	5.1	84.6	8.4	5.1	1.9	15.4	100.0
	Total	60.4	15.1	75.5	7.6	15.1	1.8	24.5	100.0
East Java	Rural	22.7	21.5	44.2	33.1	21.5	1.2	55.8	100.0
	Urban	56.8	12.7	69.5	17.2	12.7	0.6	30.5	100.0
	Total	36.8	17.8	54.6	26.6	17.8	1.0	45.4	100.0

Province	Location	Improved sanitation %			Unimproved sanitation %				All %
		Septic tank	Pit latrine	Total	Water body garden, field, beach	Pit latrine	Other	Total	
Banten	Rural	22.7	11.2	33.9	52.5	11.2	2.4	66.1	100.0
	Urban	65.8	11.1	76.9	11.5	11.1	0.5	23.1	100.0
	Total	46.8	11.1	57.9	29.7	11.1	1.3	42.1	100.0
B a l i	Rural	48.6	9.5	58.1	28.6	9.5	3.8	41.9	100.0
	Urban	76.9	7.2	84.1	7.8	7.2	1.0	15.9	100.0
	Total	63.8	8.2	72.0	17.5	8.2	2.3	28.0	100.0
West Nusa Tenggara	Rural	17.1	10.5	27.6	58.3	10.5	3.7	72.4	100.0
	Urban	31.2	14.7	45.9	37.1	14.7	2.3	54.1	100.0
	Total	22.2	12.0	34.2	50.6	12.0	3.2	65.8	100.0
East Nusa Tenggara	Rural	7.8	28.3	36.1	24.1	28.3	11.6	63.9	100.0
	Urban	34.3	29.4	63.7	5.9	29.4	1.0	36.3	100.0
	Total	11.9	28.5	40.4	21.2	28.5	9.9	59.6	100.0
West Kalimantan	Rural	15.3	18.4	33.7	43.1	18.4	4.9	66.3	100.0
	Urban	64.8	11.6	76.4	10.3	11.6	1.8	23.6	100.0
	Total	28.3	16.6	44.9	34.4	16.6	4.0	55.1	100.0
Central Kalimantan	Rural	8.4	16.1	24.4	58.5	16.1	1.1	75.6	100.0
	Urban	43.3	18.3	61.6	19.9	18.3	0.3	38.5	100.0
	Total	18.6	16.7	35.3	47.1	16.7	0.9	64.7	100.0
South Kalimantan	Rural	16.6	20.5	37.1	41.6	20.5	0.8	62.9	100.0
	Urban	42.1	19.6	61.8	17.8	19.6	0.8	38.2	100.0
	Total	26.1	20.2	46.3	32.8	20.2	0.8	53.7	100.0
East Kalimantan	Rural	25.9	22.5	48.3	27.2	22.5	2.0	51.7	100.0
	Urban	61.7	13.3	74.9	11.7	13.3	0.2	25.1	100.0
	Total	45.3	17.5	62.8	18.8	17.5	1.0	37.2	100.0
North Sulawesi	Rural	41.7	18.1	59.8	19.0	18.1	3.0	40.2	100.0
	Urban	54.0	20.1	74.1	4.2	20.1	1.7	25.9	100.0
	Total	46.4	18.9	65.3	13.4	18.9	2.5	34.8	100.0
Central Sulawesi	Rural	23.5	12.5	36.0	43.6	12.5	7.9	64.0	100.0
	Urban	67.4	10.4	77.8	10.1	10.4	1.7	22.2	100.0
	Total	32.3	12.1	44.4	36.9	12.1	6.6	55.6	100.0
South Sulawesi	Rural	29.9	16.0	45.9	36.1	16.0	2.0	54.1	100.0
	Urban	71.2	8.9	80.1	10.0	8.9	1.1	19.9	100.0
	Total	43.0	13.7	56.8	27.8	13.7	1.7	43.3	100.0
Southeast Sulawesi	Rural	22.5	20.0	42.5	33.8	20.0	3.7	57.5	100.0
	Urban	62.2	13.1	75.3	10.9	13.1	0.8	24.7	100.0
	Total	31.2	18.5	49.7	28.8	18.5	3.0	50.3	100.0
Gorontalo	Rural	16.8	12.4	29.2	52.2	12.4	6.2	70.8	100.0
	Urban	44.4	17.9	62.4	17.4	17.9	2.4	37.6	100.0
	Total	24.3	13.9	38.1	42.8	13.9	5.2	61.9	100.0
West Sulawesi	Rural	16.5	13.7	30.1	53.1	13.7	3.1	69.9	100.0
	Urban	42.4	13.2	55.6	30.5	13.2	0.7	44.4	100.0
	Total	20.3	13.6	33.9	49.8	13.6	2.8	66.1	100.0
Maluku	Rural	15.7	12.0	27.7	54.9	12.0	5.3	72.3	100.0
	Urban	63.2	9.5	72.7	17.4	9.5	0.5	27.4	100.0
	Total	29.3	11.3	40.7	44.1	11.3	3.9	59.4	100.0

Province	Location	Improved sanitation %			Unimproved sanitation %				All %
		Septic tank	Pit latrine	Total	Water body garden, field, beach	Pit latrine	Other	Total	
North Maluku	Rural	29.3	10.1	39.4	47.1	10.1	3.4	60.6	100.0
	Urban	69.5	7.9	77.4	13.9	7.9	0.8	22.6	100.0
	Total	39.2	9.6	48.8	39.0	9.6	2.7	51.2	100.0
West Papua	Rural	16.9	10.1	27.0	59.8	10.1	3.3	73.1	100.0
	Urban	66.0	5.6	71.6	21.5	5.6	1.2	28.4	100.0
	Total	33.8	8.6	42.4	46.5	8.6	2.6	57.6	100.0
Papua	Rural	10.7	16.8	27.6	37.4	16.8	18.3	72.4	100.0
	Urban	56.9	16.0	72.9	10.3	16.0	0.9	27.1	100.0
	Total	21.5	16.6	38.1	31.1	16.6	14.2	61.9	100.0
Indonesia Total	**Rural**	**24.4**	**17.8**	**42.2**	**37.3**	**17.8**	**2.8**	**57.9**	**100.0**
	Urban	**62.3**	**9.7**	**72.0**	**17.2**	**9.7**	**1.0**	**28.0**	**100.0**
	Total	**40.7**	**14.3**	**55.0**	**28.7**	**14.3**	**2.0**	**45.0**	**100.0**

Source: Susenas 2006

Table C3. Annual incidence of diarrheal disease for children under five years, by province

Province	Diarrheal incidence	Province	Diarrheal incidence
Nanggroe Aceh Darussalam	2.3232	West Nusa Tenggara	2.8512
North Sumatra	2.5978	East Nusa Tenggara	2.7245
West Sumatra	3.0202	West Kalimantan	1.7530
R i a u	1.2883	Central Kalimantan	0.5069
J a m b i	1.7107	South Kalimantan	2.0909
South Sumatra	0.6970	East Kalimantan	2.3443
Bengkulu	1.7318	North Sulawesi	2.0064
Lampung	1.9430	Central Sulawesi	1.3517
Bangka Belitung	1.9853	South Sulawesi	3.2736
Riau Archipelago	1.2883	Southeast Sulawesi	1.9008
Jakarta	1.6474	Gorontalo	2.5766
West Java	3.1891	West Sulawesi	3.2736
Central Java	1.6685	Maluku	2.3232
Yogyakarta	1.0982	North Maluku	2.3232
East Java	2.0698	West Papua	2.3232
Banten	2.6400	Papua	2.3232
B a l i	2.5133	**National**	**2.3232**

Source: Indonesia Demographic and Health Survey 2002-3

Table C4. Treatment seeking behavior by province and rural/urban grouping

Province	Location	% Seeking outpatient treatment			% Self treatment	Total
		Formal provider	Informal provider	Total		
NAD	Rural	29	9	38	62	100
	Urban	33	8	41	59	100
	Total	30	9	38	62	100
North Sumatra	Rural	17	11	27	73	100
	Urban	25	7	32	68	100
	Total	21	9	29	71	100
West Sumatra	Rural	22	16	38	62	100
	Urban	32	12	43	57	100
	Total	24	15	39	61	100
Riau	Rural	14	4	18	82	100
	Urban	28	3	30	70	100
	Total	19	3	22	78	100
Jambi	Rural	19	3	22	78	100
	Urban	38	6	44	56	100
	Total	25	4	29	71	100
South Sumatra	Rural	20	6	26	74	100
	Urban	29	2	31	69	100
	Total	23	5	28	72	100
Bengkulu	Rural	18	8	26	74	100
	Urban	30	7	36	64	100
	Total	21	8	29	71	100
Lampung	Rural	17	12	29	71	100
	Urban	24	9	34	66	100
	Total	19	11	30	70	100
Bangka Belitung	Rural	22	7	27	73	100
	Urban	32	8	40	60	100
	Total	25	7	32	68	100
Riau Archipelago	Rural	31	6	37	63	100
	Urban	29	5	33	67	100
	Total	29	5	34	66	100
Jakarta	Total	36	3	39	61	100
West Java	Rural	26	13	33	67	100
	Urban	39	11	40	60	100
	Total	32	12	36	64	100
Central Java	Rural	24	14	38	62	100
	Urban	33	8	41	59	100
	Total	28	11	39	61	100

Province	Location	% Seeking outpatient treatment			% Self treatment	Total
		Formal provider	Informal provider	Total		
Yogyakarta	Rural	32	8	40	60	100
	Urban	32	4	36	64	100
	Total	32	6	38	62	100
East Java	Rural	19	13	33	67	100
	Urban	27	9	36	64	100
	Total	23	11	34	66	100
Banten	Rural	17	6	23	77	100
	Urban	26	4	30	70	100
	Total	22	5	27	73	100
B a l i	Rural	36	14	50	50	100
	Urban	38	6	44	56	100
	Total	37	10	47	53	100
West Nusa Tenggara	Rural	27	10	36	64	100
	Urban	27	7	34	66	100
	Total	27	9	35	65	100
East Nusa Tenggara	Rural	37	8	45	55	100
	Urban	45	2	48	52	100
	Total	38	7	46	54	100
West Kalimantan	Rural	20	8	28	72	100
	Urban	24	6	30	70	100
	Total	22	7	29	71	100
Central Kalimantan	Rural	20	4	24	76	100
	Urban	24	7	30	70	100
	Total	21	5	26	74	100
South Kalimantan	Rural	17	10	27	73	100
	Urban	22	5	27	73	100
	Total	19	8	27	73	100
East Kalimantan	Rural	28	8	30	70	100
	Urban	34	4	37	63	100
	Total	31	6	34	66	100
North Sulawesi	Rural	25	7	31	69	100
	Urban	31	3	34	66	100
	Total	27	5	32	68	100

Province	Location	% Seeking outpatient treatment			% Self treatment	Total
		Formal provider	Informal provider	Total		
Central Sulawesi	Rural	18	7	26	74	100
	Urban	32	5	37	63	100
	Total	21	7	28	72	100
South Sulawesi	Rural	21	6	27	73	100
	Urban	27	4	30	70	100
	Total	23	5	28	72	100
Southeast Sulawesi	Rural	19	4	23	77	100
	Urban	20	2	22	78	100
	Total	19	4	23	77	100
Gorontalo	Rural	21	7	29	71	100
	Urban	30	10	40	60	100
	Total	24	8	32	68	100
West Sulawesi	Rural	17	3	20	80	100
	Urban	26	4	30	70	100
	Total	18	3	21	79	100
Maluku	Rural	23	4	27	73	100
	Urban	25	2	27	73	100
	Total	17	3	19	81	100
North Maluku	Rural	20	6	26	74	100
	Urban	34	7	41	59	100
	Total	23	6	29	71	100
West Papua	Rural	30	1	31	69	100
	Urban	19	12	31	69	100
	Total	22	9	31	69	100
Papua	Rural	28	3	31	69	100
	Urban	26	2	28	72	100
	Total	27	3	30	70	100
Indonesia Total	**Rural**	**23**	**10**	**32**	**68**	**100**
	Urban	**32**	**7**	**37**	**63**	**100**
	Total	**33**	**2**	**34**	**66**	**100**

Source: Susenas 2006

Table C5. Comparison of alternative sources of time value

Province	GDP per capita		Average compensation to employees		Minimum wage		Average wage	
	Year[1] (IDR mill.)	Hour (IDR th.)	Year[1] (IDR mill.)	Hour (IDR th.)	Year[1] (IDR mill)	Hour (IDR th.)	Year[1] (IDR mill)	Hour (IDR th.)
NAD	8.3	4.1	17.2	8.5	9.8	4.9	11.0	5.5
North Sumatra	11.6	5.7	24.1	12.0	8.9	4.4	9.5	4.8
West Sumatra	10.4	5.2	21.7	10.8	7.8	3.9	9.6	4.8
Riau	18.4	9.1	38.2	19.0	9.1	4.5	11.5	5.7
Jambi	7.4	3.7	15.4	7.7	6.8	3.4	11.1	5.5
South Sumatra	8.3	4.1	17.2	8.6	7.2	3.6	9.2	4.6
Bengkulu	6.9	3.4	14.3	7.1	6.2	3.1	9.8	4.9
Lampung	5.8	2.9	12.1	6.0	6.1	3.0	6.9	3.4
Bangka Belitung Is.	13.0	6.4	27.1	13.4	13.0	6.4	11.2	5.6
Riau Archipelago	31.3	15.5	64.9	32.2	7.3	3.6	14.8	7.3
DKI Jakarta	52.3	26.0	108.5	53.8	9.8	4.9	14.7	7.3
West Java	10.1	5.0	20.9	10.4	5.4	2.6	9.0	4.4
Central Java	6.7	3.4	13.9	6.9	5.4	2.6	7.0	3.4
DI Yogyakarta	8.1	4.0	16.7	8.3	5.5	2.7	8.7	4.3
East Java	11.8	5.8	24.5	12.2	4.7	2.3	7.2	3.5
Banten	10.0	4.9	20.7	10.3	7.0	3.4	11.2	5.6
Bali	10.7	5.3	22.2	11.0	6.1	3.0	10.1	5.0
West Nusa Tenggara	6.6	3.3	13.6	6.7	6.6	3.3	6.2	3.1
East Nusa Tenggara	3.7	1.9	7.6	3.8	6.6	3.3	8.5	4.2
West Kalimantan	8.9	4.4	18.4	9.2	6.1	3.1	9.8	4.9
Central Kalimantan	11.7	5.8	24.3	12.0	7.6	3.8	11.6	5.7
South Kalimantan	9.2	4.6	19.2	9.5	7.5	3.7	10.0	4.9
East Kalimantan	24.8	12.3	51.5	25.5	8.2	4.1	17.7	8.8
North Sulawesi	8.9	4.4	18.5	9.2	6.9	3.4	10.8	5.4
Central Sulawesi	7.9	4.0	16.5	8.2	6.9	3.4	8.6	4.2
South Sulawesi	7.4	3.6	15.3	7.6	7.3	3.6	10.1	5.0
Southeast Sulawesi	7.1	3.5	14.6	7.2	7.3	3.6	9.5	4.7
Gorontalo	3.9	1.9	8.1	4.1	6.3	3.2	10.0	4.9
West Sulawesi	4.9	2.4	10.1	5.0	7.3	3.6	8.8	4.3
Maluku	3.9	1.9	8.1	4.0	6.9	3.4	11.0	5.5
North Maluku	3.1	1.5	6.5	3.2	6.3	3.2	11.2	5.6
West Papua	9.0	4.4	18.6	9.3	9.9	4.9	13.7	6.8
Papua	24.8	12.3	51.5	25.5	9.9	4.9	19.1	9.4
National	**11.8**	**5.8**	**24.5**	**12.2**	**7.2**	**3.6**	**9.1**	**4.5**

Source: Statistics Indonesia. Annual values in IDR million. Hourly valued in IDR thousand.
[1] Annual value converted to hourly value, assuming 8 working hours/day, and 252 working days/year.

Table C6. Value of human life using human capital approach (IDR million)

Province	Annual compensation to employees	Value of human life					
		Low value		Base Case Value		High value	
		0-15 years	15+ years	0-15 years	15+ years	0-15 years	15+ years
NAD	17.2	438.6	220.8	518.2	238.2	742.2	278.2
North Sumatra	24.1	617.4	310.7	729.4	335.3	1,044.5	391.6
West Sumatra	21.7	553.6	278.6	654.1	300.7	936.7	351.2
Riau	38.2	976.9	491.6	1,154.1	530.5	1,652.8	619.7
Jambi	15.4	395.1	198.8	466.8	214.5	668.4	250.6
South Sumatra	17.2	439.9	221.4	519.7	238.9	744.3	279.0
Bengkulu	14.3	365.5	184.0	431.9	198.5	618.5	231.9
Lampung	12.1	309.0	155.5	365.1	167.8	522.8	196.0
Bangka Belitung Is.	27.1	692.3	348.4	817.9	375.9	1,171.3	439.1
Riau Archipelago	64.9	1,660.7	835.8	1,962.0	901.9	2,809.8	1,053.4
DKI Jakarta	108.5	2,773.6	1,395.8	3,276.8	1,506.2	4,692.7	1,759.3
West Java	20.9	535.6	269.5	632.8	290.8	906.2	339.7
Central Java	13.9	356.1	179.2	420.7	193.4	602.5	225.9
DI Yogyakarta	16.7	427.3	215.0	504.8	232.0	722.9	271.0
East Java	24.5	627.5	315.8	741.4	340.8	1,061.7	398.1
Banten	20.7	530.4	266.9	626.6	288.0	897.3	336.4
Bali	22.2	567.7	285.7	670.7	308.3	960.5	360.1
West Nusa Tenggara	18.4	471.2	237.1	556.7	255.9	797.2	298.9
East Nusa Tenggara	24.3	621.1	312.6	733.8	337.3	1,050.8	394.0
West Kalimantan	19.2	490.3	246.7	579.2	266.3	829.5	311.0
Central Kalimantan	51.5	1,315.8	662.2	1,554.5	714.6	2,226.3	834.6
South Kalimantan	18.5	473.0	238.1	558.9	256.9	800.4	300.1
East Kalimantan	16.5	421.4	212.1	497.8	228.8	712.9	267.3
North Sulawesi	15.3	391.2	196.9	462.1	212.4	661.8	248.1
Central Sulawesi	14.6	374.2	188.3	442.1	203.2	633.1	237.4
South Sulawesi	8.1	207.8	104.6	245.5	112.9	351.6	131.8
Southeast Sulawesi	10.1	258.2	129.9	305.0	140.2	436.8	163.8
Gorontalo	13.6	348.1	175.2	411.2	189.0	588.9	220.8
West Sulawesi	7.6	193.9	97.6	229.1	105.3	328.1	123.0
Maluku	8.1	205.8	103.6	243.1	111.8	348.2	130.5
North Maluku	6.5	165.2	83.1	195.2	89.7	279.5	104.8
West Papua	18.6	476.7	239.9	563.2	258.9	806.6	302.4
Papua	51.5	1,316.7	662.6	1,555.6	715.0	2,227.7	835.2
National average	**24.5**	**626.6**	**315.3**	**740.2**	**340.3**	**1,060.1**	**397.4**

Source: Authors' estimates

Table C7. Main rivers in Indonesia

Province	River	River basin area (km²)	Flow (m³/second)	
			Maximum	Minimum
North Sumatra	Asahan	4,669	481	15
	Gambus	1,013	299	30
West Sumatra	Batang Hari	4,952	4,800	35
	Batang Kuantan	2,215	808	3
	Batang Pasaman	1,395	1,446	27
Lampung	W. Tulang Bawang	3,427	862	5
	W. Sekampung	1,696	1,276	3
	W Seputih	1,648	302	0
	Kali Pemali	1,111	701	-
Yogyakarta	Kali Progo	3,388	2,500	0
East Java	Bengawan Solo	62,986	13,497	14
	Kali Brantas	70,167	34,507	72
Banten	Ciujung	4,549	4,183	20
	Cisadane	1,146	350	-
West Nusa Tenggara	Parado		1,499	441
	Tiu Kulit		1,047	308
East Nusa Tenggara	Babak		587	274
	Meninting		440	169
Central Kalimantan	Barito	32,067	5,663	63
	Kahayan	14,175	2,267	101
	Katingan	11,929	3,902	51
Central Sulawesi	Tambalako	1,353	976	1
	Buol	1,413	421	31
South Sulawesi	Cenranae	11,866	6,963	30

Table C8. Main lakes in Indonesia

Province	Lake	Surface area km²	Volume m³
NAD	Lhok Gajah	10	400,000
	Paya Sikam	77	1,170,000
North Sumatra	Aek Natona	9	800,000
	Hasang	3	350,000
West Sumatra	Telaga Bir	5	850,000
	Telaga Kay	2	600,000
R i a u	Guntung	2	50,000
	Sekanak	7	171,000
South Sumatra	Kolong Kac	100	3,000,000
	Air Siku	200	12,000,000
Lampung	Way Tengko	3	470,000
	Way Sido M	2	490,000
	Way Batu L	5	640,817
West Java	Tonjong	1	730,000
Central Java	Wonosari	2	50,000
	Sumber Agu	1	75,000
Yogyakarta	Mejing	3	51,000
	Kalen	1	24,000
North Sulawesi	Karuyan	2	50,000
	Sidodadi	3	50,000
South Sulawesi	Tonjong	1	730,000
	Palaguna	86	1,300,000
	Sabulakoa	32	356,400
Southeast Sulawesi	Lakara	34	181,300

Table C9. Proportion of untreated sewage discharged to water bodies[1]

Province	Location	% sewage discharged directly into water body	% open defecation in water courses	Septic tanks not managed properly		Leaking pit latrine		Total
				Total %	% to ground water	Total %	% to ground water	
NAD	Rural	31.49	11.79	12.40	6.20	15.54	7.77	57.25
	Urban	22.91	3.95	34.27	17.14	9.41	4.71	48.69
	Total	29.63	10.09	17.14	8.57	14.21	7.10	55.39
North Sumatra	Rural	24.68	11.16	14.26	7.13	18.93	9.47	52.43
	Urban	23.71	3.19	35.75	17.88	9.32	4.66	49.43
	Total	24.26	7.69	23.62	11.81	14.75	7.37	51.13
West Sumatra	Rural	41.73	14.74	9.86	4.93	8.67	4.33	65.73
	Urban	26.74	6.51	31.87	15.94	7.18	3.59	52.77
	Total	37.08	12.19	16.69	8.34	8.20	4.10	61.72
Riau	Rural	16.96	7.47	0.54	0.27	35.52	17.76	42.46
	Urban	21.77	0.96	35.47	17.74	11.67	5.83	46.29
	Total	19.36	4.22	18.01	9.00	23.59	11.80	44.38
Jambi	Rural	43.84	5.25	9.76	4.88	16.62	8.31	62.27
	Urban	28.93	2.92	32.72	16.36	8.63	4.32	52.52
	Total	39.80	4.61	15.98	7.99	14.46	7.23	59.63
South Sumatra	Rural	37.75	4.59	9.01	4.51	20.66	10.33	57.17
	Urban	23.55	1.92	32.46	16.23	12.30	6.15	47.85
	Total	33.16	3.72	16.59	8.30	17.96	8.98	54.15
Bengkulu	Rural	29.58	8.69	8.20	4.10	22.00	11.00	53.36
	Urban	16.56	7.68	28.08	14.04	16.15	8.07	46.35
	Total	26.07	8.42	13.56	6.78	20.42	10.21	51.48
Lampung	Rural	15.14	4.09	10.29	5.14	31.18	15.59	39.96
	Urban	22.75	3.32	28.30	14.15	15.03	7.52	47.73
	Total	16.73	3.92	14.05	7.02	27.81	13.90	41.58
Bangka Belitung	Rural	12.59	25.02	18.57	9.29	8.71	4.36	51.24
	Urban	19.14	7.21	32.72	16.36	10.36	5.18	47.89
	Total	15.24	17.80	24.31	12.15	9.38	4.69	49.88
Riau Archipelago	Rural	46.37	13.47	8.12	4.06	9.06	4.53	68.43
	Urban	23.92	1.98	26.89	13.45	16.15	8.07	47.41
	Total	28.32	4.23	23.22	11.61	14.76	7.38	51.53
Jakarta	Total	4.14	2.08	41.15	41.15	5.75	5.75	53.11
West Java	Rural	34.63	15.38	28.05	14.03	11.17	5.58	69.61
	Urban	34.90	4.61	28.32	14.16	7.39	3.69	57.36
	Total	31.32	9.90	21.30	10.65	9.24	4.62	56.49

Province	Location	% sewage discharged directly into water body	% open defecation in water courses	Septic tanks not managed properly		Leaking pit latrine		Total
				Total %	% to ground water	Total %	% to ground water	
Central Java	Rural	30.52	6.62	15.09	7.55	17.51	8.76	53.44
	Urban	34.03	2.81	30.95	15.47	7.35	3.68	55.99
	Total	31.95	5.06	21.55	10.78	13.37	6.69	54.47
Yogyakarta	Rural	12.41	2.62	16.14	8.07	29.86	14.93	38.02
	Urban	25.50	3.32	39.73	19.87	5.10	2.55	51.23
	Total	20.21	3.05	30.19	15.10	15.11	7.56	45.90
East Java	Rural	30.03	5.61	11.35	5.67	21.49	10.74	52.05
	Urban	29.51	1.59	28.41	14.20	12.67	6.34	51.64
	Total	29.82	3.95	18.40	9.20	17.84	8.92	51.89
Banten	Rural	21.35	20.85	11.36	5.68	11.18	5.59	53.47
	Urban	19.39	4.76	32.92	16.46	11.09	5.55	46.15
	Total	20.25	11.88	23.38	11.69	11.13	5.57	49.38
B a l i	Rural	20.15	14.11	24.31	12.16	9.48	4.74	51.14
	Urban	23.04	2.94	38.46	19.23	7.18	3.59	48.80
	Total	21.69	8.13	31.89	15.94	8.25	4.12	49.88
West Nusa Tenggara	Rural	33.01	18.44	8.55	4.28	10.47	5.24	60.96
	Urban	36.62	6.44	15.60	7.80	14.72	7.36	58.21
	Total	34.31	14.10	11.10	5.55	12.01	6.01	59.96
East Nusa Tenggara	Rural	3.02	23.06	3.89	1.94	28.31	14.15	42.17
	Urban	9.60	3.46	17.15	8.57	29.39	14.69	36.33
	Total	4.05	19.99	5.96	2.98	28.47	14.24	41.25
West Kalimantan	Rural	31.39	12.61	7.64	3.82	18.40	9.20	57.01
	Urban	22.40	3.81	32.38	16.19	11.61	5.80	48.20
	Total	29.02	10.29	14.16	7.08	16.61	8.31	54.69
Central Kalimantan	Rural	57.91	2.42	4.18	2.09	16.05	8.03	70.44
	Urban	28.97	1.15	21.64	10.82	18.28	9.14	50.07
	Total	49.41	2.04	9.31	4.65	16.71	8.35	64.46
South Kalimantan	Rural	41.99	2.70	8.30	4.15	20.49	10.25	59.08
	Urban	27.10	1.42	21.07	10.54	19.63	9.82	48.86
	Total	36.45	2.22	13.05	6.53	20.17	10.09	55.27
East Kalimantan	Rural	28.66	4.50	12.94	6.47	22.47	11.24	50.86
	Urban	25.40	1.01	30.83	15.41	13.25	6.63	48.45
	Total	26.89	2.60	22.67	11.34	17.46	8.73	49.54

Province	Location	% sewage discharged directly into water body	% open defecation in water courses	Septic tanks not managed properly		Leaking pit latrine		Total
				Total %	% to ground water	Total %	% to ground water	
North Sulawesi	Rural	24.38	5.58	20.84	10.42	18.12	9.06	49.44
	Urban	15.43	2.81	27.02	13.51	20.06	10.03	41.77
	Total	20.97	4.53	23.20	11.60	18.86	9.43	46.52
Central Sulawesi	Rural	29.77	17.71	11.75	5.87	12.52	6.26	59.61
	Urban	24.13	3.09	33.70	16.85	10.42	5.21	49.28
	Total	28.64	14.78	16.16	8.08	12.10	6.05	57.54
South Sulawesi	Rural	17.10	15.27	14.95	7.47	16.00	8.00	47.84
	Urban	22.72	3.58	35.58	17.79	8.92	4.46	48.54
	Total	18.89	11.56	21.51	10.75	13.75	6.87	48.07
Southeast Sulawesi	Rural	14.20	16.26	11.24	5.62	20.05	10.02	46.10
	Urban	20.76	3.59	31.08	15.54	13.11	6.56	46.44
	Total	15.64	13.49	15.59	7.80	18.53	9.26	46.18
Gorontalo	Rural	24.81	22.03	8.41	4.21	12.38	6.19	57.23
	Urban	18.77	7.20	22.22	11.11	17.94	8.97	46.04
	Total	23.18	18.03	12.14	6.07	13.88	6.94	54.21
West Sulawesi	Rural	28.39	17.52	8.23	4.11	13.69	6.84	56.87
	Urban	24.73	8.91	21.20	10.60	13.19	6.60	50.83
	Total	27.85	16.25	10.13	5.07	13.61	6.81	55.96
Maluku	Rural	20.14	24.68	7.85	3.93	12.04	6.02	54.75
	Urban	22.79	5.65	31.58	15.79	9.51	4.76	48.98
	Total	20.90	19.21	14.67	7.34	11.31	5.66	53.09
North Maluku	Rural	17.78	21.72	14.66	7.33	10.09	5.04	51.87
	Urban	18.34	7.25	34.75	17.37	7.91	3.96	46.92
	Total	17.92	18.15	19.62	9.81	9.55	4.78	50.65
West Papua	Rural	32.74	18.87	8.45	4.22	10.06	5.03	60.86
	Urban	25.32	7.58	33.02	16.51	5.61	2.81	52.21
	Total	30.12	14.95	16.88	8.44	8.62	4.31	57.81
Papua	Rural	12.89	31.85	5.37	2.69	16.82	8.41	55.82
	Urban	17.49	4.40	28.47	14.23	15.96	7.98	44.10
	Total	13.96	25.47	10.74	5.37	16.62	8.31	53.10
Indonesia Total	**Rural**	**27.57**	**10.67**	**12.19**	**6.09**	**17.80**	**8.90**	**53.23**
	Urban	**28.58**	**3.12**	**31.15**	**15.57**	**9.75**	**4.87**	**52.15**
	Total	**27.99**	**7.43**	**20.34**	**10.17**	**14.34**	**7.17**	**52.75**

Source: Authors' estimates. [1] All figures presented as % of entire rural, urban or total population

Table C10. Total release of domestic polluting substances to water bodies

Province	Total release per day			Polluting substances (tons per year)				
	Feces ('000 kg)	Urine (m^3)	Gray (million m^3)	BOD	N	P	TSS	Coliform count (10^{15})
NAD	336.7	3,367	44.9	40,964	7,374	1,884	55,711	90,763
North Sumatra	967.8	9,678	129.0	117,745	21,194	5,416	160,133	240,818
West Sumatra	429.0	4,290	57.2	52,195	9,395	2,401	70,985	128,857
Riau	317.1	3,171	42.3	38,586	6,946	1,775	52,478	68,496
Jambi	240.1	2,401	32.0	29,212	5,258	1,344	39,729	69,680
South Sumatra	560.7	5,606	74.8	68,212	12,278	3,138	92,769	147,745
Bengkulu	121.1	1,211	16.2	14,738	2,653	678	20,044	30,350
Lampung	449.9	4,499	60.0	54,742	9,854	2,518	74,449	91,048
Bangka Belitung	80.5	805	10.7	9,789	1,762	450	13,313	19,533
Riau Archipelago	103.5	1,035	13.8	12,588	2,266	579	17,119	25,949
Jakarta	714.3	7,143	95.2	86,910	15,644	3,998	118,198	184,646
West Java	3359.5	33,595	447.9	408,741	73,573	18,802	555,888	923,661
Central Java	2625.1	26,251	350.0	319,382	57,489	14,692	434,360	695,859
Yogyakarta	233.4	2,334	31.1	28,398	5,112	1,306	38,622	52,143
East Java	2849.0	28,490	379.9	346,627	62,393	15,945	471,412	719,443
Banten	683.5	6,835	91.1	83,156	14,968	3,825	113,093	164,263
Bali	256.9	2,569	34.2	31,252	5,625	1,438	42,503	62,362
West Nusa Tenggara	379.6	3,796	50.6	46,183	8,313	2,124	62,808	110,773
East Nusa Tenggara	269.6	2,696	35.9	32,800	5,904	1,509	44,608	54,124
West Kalimantan	333.0	3,330	44.4	40,519	7,293	1,864	55,106	88,646
Central Kalimantan	186.3	1,863	24.8	22,668	4,080	1,043	30,828	58,449
South Kalimantan	277.5	2,775	37.0	33,764	6,077	1,553	45,918	74,650
East Kalimantan	218.3	2,183	29.1	26,561	4,781	1,222	36,123	52,640
North Sulawesi	150.4	1,504	20.1	18,299	3,294	842	24,887	34,053
Central Sulawesi	200.2	2,002	26.7	24,355	4,384	1,120	33,123	56,057
South Sulawesi	546.7	5,467	72.9	66,517	11,973	3,060	90,463	127,915
Southeast Sulawesi	138.7	1,387	18.5	16,877	3,038	776	22,953	31,177
Gorontalo	76.6	766	10.2	9,317	1,677	429	12,672	20,204
West Sulawesi	82.2	822	11.0	9,996	1,799	460	13,594	22,376
Maluku	101.3	1,013	13.5	12,320	2,218	567	16,755	26,165
North Maluku	68.3	683	9.1	8,307	1,495	382	11,297	16,831
West Papua	55.8	558	7.4	6,784	1,221	312	9,227	15,690
Papua	152.6	1,526	20.3	18,569	3,342	854	25,254	39,446
Indonesia Total	**17565**	**175,503**	**2340.0**	**2,135,288**	**384,352**	**98,223**	**2,903,992**	**4,505,582**

Source: Authors' estimates

Table C11. Industrial pollution load in Jakarta, 2004

Industry sub-sector	Volume of waste		Polluting substances					
			BOD		N		TSS	
	m^3	%	tons	%	tons	%	tons	%
Agro industry	20	0.0	2,776	0.3	121	61.1	3,072	0.3
Food processing	158,742	5.1	473,839	49.7	38	19.2	51,012	5.6
Drinks	320	0.0	142	0.0	0	0.0	86	0.0
Textile	564,310	18.0	380,025	39.9	0	0.0	215,879	23.5
Leather	26	0.0	45	0.0	8	4.0	69	0.0
Wood processing	439	0.0	64,200	6.7	26	13.1	118	0.0
Basic chemicals	12,533	0.4	22,038	2.3	5	2.5	12,650	1.4
Non-metallic mineral processing	2,065,500	65.7	0	0.0	0	0.0	31,500	3.4
Basic metals	52,200	1.7	0	0.0	0	0.0	1,543	0.2
Metal processing	16,775	0.5	5,887	0.6	0	0.0	2,532	0.3
Electricity and gas	270,900	8.6	4,620	0.5	0	0.0	600,600	65.3
Total	**3,141,765**	**100.00**	**953,572**	**100.00**	**198**	**100.00**	**919,061**	**100.00**

Source: Ministry of Environment. Status Lingkungan Hidup Indonesia 2005. Jakarta, 2006.

Table C12. Contribution of domestic sources to overall water pollution (% of BOD)

Province	Industry		Agriculture		Domestic		Total	
	BOD ('000 tons)	%	BOD ('000 tons)	%	BOD ('000 tons)	%	BOD ('000 tons)	%
NAD	156	73	16	8	41	19	213	100
North Sumatra	477	73	59	9	118	18	654	100
West Sumatra	73	51	18	12	52	37	142	100
Riau	378	88	12	3	39	9	429	100
Jambi	36	49	9	11	29	39	74	100
South Sumatra	218	70	26	8	68	22	312	100
Bengkulu	6	24	3	15	15	62	24	100
Lampung	72	47	26	17	55	36	152	100
Bangka Belitung	43	80	1	2	10	18	54	100
Riau Archipelago	358	94	12	3	13	3	382	100
Jakarta	954	92	0	0	87	8	1,041	100
West Java	2,077	75	276	10	409	15	2,762	100
Central Java	1,006	72	67	5	319	23	1,393	100
Yogyakarta	53	55	16	16	28	29	97	100
East Java	1,608	76	149	7	347	16	2,103	100
Banten	589	86	12	2	83	12	684	100
Bali	42	51	8	10	31	38	82	100
West Nusa Tenggara	12	18	9	13	46	69	67	100
East Nusa Tenggara	4	8	8	19	33	73	45	100
West Kalimantan	94	63	15	10	41	27	149	100
Central Kalimantan	26	48	5	10	23	42	54	100
South Kalimantan	63	54	21	17	34	29	118	100
East Kalimantan	781	95	17	2	27	3	825	100
North Sulawesi	23	53	3	6	18	41	44	100
Central Sulawesi	18	39	3	8	24	54	46	100
South Sulawesi	52	40	11	8	67	51	129	100
Southeast Sulawesi	10	31	6	17	17	52	33	100
Gorontalo	4	26	1	8	9	66	14	100
West Sulawesi	52	72	11	15	10	14	73	100
Maluku	3	17	1	7	12	75	16	100
North Maluku	6	38	1	5	8	57	15	100
West Irian Jaya	20	73	1	2	7	25	27	100
Papua	10	35	1	2	19	63	29	100
Indonesia Total	**9,321**	**76**	**821**	**7**	**2,137**	**17**	**2,279**	**100**

Source: Authors' estimates

Table C13. Selected river quality indicators, 2003

Province River	Location	Batch	pH	DO (mg/l)	BOD (mg/l)	TSS (mg/l)	TDS (mg/l)	DO (2005)
NAD Krueng Tamiang	Up-stream	I	7.0	6.7	0.6	-	250.0	6.2 - 9
		II	7.2	7.0	0.7	-	500.0	
	Down-stream	I	6.0	6.0	3.3	-	580.0	
		II	6.5	6.6	2.5	-	1700.0	
North Sumatra Deli	Up-stream	I	8.7	5.7	3.2	36.0	-	0.7 - 7.7
		II	7.3	8.4	4.1	36.0	-	
	Down-stream	I	6.6	2.4	6.5	20.0	-	
		II	6.8	2.4	7.7	104.0	-	
West Sumatra Batang Agam								5.2 - 7
Riau Kampar								1.2 - 7.8
Jambi Batang Hari	Up-stream	I	7.5	5.7	4.0	206.0	59.0	3 - 6.5
		II	6.9	5.9	1.0	72.0	76.0	
	Down-stream	I	5.8	5.3	1.4	4.0	74.0	
		II	6.0	5.7	4.0	76.0	104.0	
South Sumatra Musi	Up-stream	I	6.1	3.2	8.0	24.0	-	1.8 - 7.9
		II	7.4	3.2	1.7	33.7	-	
	Down-stream	I	6.0	4.2	8.7	25.0	-	
		II	8.0	3.0	1.8	32.2	-	
Bengkulu Air Bengkulu	Up-stream	I	6.8	4.1	1.0	24.2	30.0	1.1 - 3.8
		II	6.6	2.9	20.0	95.2	90.0	
	Down-stream	I	-	-	-	-	-	
		II	6.0	3.8	3.4	156.0	20.0	
Lampung Way Sekampung								1.9 - 4
Bangka-Belitung Rangkui	Up-stream	I	5.9	1.6	12.0	-	68.2	1.6 - 7.5
		II	5.7	7.4	4.5	-	87.4	
	Down-stream	I	6.8	2.1	6.0	-	11.4	
		II	8.0	8.8	5.2	-	15.7	
Jakarta Ciliwung	Up-stream	I	7.6	2.7	0.8	7.0	-	0 - 5.8
		II	7.5	4.1	5.1	10.0	-	
	Down-stream	I	7.0	0.4	20.8	30.0	-	
		II	7.3	2.1	47.1	59.0	-	
West Java Citarum	Up-stream	I	9.5	0.8	34.0	98.0	667.0	0 - 5.9
		II	7.2	3.9	8.2	800.0	170.0	
	Down-stream	I	7.4	3.1	12.0	75.0	310.0	
		II	7.1	2.6	17.2	3220.0	134.0	

Province River	Location	Batch	pH	DO (mg/l)	BOD (mg/l)	TSS (mg/l)	TDS (mg/l)	DO (2005)
Banten Cisadane	Up-stream	I	8.0	7.0	3.4	38.0	-	5.1 - 6.3
		II	8.0	7.6	2.7	47.0	-	
	Down-stream	I	7.0	3.4	3.9	24.0	-	
		II	7.4	0.2	16.9	14.0	-	
Central Java Yogyakarta Progo	Up-stream	I	7.5	7.7	2.8	28.0	180.0	6.3-8.0 [a]
		II	7.4	7.7	1.1	18.0	212.0	4.9-6.5 [b]
	Down-stream	I	8.1	6.8	6.8	-	126.0	
		II	8.2	7.3	7.8	-	171.0	
East Java Brantas	Up-stream	I	7.7	-	110.0	28.0	-	0 - 8.3
		II	7.0	-	268.0	98.0	-	
	Down-stream	I	3.5	-	139.0	98.0	-	
		II	7.2	-	177.0	20.0	-	
Bali Tukad Badung	Up-stream	I	7.4	5.1	1.9	10.0	-	2.8 - 5
		II	7.0	6.8	1.9	16.0	-	
	Down-stream	I	6.9	7.1	4.6	20.0	-	
		II	7.0	6.9	2.5	21.0	-	
West Nusa Tenggara Jangkok								4 - 7.4
East Nusa Tenggara Kali Dendeng								1.1 - 3.5
West Kalimantan Kapuas								2.5 - 5
Central Kalimantan Kahayan								5.1 - 6
East Kalimantan Mahakam								3.1 - 5.7
North Sulawesi Tondano								6.7 - 9
Central Sulawesi Palu								3 - 7.8
South Sulawesi Jeneberang, Tallo								4 - 9
Southeast Sulawesi Konaweha	Up-stream	I	6.0	5.0	3.5	2.8	60.0	1.1 - 9
		II	7.5	5.0	3.1	2.8	50.0	
	Down-stream	I	7.4	6.0	4.0	10.5	136.0	
		II	7.4	6.2	4.0	10.5	136.0	
Gorontalo Bone	Up-stream	I	7.1	7.4	2.0	1.7	34.5	5.3 - 7.8
		II	-	-	-	-	-	
	Down-stream	I	7.2	6.9	4.2	3.4	27.2	
		II	-	-	-	-	-	
North Maluku Tabobo								4.8 - 5.4
Papua Anafre								3.3 - 7

Source: Status of the Environment 2003 and 2005.

Table C14. Main sources of household drinking water

Province	Location	Pack-aged water	Piped from plant	Ground water	Well		Spring		River	Rain water	Others	Total
					Protected	Unprotected	Protected	Unprotected				
NAD	Rural	1.33	6.14	2.45	44.92	27.03	5.23	3.74	6.98	1.77	0.41	100
	Urban	15.60	28.27	5.78	37.15	7.22	2.67	0.65	0.39	1.04	1.22	100
	Total	4.42	10.93	3.17	43.24	22.74	4.68	3.07	5.55	1.61	0.58	100
North Sumatra	Rural	0.67	8.89	11.54	31.30	17.21	10.83	9.98	5.38	3.53	0.67	100
	Urban	4.07	47.93	9.14	29.62	4.93	2.56	0.52	0.53	0.60	0.10	100
	Total	2.15	25.89	10.49	30.57	11.87	7.23	5.86	3.27	2.25	0.42	100
West Sumatra	Rural	0.51	13.74	1.76	31.32	19.05	10.83	13.82	5.14	3.63	0.21	100
	Urban	4.68	43.77	6.23	32.61	5.81	4.12	2.04	0.05	0.49	0.20	100
	Total	1.80	23.05	3.14	31.72	14.95	8.75	10.17	3.56	2.65	0.21	100
Riau	Rural	0.91	2.04	0.99	33.44	25.13	0.50	1.30	3.25	32.38	0.07	100
	Urban	13.24	3.83	6.81	41.32	9.78	4.89	0.35	0.35	19.29	0.14	100
	Total	5.19	2.66	3.01	36.17	19.80	2.03	0.97	2.24	27.84	0.09	100
Jambi	Rural	1.16	9.57	0.92	33.40	24.09	1.87	2.04	15.14	11.74	0.07	100
	Urban	4.40	36.09	1.90	29.87	8.62	0.29	0.19	1.74	16.71	0.19	100
	Total	2.03	16.76	1.19	32.44	19.90	1.44	1.54	11.51	13.09	0.11	100
South Sumatra	Rural	0.89	5.27	1.17	43.70	20.73	2.45	2.16	13.45	9.61	0.57	100
	Urban	5.12	47.81	0.74	30.40	8.59	0.80	0.21	5.00	1.02	0.32	100
	Total	2.26	19.02	1.03	39.40	16.81	1.92	1.53	10.72	6.83	0.48	100
Bengkulu	Rural	0.80	7.58	1.13	35.84	37.79	6.00	6.15	4.48	0.05	0.18	100
	Urban	2.79	27.64	7.21	48.86	11.92	0.63	0.87	0.04	-	0.04	100
	Total	1.34	13.00	2.77	39.36	30.80	4.55	4.72	3.28	0.04	0.14	100
Lampung	Rural	0.63	2.60	0.93	58.30	24.99	3.39	4.24	2.23	2.01	0.68	100
	Urban	4.75	13.79	7.86	61.42	9.82	0.87	0.66	0.40		0.44	100
	Total	1.49	4.93	2.38	58.95	21.82	2.86	3.50	1.85	1.59	0.63	100
Bangka Belitung	Rural	1.59	2.16	2.98	49.84	36.38	1.05	3.25	2.58	-	0.18	100
	Urban	7.77	6.99	8.90	50.12	22.51	3.03	0.34		-	0.34	100
	Total	4.09	4.12	5.38	49.96	30.76	1.85	2.07	1.53	-	0.24	100
Riau Archipelago	Rural	0.20	2.98	0.49	26.99	34.78	11.19	11.74	4.95	6.29	0.40	100
	Urban	8.99	46.44	1.29	28.48	6.25	1.73	0.43	0.42	3.68	2.28	100
	Total	7.27	37.93	1.13	28.19	11.84	3.59	2.64	1.31	4.19	1.92	100
Jakarta	Total	20.80	39.73	33.20	4.85	0.30	0.70	-	0.04	0.16	0.22	100
West Java	Rural	1.33	7.44	16.51	35.57	10.90	17.01	10.12	1.04	0.06	0.02	100
	Urban	7.29	17.95	31.58	33.61	4.65	3.53	0.97	0.06	-	0.37	100
	Total	4.37	12.79	24.18	34.57	7.72	10.15	5.46	0.54	0.03	0.20	100

Province	Location	Pack-aged water	Piped from plant	Ground water	Well		Spring		River	Rain water	Others	Total
					Protected	Unprotected	Protected	Unprotected				
Central Java	Rural	0.49	8.54	8.55	44.72	10.83	18.48	6.86	0.90	0.51	0.13	100
	Urban	3.27	28.74	13.65	42.84	6.34	4.06	0.38	0.40		0.32	100
	Total	1.63	16.77	10.62	43.95	9.00	12.60	4.22	0.70	0.30	0.21	100
Yogyakarta	Rural	0.58	15.49	2.89	37.71	13.57	8.11	8.71	0.35	11.55	1.05	100
	Urban	14.30	13.28	8.84	58.35	4.31	0.54	0.34	-	-	0.05	100
	Total	8.75	14.17	6.44	50.00	8.05	3.60	3.72	0.14	4.67	0.45	100
East Java	Rural	1.66	8.68	13.98	45.67	8.85	14.86	3.91	0.65	0.85	0.88	100
	Urban	10.50	30.69	16.99	31.66	4.20	4.29	0.67	0.48	0.13	0.40	100
	Total	5.32	17.78	15.23	39.88	6.92	10.49	2.57	0.58	0.56	0.68	100
Banten	Rural	1.56	4.44	16.27	39.28	17.02	7.54	6.14	5.93	0.77	1.04	100
	Urban	12.43	19.64	46.98	14.56	2.85	2.54	0.25	0.10	0.35	0.29	100
	Total	7.62	12.92	33.39	25.50	9.12	4.75	2.86	2.68	0.54	0.62	100
B a l i	Rural	1.87	37.12	3.89	17.03	1.95	21.82	5.34	2.54	7.45	0.98	100
	Urban	26.88	39.27	8.48	17.20	1.48	5.58	0.78	0.23	0.04	0.07	100
	Total	15.27	38.27	6.35	17.12	1.70	13.12	2.90	1.30	3.48	0.49	100
West Nusa Tenggara	Rural	2.06	13.17	8.33	44.80	13.25	12.94	3.14	2.26	-	0.06	100
	Urban	7.02	22.67	6.71	48.61	7.28	6.17	1.39	-	-	0.14	100
	Total	3.86	16.61	7.75	46.18	11.09	10.49	2.50	1.44	-	0.09	100
East Nusa Tenggara	Rural	0.24	13.37	0.92	17.32	9.89	28.42	21.32	5.67	2.79	0.05	100
	Urban	2.96	57.92	0.82	25.23	5.98	1.90	1.79	2.41	0.05	0.93	100
	Total	0.67	20.33	0.90	18.56	9.28	24.28	18.27	5.16	2.36	0.19	100
West Kalimantan	Rural	0.41	7.16	1.46	6.77	12.68	5.21	3.62	30.51	32.13	0.04	100
	Urban	8.05	15.16	0.19	9.16	4.20	2.19	0.40	4.37	56.04	0.25	100
	Total	2.43	9.27	1.13	7.40	10.45	4.42	2.77	23.62	38.43	0.10	100
Central Kalimantan	Rural	0.28	7.63	4.61	21.43	9.31	0.84	0.56	48.80	6.42	0.13	100
	Urban	3.03	39.60	24.86	15.51	3.22	0.33	0.55	10.52	2.28	0.10	100
	Total	1.09	17.01	10.55	19.69	7.52	0.69	0.56	37.56	5.20	0.12	100
South Kalimantan	Rural	0.44	15.35	16.45	16.73	18.15	0.79	1.54	26.49	3.70	0.37	100
	Urban	5.54	67.42	3.01	16.14	4.13	0.02	-	3.28	-	0.46	100
	Total	2.34	34.72	11.45	16.51	12.93	0.51	0.97	17.86	2.32	0.40	100
East Kalimantan	Rural	1.72	19.49	3.64	20.05	18.33	3.91	1.74	21.67	8.97	0.47	100
	Urban	5.36	72.40	2.70	5.03	2.25	1.85	0.41	4.55	5.13	0.32	100
	Total	3.70	48.29	3.13	11.88	9.58	2.79	1.01	12.35	6.88	0.39	100

Province	Location	Pack-aged water	Piped from plant	Ground water	Well		Spring		River	Rain water	Others	Total
					Protected	Unprotected	Protected	Unprotected				
North Sulawesi	Rural	1.45	22.57	1.78	40.35	8.50	19.32	3.96	0.28	1.75	0.03	100
	Urban	6.70	38.70	10.84	31.65	6.98	3.85	0.68	0.47	-	0.13	100
	Total	3.45	28.72	5.24	37.03	7.92	13.43	2.71	0.35	1.09	0.07	100
Central Sulawesi	Rural	0.50	12.41	10.02	29.91	15.00	18.83	4.14	7.69	1.41	0.11	100
	Urban	11.64	40.86	28.01	8.80	0.40	9.18	0.41	0.18	-	0.52	100
	Total	2.73	18.12	13.63	25.67	12.07	16.89	3.39	6.18	1.13	0.19	100
South Sulawesi	Rural	0.42	9.78	11.78	36.87	19.61	11.60	6.66	2.31	0.86	0.13	100
	Urban	4.19	59.23	7.19	20.98	5.03	1.53	0.75	0.97	0.03	0.08	100
	Total	1.62	25.50	10.32	31.81	14.97	8.40	4.78	1.88	0.59	0.11	100
Southeast Sulawesi	Rural	0.33	19.49	1.64	36.20	19.60	12.31	5.53	2.44	2.14	0.33	100
	Urban	2.65	58.74	5.50	20.66	6.29	4.93	0.83	0.29	0.03	0.08	100
	Total	0.84	28.09	2.49	32.79	16.68	10.69	4.50	1.97	1.68	0.27	100
Gorontalo	Rural	0.75	9.33	0.71	53.55	20.10	5.51	1.59	7.38	0.11	0.96	100
	Urban	1.07	34.12	4.76	52.43	7.12	0.49	-	-	-	-	100
	Total	0.84	16.02	1.81	53.25	16.60	4.15	1.16	5.39	0.08	0.70	100
West Sulawesi	Rural	0.37	8.32	2.95	30.90	17.02	11.75	15.67	10.87	1.70	0.45	100
	Urban	3.37	38.73	9.70	34.90	5.95	5.70		0.14		1.51	100
	Total	0.81	12.80	3.94	31.49	15.39	10.86	13.37	9.29	1.45	0.60	100
Maluku	Rural	0.05	14.43	1.14	39.42	13.93	23.12	5.75	1.60	0.42	0.13	100
	Urban	1.89	46.98	4.74	25.03	6.46	6.86	0.36	1.43	4.85	1.39	100
	Total	0.58	23.79	2.17	35.28	11.78	18.45	4.20	1.55	1.70	0.49	100
North Maluku	Rural	0.36	9.02	0.96	42.52	29.38	6.80	4.69	3.66	2.56	0.05	100
	Urban	0.84	63.65	1.65	17.35	11.55	0.76	-	-	4.20	-	100
	Total	0.48	22.50	1.13	36.31	24.98	5.31	3.53	2.76	2.97	0.04	100
West Papua	Rural	0.44	11.00	1.09	10.84	10.40	7.96	27.13	18.67	12.30	0.17	100
	Urban	13.27	45.82	2.44	11.33	14.26	2.05	1.86	1.60	7.38	-	100
	Total	4.89	23.09	1.56	11.01	11.74	5.91	18.36	12.75	10.59	0.11	100
Papua	Rural	1.80	5.17	0.61	7.22	9.73	10.31	35.30	17.28	12.43	0.14	100
	Urban	8.67	42.48	9.21	19.37	5.75	6.08	0.34	0.25	7.37	0.48	100
	Total	3.40	13.84	2.61	10.04	8.80	9.32	27.18	13.33	11.26	0.22	100
Indonesia Total	**Rural**	**1.02**	**9.03**	**9.23**	**38.15**	**14.26**	**12.85**	**6.89**	**4.78**	**3.41**	**0.38**	**100**
	Urban	**8.95**	**30.80**	**19.47**	**29.98**	**4.77**	**3.14**	**0.60**	**0.61**	**1.35**	**0.33**	**100**
	Total	**4.41**	**18.34**	**13.61**	**34.66**	**10.20**	**8.70**	**4.20**	**3.00**	**2.53**	**0.36**	**100**

Source: Susenas 2006

Table C15. Fish catch value, actual catch and estimated loss due to poor sanitation

Province	Dissolved oxygen levels in major rivers		Actual fish catch as % of optimum (base case)	Domestic sanitation as % water pollution	Loss of fish catch due to poor domestic sanitation	
	Range	Median			IDR million	USD million
NAD	6.2 - 9	7.6	100%	19%	-	-
North Sumatra	0.7 - 7.7	4.2	32%	18%	37,428	4.24
West Sumatra	5.2 - 7	6.1	71%	37%	14,357	1.63
R i a u	1.2 - 7.8	4.5	40%	9%	72,032	8.16
J a m b i	3 - 6.5	4.8	36%	39%	45,540	5.16
South Sumatra	1.8 - 7.9	4.9	36%	22%	138,926	15.74
Bengkulu	1.1 - 3.8	2.5	30%	62%	8,682	0.98
Lampung	1.9 - 4	3.0	30%	36%	56,158	6.36
Bangka Belitung	1.6 - 7.5	4.6	34%	18%	n.a.	n.a.
Riau Archipelago	1.2 - 7.8	4.5	40%	3%	n.a.	n.a.
Jakarta	0 - 5.8	2.9	30%	8%	n.a.	n.a.
West Java	0 - 5.9	3.0	30%	15%	18,375	2.08
Central Java	6.3 - 8	7.2	92%	23%	2,227	0.25
Yogyakarta	4.9 - 6.5	5.7	62%	29%	1,725	0.20
East Java	0 - 8.3	4.2	31%	16%	23,253	2.63
Banten	5.1 - 6.3	5.7	62%	12%	241	0.03
B a l i	2.8 - 5	3.9	29%	38%	5,477	0.62
West Nusa Tenggara	4 - 7.4	5.7	62%	69%	10,040	1.14
East Nusa Tenggara	1.1 - 3.5	2.3	n.a.	73%	n.a.	n.a.
West Kalimantan	2.5 - 5	3.8	28%	27%	119,951	13.59
Central Kalimantan	5.1 - 6	5.6	61%	42%	90,057	10.20
South Kalimantan	5.1 - 6	5.5	60%	29%	100,807	11.42
East Kalimantan	3.1 - 5.7	4.4	39%	3%	8,028	2.04
North Sulawesi	6.7 - 9	7.9	100%	41%	-	-
Central Sulawesi	3 - 7.8	5.4	59%	54%	505	0.06
South Sulawesi	4 - 9	6.5	80%	51%	5,011	0.57
Southeast Sulawesi	1.1 - 9	5.1	51%	52%	31,566	3.58
Gorontalo	5.3 - 7.8	6.6	81%	66%	960	0.11
West Sulawesi	4 - 9	6.5	80%	14%	21	0.00
Maluku	4.8 - 5.4	5.1	51%	75%	903	0.10
North Maluku	4.8 - 5.4	5.1	51%	57%	682	0.08
West Papua	3.3 - 7	5.2	52%	25%	10,008	1.13
Papua	3.3 - 7	5.2	52%	63%	25,099	2.84
Indonesia Total					**812,961**	**92**
Province average		***4.98***	***53%***	***34%***	***30,654***	***3.47***

Source: Authors' estimates. n.a. – not available.

Table C16. Population experiencing sub-optimal latrine access time, by province

Province	Location	Population with access time already minimized (%)	Adult population > 15 year	Population experiencing sub-optimal access (proximity, waiting time)		Adult population experiencing sub-optimal access (proximity, waiting time)	
				Shared latrines (proportion)	Open defecation (proportion)	Shared latrines (number)	Open defecation (number)
NAD	Rural	0.63	1,284,723	0.15	0.23	187,248	289,544
	Urban	0.86	1,684,430	0.09	0.05	149,240	81,105
North Sumatra	Rural	0.76	4,427,901	0.09	0.16	381,242	690,753
	Urban	0.91	3,940,904	0.06	0.02	246,701	95,468
West Sumatra	Rural	0.59	2,172,334	0.14	0.27	294,894	589,952
	Urban	0.82	971,255	0.11	0.07	103,342	68,401
Riau	Rural	0.86	2,013,579	0.06	0.09	117,090	171,255
	Urban	0.94	1,188,266	0.06	0.00	65,771	4,991
Jambi	Rural	0.71	1,335,719	0.10	0.19	135,175	256,458
	Urban	0.90	510,799	0.06	0.04	29,090	22,679
South Sumatra	Rural	0.72	3,151,469	0.07	0.21	229,427	658,736
	Urban	0.89	1,664,243	0.08	0.03	137,134	47,681
Bengkulu	Rural	0.68	761,271	0.06	0.26	45,296	197,264
	Urban	0.90	308,655	0.07	0.03	21,807	8,172
Lampung	Rural	0.84	3,958,375	0.07	0.09	289,555	354,473
	Urban	0.86	1,064,745	0.09	0.05	93,485	56,458
Bangka Belitung	Rural	0.64	432,667	0.04	0.32	17,220	138,270
	Urban	0.88	326,007	0.04	0.08	12,307	27,434
Riau Archipelago	Rural	0.75	192,789	0.06	0.19	11,384	36,365
	Urban	0.87	782,162	0.12	0.01	93,742	8,506
Jakarta	Urban	0.87	6,775,989	0.12	0.00	838,190	26,426
West Java	Rural	0.69	13,335,108	0.17	0.15	2,201,626	1,950,260
	Urban	0.85	14,641,471	0.11	0.04	1,557,853	621,530
Central Java	Rural	0.70	13,847,786	0.10	0.20	1,333,542	2,777,173
	Urban	0.79	9,610,228	0.08	0.12	786,117	1,184,220
Yogyakarta	Rural	0.89	1,068,656	0.07	0.04	78,333	40,075
	Urban	0.78	1,598,470	0.18	0.04	290,442	56,826
East Java	Rural	0.68	16,262,127	0.09	0.23	1,487,985	3,765,089
	Urban	0.81	11,370,357	0.09	0.10	1,034,703	1,112,874
Banten	Rural	0.57	2,867,753	0.11	0.32	313,876	905,278
	Urban	0.85	3,420,838	0.11	0.05	360,556	158,043
Bali	Rural	0.68	1,292,705	0.09	0.23	114,146	295,028
	Urban	0.82	1,250,906	0.13	0.05	159,053	61,451
West Nusa Tenggara	Rural	0.49	1,803,200	0.06	0.45	113,962	807,247
	Urban	0.63	1,010,130	0.10	0.27	101,973	269,250

Province	Location	Population with access time already minimized (%)	Adult population > 15 year	Population experiencing sub-optimal access (proximity, waiting time)		Adult population experiencing sub-optimal access (proximity, waiting time)	
				Shared latrines (proportion)	Open defecation (proportion)	Shared latrines (number)	Open defecation (number)
East Nusa Tenggara	Rural	0.74	2,264,310	0.06	0.21	131,217	466,504
	Urban	0.85	457,375	0.12	0.03	56,143	13,413
West Kalimantan	Rural	0.67	1,987,646	0.06	0.28	112,401	552,019
	Urban	0.92	773,794	0.04	0.04	30,681	34,415
Central Kalimantan	Rural	0.61	910,164	0.12	0.27	112,997	242,263
	Urban	0.84	385,810	0.09	0.07	34,761	25,869
South Kalimantan	Rural	0.69	1,430,181	0.12	0.19	176,699	265,370
	Urban	0.85	914,511	0.11	0.04	99,270	37,518
East Kalimantan	Rural	0.80	867,659	0.09	0.11	79,391	91,104
	Urban	0.90	1,169,353	0.08	0.02	97,466	19,382
North Sulawesi	Rural	0.76	975,574	0.10	0.14	98,045	132,654
	Urban	0.84	591,135	0.14	0.02	81,045	13,478
Central Sulawesi	Rural	0.59	1,217,258	0.06	0.35	78,270	426,527
	Total	0.63	330,067	0.07	0.29	23,781	96,767
South Sulawesi	Rural	0.66	1,601,740	0.05	0.28	86,574	450,489
	Urban	0.84	3,578,691	0.10	0.06	356,438	211,769
Southeast Sulawesi	Rural	0.67	992,751	0.06	0.26	61,948	262,235
	Urban	0.82	298,292	0.11	0.07	32,588	19,777
Gorontalo	Rural	0.47	456,520	0.12	0.42	52,591	190,916
	Urban	0.71	171,111	0.18	0.10	31,596	17,415
West Sulawesi	Rural	0.54	206,769	0.06	0.40	12,520	82,966
	Urban	0.74	461,974	0.09	0.17	40,030	78,512
Maluku	Rural	0.55	584,610	0.12	0.34	69,422	195,991
	Urban	0.81	251,628	0.09	0.09	23,389	23,779
North Maluku	Rural	0.54	429,424	0.15	0.32	62,288	135,301
	Urban	0.83	148,961	0.10	0.08	14,479	11,228
West Irian Jaya	Rural	0.51	310,602	0.11	0.37	34,508	116,359
	Urban	0.82	113,069	0.16	0.02	17,644	2,637
Papua	Rural	0.56	423,671	0.09	0.35	39,126	147,056
	Urban	0.87	905,891	0.12	0.01	110,564	8,832
Indonesia Total	**Rural**	**0.69**	**84,867,042**	**0.10**	**0.21**	**8,559,997**	**17,680,974**
	Urban	**0.84**	**72,671,521**	**0.10**	**0.06**	**7,131,377**	**4,526,305**
	Total	**0.75**	**157,538,564**	**0.10**	**0.15**	**15,691,374**	**22,207,279**

Source: Authors' estimates

Table C17. Economic loss due to degraded and unavailable land

Province	Location	Size of degraded land (m^2)		Average land value (IDR/m^2)	Total loss of land value (IDR million)	
		Human waste	Solid waste		Human waste	Solid waste
NAD	Rural	854,077	323,658	2,472	-	809
	Urban	119,798	242,644	5,032	1,198	1,213
North Sumatra	Rural	1,347,375	924,103	2,472	-	2,310
	Urban	194,425	1,350,337	5,032	1,944	6,752
West Sumatra	Rural	1,482,243	262,486	2,472	-	656
	Urban	255,112	345,194	5,032	2,551	1,726
Riau	Rural	1,191,586	422,756	2,472	-	1,057
	Urban	51,605	390,244	5,032	516	1,951
Jambi	Rural	238,069	214,052	2,472	-	535
	Urban	52,989	182,423	5,032	530	912
South Sumatra	Rural	518,533	549,063	2,472	-	1,373
	Urban	116,639	683,891	5,032	1,166	3,419
Bengkulu	Rural	244,961	130,086	2,472	-	325
	Urban	24,092	120,016	5,032	241	600
Lampung	Rural	683,001	722,732	2,472	-	1,807
	Urban	87,463	492,283	5,032	875	2,461
Bangka Belitung	Rural	434,983	127,928	2,472	-	320
	Urban	67,978	70,795	5,032	680	354
Riau Archipelago	Rural	108,821	38,608	2,472	-	97
	Urban	62,903	237,839	5,032	629	1,189
Jakarta	Urban	315,628	4,751,680	20,040	12,625	95,034
West Java	Rural	10,477,635	2,952,320	9,976	-	29,523
	Urban	2,653,561	6,267,958	20,040	106,142	125,359
Central Java	Rural	3,987,184	3,866,681	9,976	-	38,667
	Urban	1,063,327	3,625,169	20,040	42,533	72,503
Yogyakarta	Rural	58,176	239,540	9,976	-	2,395
	Urban	111,478	718,760	20,040	4,459	14,375
East Java	Rural	3,798,523	3,360,341	9,976	-	33,603
	Urban	571,093	4,407,293	20,040	22,844	88,146
Banten	Rural	3,210,506	990,255	9,976	-	9,903
	Urban	836,274	1,501,591	20,040	33,451	30,032
Bali	Rural	698,942	251,435	2,472	-	629
	Urban	137,857	472,616	5,032	1,379	2,363
West Nusa Tenggara	Rural	1,615,800	486,577	2,472	-	1,216
	Urban	245,414	347,900	5,032	2,454	1,739

Province	Location	Size of degraded land (m^2)		Average land value (IDR/m^2)	Total loss of land value (IDR million)	
		Human waste	Solid waste		Human waste	Solid waste
East Nusa Tenggara	Rural	1,690,743	777,379	2,472	-	1,943
	Urban	66,628	163,821	5,032	666	819
West Kalimantan	Rural	920,283	613,747	2,472	-	1,534
	Urban	88,525	203,745	5,032	885	1,019
Central Kalimantan	Rural	72,054	158,160	2,472	-	395
	Urban	19,499	115,604	5,032	195	578
South Kalimantan	Rural	156,299	445,801	2,472	-	1,114
	Urban	31,859	435,748	5,032	319	2,179
East Kalimantan	Rural	127,667	192,270	2,472	-	481
	Urban	56,719	625,445	5,032	567	3,127
North Sulawesi	Rural	136,940	186,177	2,472	-	465
	Urban	36,542	202,564	5,032	365	1,013
Central Sulawesi	Rural	732,068	246,820	2,472	-	617
	Total	25,756	133,077	5,032	258	665
South Sulawesi	Rural	2,801,213	1,150,645	2,472	-	2,877
	Urban	230,936	815,153	5,032	2,309	4,076
Southeast Sulawesi	Rural	789,136	277,392	2,472	-	693
	Urban	49,216	139,582	5,032	492	698
Gorontalo	Rural	440,242	43,926	2,472	-	110
	Urban	47,526	22,331	5,032	475	112
West Sulawesi	Rural	451,157	170,199	2,472	-	426
	Urban	64,077	69,689	5,032	641	348
Maluku	Rural	701,687	226,206	2,472	-	566
	Urban	75,821	69,710	5,032	758	349
North Maluku	Rural	497,916	143,512	2,472	-	359
	Urban	57,049	50,143	5,032	570	251
West Irian Jaya	Rural	303,254	114,018	2,472	-	285
	Urban	43,548	54,745	5,032	435	274
Papua	Rural	769,479	332,541	2,472	-	831
	Urban	70,306	159,667	5,032	703	798
Indonesia Total	**Rural**	**41.5**	**20.9**	**2,470-10,000**	**-**	**137,717**
	Urban	**7.9**	**29.5**	**5,030-20,040**	**245,418**	**466,118**
	Total	**49.5**	**50.4**	**2,470-20,040**	**245,418**	**604,718**

Source: Authors' estimates

Table C18. Population exposed to sub-standard practices of waste disposal

Province	Location	Improved sanitation (proportion)		Exposed population (numbers)		
		Enclosed defecation sites	Solid waste collected	Exposed to open sewers	Exposed to open defecation sites	Exposed to open dumping of solid waste
NAD	Rural	0.70	0.01	163,850	910,107	114,786
	Urban	0.94	0.29	113,552	65,735	18,328
North Sumatra	Rural	0.79	0.01	362,807	1,421,166	296,532
	Urban	0.97	0.34	576,911	186,903	462,339
West Sumatra	Rural	0.64	0.01	53,262	1,175,986	85,414
	Urban	0.91	0.37	64,887	130,190	28,839
Riau	Rural	0.89	0.00	67,072	342,611	107,859
	Urban	0.99	0.35	233,095	9,763	177,480
Jambi	Rural	0.74	0.01	203,668	500,374	162,817
	Urban	0.94	0.32	117,292	43,209	106,417
South Sumatra	Rural	0.72	0.02	96,823	1,278,896	69,750
	Urban	0.96	0.38	232,122	88,405	170,562
Bengkulu	Rural	0.65	0.01	3,143	387,874	3,143
	Urban	0.96	0.43	26,501	15,749	23,735
Lampung	Rural	0.88	0.02	117,444	680,721	45,039
	Urban	0.93	0.41	100,477	106,983	29,507
Bangka Belitung	Rural	0.57	0.01	8,509	270,578	15,558
	Urban	0.89	0.11	35,045	49,398	38,832
Riau Archipelago	Rural	0.75	0.00	6,125	69,393	9,850
	Urban	0.99	0.35	142,062	15,407	108,167
Jakarta	Urban	0.99	0.83	1,072,418	46,627	892,187
West Java	Rural	0.81	0.02	589,559	3,744,756	553,072
	Urban	0.94	0.43	1,318,603	1,157,100	1,063,060
Central Java	Rural	0.73	0.01	403,693	5,115,993	210,456
	Urban	0.84	0.25	513,465	2,135,753	323,678
Yogyakarta	Rural	0.95	0.01	21,193	69,257	40,723
	Urban	0.95	0.47	127,718	95,037	135,538
East Java	Rural	0.69	0.01	322,680	6,685,314	547,906
	Urban	0.87	0.40	663,783	1,950,984	675,743
Banten	Rural	0.58	0.03	127,740	1,835,011	127,740
	Urban	0.94	0.38	454,645	299,851	337,820
Bali	Rural	0.70	0.06	6,431	514,983	6,431
	Urban	0.93	0.38	56,744	114,011	53,611
West Nusa Tenggara	Rural	0.40	-	58,995	1,630,275	126,456
	Urban	0.64	0.14	125,238	529,247	93,073

Province	Location	Improved sanitation (proportion)		Exposed population (numbers)		
		Enclosed defecation sites	Solid waste collected	Exposed to open sewers	Exposed to open defecation sites	Exposed to open dumping of solid waste
East Nusa Tenggara	Rural	0.73	0.00	86,413	1,010,107	140,834
	Urban	0.96	0.28	42,492	26,583	24,611
West Kalimantan	Rural	0.63	0.01	316,551	1,098,584	168,808
	Urban	0.94	0.22	46,885	64,809	34,098
Central Kalimantan	Rural	0.65	0.02	57,671	486,161	34,931
	Urban	0.91	0.23	9,081	49,806	9,081
South Kalimantan	Rural	0.75	0.01	44,568	512,843	75,455
	Urban	0.95	0.37	120,428	69,708	64,738
East Kalimantan	Rural	0.86	0.03	52,448	179,092	57,437
	Urban	0.98	0.56	152,909	36,652	132,179
North Sulawesi	Rural	0.82	0.03	84,271	244,844	47,267
	Urban	0.97	0.34	34,047	24,469	9,739
Central Sulawesi	Rural	0.53	0.01	102,274	867,196	70,163
	Total	0.61	0.39	44,564	181,080	13,341
South Sulawesi	Rural	0.63	0.00	214,460	1,985,737	164,154
	Urban	0.92	0.55	174,917	180,405	124,157
Southeast Sulawesi	Rural	0.65	0.01	27,881	551,674	15,664
	Urban	0.91	0.39	102,228	38,570	93,720
Gorontalo	Rural	0.44	0.00	16,927	388,416	13,305
	Urban	0.86	0.12	30,605	33,278	18,589
West Sulawesi	Rural	0.47	0.00	16,840	419,043	28,511
	Urban	0.77	0.55	18,473	44,295	9,930
Maluku	Rural	0.55	0.00	55,105	405,133	58,278
	Urban	0.87	0.16	49,086	46,018	22,900
North Maluku	Rural	0.58	0.00	31,281	285,056	15,607
	Urban	0.90	0.25	31,716	22,120	25,355
West Irian Jaya	Rural	0.50	0.03	14,517	242,516	13,206
	Urban	0.97	0.38	18,122	5,332	3,292
Papua	Rural	0.54	0.03	42,340	655,345	38,516
	Urban	0.99	0.38	52,854	6,501	9,601
Indonesia Total	**Rural**	**0.72**	**0.01**	**3,776,541.2**	**35,965,044.9**	**3,465,666.0**
	Urban	**0.92**	**0.41**	**6,902,966.0**	**7,869,978.1**	**5,334,245.2**
	Total	**0.80**	**0.18**	**10,679,507.2**	**43,835,023.0**	**8,799,911.2**

Source: Authors' estimates

Table C19. Time used accessing latrines

Province	Location	Total time spent accessing (million hours)		Value (IDR billion)	
		Shared latrines	Open defecation	Shared latrines	Open defecation
NAD	Rural	17	26	17	27
	Urban	27	7	28	8
North Sumatra	Rural	35	63	50	91
	Urban	45	9	65	13
West Sumatra	Rural	27	54	35	70
	Urban	19	6	24	8
Riau	Rural	11	16	14	20
	Urban	12	0	27	1
Jambi	Rural	12	23	28	53
	Urban	5	2	12	5
South Sumatra	Rural	21	60	19	55
	Urban	25	4	23	4
Bengkulu	Rural	4	18	4	17
	Urban	4	1	4	1
Lampung	Rural	26	32	27	33
	Urban	17	5	18	5
Bangka Belitung	Rural	2	13	1	11
	Urban	2	3	2	2
Riau Archipelago	Rural	1	3	1	3
	Urban	17	1	12	1
Jakarta	Urban	153	2	110	2
West Java	Rural	201	178	324	287
	Urban	284	57	459	92
Central Java	Rural	122	253	196	409
	Urban	143	108	556	419
Yogyakarta	Rural	7	4	28	14
	Urban	53	5	205	20
East Java	Rural	136	344	878	2,222
	Urban	189	102	1,221	657
Banten	Rural	29	83	185	534
	Urban	66	14	82	18
Bali	Rural	10	27	13	34
	Urban	29	6	36	7
West Nusa Tenggara	Rural	10	74	9	61
	Urban	19	25	15	20

Province	Location	Total time spent accessing (million hours)		Value (IDR billion)	
		Shared latrines	Open defecation	Shared latrines	Open defecation
East Nusa Tenggara	Rural	12	43	10	35
	Urban	10	1	10	1
West Kalimantan	Rural	10	50	10	50
	Urban	6	3	6	3
Central Kalimantan	Rural	10	22	15	32
	Urban	6	2	9	3
South Kalimantan	Rural	16	24	24	35
	Urban	18	3	22	4
East Kalimantan	Rural	7	8	9	10
	Urban	18	2	22	2
North Sulawesi	Rural	9	12	12	16
	Urban	15	1	20	2
Central Sulawesi	Rural	7	39	9	52
	Total	4	9	4	7
South Sulawesi	Rural	8	41	6	33
	Urban	65	19	53	16
Southeast Sulawesi	Rural	6	24	3	11
	Urban	6	2	3	1
Gorontalo	Rural	5	17	2	8
	Urban	6	2	6	2
West Sulawesi	Rural	1	8	1	8
	Urban	7	7	8	8
Maluku	Rural	6	18	9	26
	Urban	4	2	6	3
North Maluku	Rural	6	12	8	18
	Urban	3	1	3	1
West Irian Jaya	Rural	3	11	4	12
	Urban	3	0	4	0
Papua	Rural	4	13	11	41
	Urban	20	1	62	2
Indonesia Total	**Rural**	**781**	**1,613**	**1,963**	**4,330**
	Urban	**1,302**	**413**	**3,137**	**1,337**
	Total	**2,083**	**2,026**	**5,102**	**5,667**

Source: Authors' estimates

Table C20. Economic impact of lower foreign tourist numbers, 2006

Province	Current tourism value[1] (IDR billion)	Current hotel occupancy rate (%)	Future potential value[2] (IDR billion)	Annual economic loss[3] (IDR billion)
NAD	6	48.7	10	0
North Sumatra	657	37.4	1,405	37
West Sumatra	158	40.2	315	8
Riau	188	42.1	358	8
Jambi	14	34.8	32	1
South Sumatra	34	36.7	74	2
Bengkulu	2	21.8	7	0
Lampung	22	45.6	39	1
Bangka Belitung	8	38.1	17	0
Riau Archipelago	5,673	42.1	10,780	255
Jakarta	5,938	51.1	9,299	168
West Java	1,160	37.8	2,458	65
Central Java	519	43.2	961	22
Yogyakarta	621	45.6	1,089	23
East Java	1,228	48.3	2,035	40
Banten	435	33.3	1,046	31
Bali	20,574	47.8	34,434	693
West Nusa Tenggara	916	32.5	2,251	67
East Nusa Tenggara	98	43.9	179	4
West Kalimantan	172	40.5	341	8
Central Kalimantan	6	42.7	11	0
South Kalimantan	44	47.0	75	2
East Kalimantan	232	54.5	341	5
North Sulawesi	148	51.9	228	4
Central Sulawesi	14	52.9	21	0
South Sulawesi	293	38.2	613	16
Southeast Sulawesi	6	43.6	11	0
Gorontalo	4	51.9	6	0
West Sulawesi	2	38.2	4	0
Maluku	28	48.1	47	1
North Maluku	2	48.1	3	0
West Papua	8	23.5	27	1
Papua	54	34.8	124	4
Indonesia Total	**39,267**	**45.0**	**68,643**	**1,465**

[1] Ministry of Culture and Tourism. Statistical report on visitor arrivals to Indonesia 2006. Jakarta: Data and Information Center. 2007.
[2] Calculated as the revenue from tourists, assuming 80% occupancy of existing (foreign) tourist hotels.
[3] Calculated as the gap between current and potential value, multiplied by 5% attribution to sanitation.