



## **Economic Aspects of Sanitation in Developing Countries**

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## Economic Aspects of Sanitation in Developing Countries

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### Abstract

**Background:** Improved sanitation has been shown to have great impacts on people's health and economy. However, the progress of achieving the Millennium Development Goals (MDGs) on halving the proportion of people without access to clean water and basic sanitation by 2015 has thus far been delayed. One of the reasons for the slow progress is that policy makers, as well as the general public, have not fully understood the importance of the improved sanitation solutions. This paper, by gathering relevant research findings, aims to report and discuss currently available evidence on the economic aspects of sanitation, including the economic impacts of unimproved sanitation and the costs and economic benefits of some common improved sanitation options in developing countries.

**Methods:** Data used in this paper were obtained from different information sources: international and national journal articles and reports, web-based statistics, and fact sheets. We used both online search and hand search methods to gather the information.

**Results:** Scientific evidence has demonstrated that the economic cost associated with poor sanitation is substantial. At the global level, failure to meet the MDG water and sanitation target would have ramifications in the area of US\$38 billion, and sanitation accounts for 92% of this amount. In developing countries, the spending required to provide new coverage to meet the MDG sanitation target (not including program costs) is US\$142 billion (US\$ year 2005). This translates to a per capita spending of US\$28 for sanitation. Annually, this translates to roughly US\$14 million. The evidence compiled in this paper demonstrates that investing in sanitation is socially and economically worthwhile. For every US\$1 invested, achieving the sanitation MDG target and universal sanitation access in the non-OECD countries would result in a global return of US\$9.1 and US\$11.2, respectively.

**Conclusion:** Given the current state of knowledge, sanitation is undeniably a profitable investment. It is clear that achieving the MDG sanitation target not only saves lives but also provides a foundation for economic growth.

**Keywords:** economics, cost, impacts, sanitation, developing countries

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## Introduction

Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and feces. An improved sanitation facility is one that hygienically separates human excreta from human contact. Improved sanitation generally involves physically closer facilities, less waiting time, and safer disposal of excreta.<sup>1,2</sup>

According to 2006 figures, approximately 2.6 billion people do not use improved sanitation facilities, two-thirds of whom live in Asia and sub-Saharan Africa.<sup>1</sup> While 99% of people living in industrialized countries have access to improved sanitation, only 53% of populations in developing countries have such access. Within developing countries, urban sanitation coverage is 71%, while rural coverage is 39%.<sup>3</sup> In Asia, although Thailand and Singapore have achieved universal sanitation coverage, the proportions of populations having access to improved sanitation in Cambodia, Indonesia, Vietnam and the Philippines in 2005 were 28%, 57%, 69% and 76%, respectively.<sup>4</sup>

Poor sanitation is responsible for one of the heaviest existing disease burdens worldwide. The diseases associated with poor sanitation and unsafe water account for about 10% of the global burden of disease.<sup>5</sup> Diseases associated with poor sanitation are diarrhoeal diseases, acute respiratory infections, undernutrition and other tropical diseases such as helminth and schistosomiasis infections.<sup>3,6-8</sup> Diarrhoeal diseases are the most common sanitation-related diseases. Globally, about 1.7 million people die every year from diarrhoeal diseases, and 90% are children under 5 years, mostly in developing countries. Eighty-eight percent of cases of diarrhoeal diseases worldwide are attributable to unsafe water, inadequate sanitation, and poor hygiene.<sup>9,10</sup>

In 2000, the international community committed to halving the proportion of people without access to clean water and basic sanitation by 2015 through the Millennium Development Goals (MDGs).<sup>11</sup> Overall, the world is on track to meet the water MDG, but there are major gaps in achieving the sanitation target. At the current rate of progress, the world would miss the MDG target by 13 percentage points.<sup>3</sup> Unless huge efforts are made, the proportion of people without access to basic sanitation would not be halved by 2015. Even if we meet the MDG target, there would still be

1.7 billion people without access to basic sanitation. If the trend remains as currently projected, an additional billion people who should have benefited from MDG progress would miss out, and by 2015 there would be 2.7 billion people without access to basic sanitation.<sup>3,12</sup> The United Nations declared 2008 as the International Year of Sanitation to make it a priority for governments, organizations, civil society, and private partners worldwide.<sup>13</sup>

One of the reasons for the slow progress in expanding improved sanitation coverage in the world, in general, and in developing countries in particular, is that policy makers and the general public have not fully understood the importance of the improved sanitation solutions. The governments in developing countries tend not to see improved sanitation as a necessary condition of economic development or source of improved welfare, and cost benefit analysis has not been commonly used to justify increasing spending on sanitation programs. Until now, both policy makers and the general public have not been presented with comprehensive evidence on the economic impact that sanitation has on the economy, the environment, and population welfare. While medical researchers have extensively documented the health impacts of poor sanitation, much less is known about its economic consequences. This paper, by gathering relevant research findings, aims to report and discuss currently available evidence on the economic aspects of sanitation, including the economic impacts of unimproved sanitation and the costs and economic benefits of some common improved sanitation options in developing countries. The evidence is expected to be used to justify stronger actions in order to reach the MDG sanitation target.

## Methods

Data used in this paper were obtained from different information sources: international and national journal articles and reports, web-based statistics, and fact sheets. We used both online search and hand search methods to gather the information.

The online search was performed in multiple electronic bibliographic databases, including: MEDLINE, PubMed, Web of Sciences, and EMBASE. The following main key search terms were used: (Sanitation OR safe disposal OR hygiene) AND (cost OR financing OR economic) AND (efficiency OR benefit OR



returns), etc. In addition, search engines such as Google and Google Scholar were also used.

Hand search was done in the Vietnam National Library, as well as in libraries of different institutions, such as the Ministry of Health, Hanoi Medical University, Hanoi School of Public Health, Health Strategy and Policy Institute of Vietnam, and other Non-Governmental Organizations in Vietnam. Research/studies conducted within the last 15 years were included.

In this paper, we used the WHO and UNICEF definitions of improved and unimproved (poor) sanitation. Improved sanitation consists of a flush or pour-flush toilet to a piped sewer system, a septic tank or pit latrine; a ventilated improved pit-latrine (VIP); a pit latrine with slab; or a composting toilet. Unimproved (poor) sanitation refers to several unsafe methods for disposal of excreta such as a flush/pour flush to elsewhere, a pit latrine without slab, a bucket, a hanging toilet or hanging latrine, no facilities, or a bush or field.<sup>1</sup>

## Results

### Economic impacts of unimproved sanitation

Poor sanitation causes economic losses associated with the direct costs of treating sanitation-related illnesses and lost income through reduced or lost productivity. In addition, poor sanitation also leads to time and effort losses due to distant or inadequate sanitation facilities, lower product quality resulting from poor water quality, reduced income from tourism (due to a high risk of contamination and disease), and clean up costs.<sup>14</sup>

Scientific evidence has demonstrated that the economic costs associated with poor sanitation are substantial. At the global level, failure to meet the MDG water and sanitation target would have ramifications in the area of US\$38 billion, and sanitation accounts for 92% of this amount.<sup>2,15</sup> At the regional level, a recent study conducted in Southeast Asia found that the economic costs of poor sanitation and hygiene amounted to over US\$9.2 billion a year (2005 prices) in Cambodia, Indonesia, the Philippines, and Vietnam, accounting for 2% of the total GDP for all of the countries combined. The key economic impacts in descending order of importance were health, water resources, user preferences (access time cost), and tourism. Poor sanitation affects everyone, but especially the poor

and vulnerable (children, women, the disabled, and the elderly).<sup>4</sup>

Several studies have also been conducted to estimate the economic costs associated with poor sanitation. In Ghana and Pakistan, for example, the indirect effect on child mortality of environmental risk factors mediated by malnutrition has added more than 40% to the cost of directly caused child mortality. If one took into account the effect of such malnutrition on impaired school performance and delayed entry into the labour market, the cost would double to 9% of the gross domestic product (GDP).<sup>16</sup>

In Cambodia, poor sanitation has led to economic losses of US\$448 million per year, which translates into per capita loss of approximately US\$32. The economic losses were equivalent to 7.2% of Cambodia's GDP in 2005. This amount was roughly equivalent to the contribution of the fishery sector to the GDP, or twice the forestry sector's contribution. While these economic costs were not all tangible, the immediate money 'in the hand' losses (financial losses) amounted to about US\$160 million per year, which was roughly 2.5% of the GDP, equivalent to nearly US\$12 per capita.<sup>17</sup>

Indonesia lost an estimated US\$6.3 billion due to poor sanitation and hygiene, equivalent to approximately 2.3% of the GDP. Of the impacts evaluated, health and water resources contributed most to the overall economic losses estimated in the study. Poor sanitation, including hygiene, caused at least 120 million disease episodes and 50,000 premature deaths annually. The resulting economic impact was more than US\$3.3 billion per year. The associated economic costs of polluted water attributed to poor sanitation exceeded US\$1.5 billion per year. Poor sanitation also contributed up to US\$1.2 billion per year in population welfare losses (due to additional time required to access unimproved sanitation), US\$166 million per year in tourism losses, and US\$96 million in environmental losses due to loss of productive land.<sup>18</sup>

In the Philippines, poor sanitation led to economic costs in the order of US\$1.4 billion, equivalent to about 1.5% of the GDP in 2005 and translated to per capita losses of US\$16.8 per year. The health impacts represented the largest source of quantified economic costs at about US\$1 billion, representing about 72% of total economic costs. The second most important



economic impact was on water resources, which accounted for about 23% of the total costs.<sup>19</sup>

In Vietnam, the financial losses reflecting expenditure or income losses resulting from poor sanitation were US\$780 million, equal to roughly 0.5% of the annual GDP, while overall population welfare losses were equal to 1.3% of the GDP. Most economic losses were shared between health (34%), water resources (37%), and the environment (15%). The annual losses per capita totaled US\$9.38 per year.<sup>20</sup>

Lao PDR lost an estimated US\$193 million due to poor sanitation and hygiene, equivalent to approximately 5.6% of the GDP. Of the impacts evaluated, health contributed 60% to the overall economic costs estimated in the study, followed by 18% for accessing clean drinking water, 13% for additional time to access unimproved sanitation, and 9% due to tourism losses. Poor sanitation, including hygiene, caused at least 3 million disease episodes and 6,000 premature deaths annually. The resulting economic impact was more than US\$115 million per year. The associated economic costs of polluted water attributed to poor sanitation exceeded US\$35 million per year. This excluded accessing clean water for non-drinking purposes, as well as loss of productive value for fisheries and agriculture due to polluted water. Poor sanitation also contributed US\$25 million losses per year due to additional time required to access unimproved sanitation, and possibly over US\$17 million per year in tourism losses.<sup>21</sup>

Inadequate sanitation has caused India considerable economic losses, equivalent to 6.4 percent of India's GDP in 2006 at US\$53.8 billion. This meant an annual impact of US\$48 per person. The health-related economic impacts of inadequate sanitation at US\$38.5 billion accounted for the largest category of impacts, while access time (productive time lost to access sanitation facilities or sites for defecation) and drinking water-related impacts were the other two main losses at US\$10.7 billion and US\$4.2 billion, respectively.<sup>22</sup>

### Costs of common improved sanitation options

The costs of a sanitation facility were separated into investment and recurrent costs. Investment costs included: planning and supervision,

hardware, construction, protection of water sources, and education that accompanies an investment in hardware. Recurrent costs included: operating materials to provide a service, hardware maintenance and replacement of parts, emptying of septic tanks and latrines, and continuous education activities.

According to an estimate by the WHO and UNICEF, initial investment costs (year 2000) per capita ranged from a simple pit latrine at US\$26 in Asia to a septic tank at US\$160 in Latin America and the Caribbean. Annual costs for sanitation options (both investment and recurrent costs) on a per-person-reached basis varied from a simple pit latrine at US\$3.92 in Asia to a septic tank at US\$12.39 in Latin America and the Caribbean.<sup>15,23</sup>

Rockstroem et al (2005) reported that, in rural settings, the costs per person (including both investment and recurrent costs) of a simple pit latrine, a ventilated improved pit latrine, and a pour-flush latrine were US\$45, 65, and 70, respectively. In peri-urban sites, the costs of a septic tank latrine and a sewer connection with local labour (assumed without treatment) were US\$160 and 175, respectively. In urban areas, the costs of connecting to a conventional sewer (assumed without treatment), a sewer connection and secondary wastewater treatment, and a tertiary wastewater treatment service were US\$300, 450, and 800, respectively.<sup>24</sup>

A study by Fonseca et al (2007) found that the annual per capita costs were US\$11–54 for a simple pit latrine, US\$10–172 for a VIP latrine, and up to US\$799 for a septic tank. The annual per capita sewerage connection costs were between US\$24–260.<sup>25</sup>

Several analyses have also been conducted to estimate the global costs of reaching target 10 of the Millennium Development Goal (MDG) 7 “halving, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation”, and the costs were reported to be in the range of US\$9 to 30 billion per year at the global level.<sup>26,27</sup> However, most of these analyses have ignored the costs of maintaining existing coverage levels (the costs of operating, maintaining, monitoring, and replacing existing infrastructure and facilities).<sup>28</sup>

Recent research by Hutton et al (2008) reported that providing new coverage to meet the MDG sanitation target in developing countries would require



spending US\$142 billion (year 2005)—excluding program costs. This translates to per capita spending of US\$28 for sanitation, roughly US\$14 million, annually. Developing countries in the WHO Western Pacific Region and WHO Southeast Asian strata D each required 30% of the total spending, followed by the WHO African Region needing 24%. Urban areas took 59% of the share, recurrent costs were 57% and the population already covered 60%. Additional costs of maintaining existing sanitation services were US\$216 billion. Additional program costs—incurred administratively outside the intervention area concerned—varied between 10% and 30% and were necessary to ensure effective implementation.<sup>28</sup>

### Economic benefits of improved sanitation

Improved sanitation brought multiple economic benefits, which included: (1) direct economic benefits of avoiding illnesses (the amount of money that is saved from healthcare expenses); (2) indirect economic benefits, which included a decrease in work days lost to illness and a longer lifespan, because these benefits enabled people to work more; and (3) non-health benefits such as time.<sup>15,29,30</sup>

Different studies have demonstrated that sanitation is fundamental to social and economic development, and fiscal gains from improved sanitation services are substantial. Dollar et al (1999), for example, reported that, for every 10% increase in female literacy (due to increased school attendance where proper sanitation facilities exist), a country's economy could grow by 0.3 percent.<sup>31</sup> Evans et al (2004) found that annual investments of US\$20.5 million in Tanzania and US\$6.7 million in Vietnam would yield benefits of US\$5.4 million and US\$66.7 million, respectively, for the health sector alone.<sup>32</sup> Hutton et al (2008) estimated that US\$6.3 billion could be saved annually if proper sanitation and hygiene practices were introduced in Cambodia, Indonesia, Vietnam, and the Philippines.<sup>4</sup>

Cost and benefit analyses available on a global scale have frequently concluded that the benefits still outweigh the costs regardless of which scenario is considered. Cost-benefit analysis (CBA) is an economic evaluation method used to determine if a project is worthwhile for a community; it compares the value of the benefits gained from a specific policy or

intervention to the corresponding costs. If all of the benefits are translated into monetary terms, it is possible to compare the total benefits to the costs of a potential intervention. If benefits and costs are expressed in a common monetary unit (such as US dollars), we can determine whether or not the total benefit of an intervention exceeds the total cost. The impact of a project is measured by the difference in benefits between what the situation in the study area would be with and without the project.<sup>33</sup> The most up-to-date cost-benefit analysis by Hutton et al (2007) found that achieving the MDG water and sanitation target would result in a total economic benefit of US\$38 billion annually and 92% of which would be accounted for by the MDG sanitation target. Economic benefits of sanitation have been more heavily dominated by convenience time savings, representing 90% of the total economic benefit, followed by 8% for productivity gains, and 2% for health care cost savings.<sup>15,30</sup>

The analysis by Hutton et al (2007) also reported the benefit-cost ratios of achieving the MDG sanitation target and providing universal sanitation access in the non-OECD (Organization for Economic Co-operation and Development) countries. The benefit-cost ratio is calculated as the total benefits divided by the total costs. Projects with a benefit-cost ratio greater than 1 have greater benefits than costs. For every US\$1 invested, achieving the sanitation MDG target and providing universal sanitation access in the non-OECD countries would result in a global return of US\$9.1 and US\$11.2, respectively.<sup>15,30</sup>

Moreover, the Disease Control Priorities Project recently found that hygiene promotion to prevent diarrhoea was the most cost-effective health intervention in the world at only \$3.35 per DALY loss averted, with sanitation promotion following closely behind at just \$11.15 per DALY loss averted.<sup>23</sup>

### Discussion

We have demonstrated that sanitation is fundamental to both good health and social and economic development. Millennium Development Goal 7 addresses the sanitation target as a key area of human development. Without the improvement of sanitation, none of the other Millennium Development Goals would be achieved.<sup>11</sup> In 2007, improved sanitation was chosen by 11,300 readers of the British Medical



Journal as the most important medical advancement since 1840.<sup>34</sup> A recent paper by Shandra et al (2011) demonstrated that higher levels of access to an improved water source and an improved sanitation facility are associated with lower levels of child mortality within Sub-Saharan African nations.<sup>35</sup>

Poor sanitation was shown to cause a wide range of adverse impacts on population health, as well as national economies. The magnitude of economic losses associated with poor sanitation in developing countries has been substantial. The economic losses of 2% of the total GDP in 4 countries (Cambodia, Indonesia, the Philippines, and Vietnam) represent only the impacts of poor sanitation on five areas: health, water resources, environment, tourism, and other welfare concerns. This figure would have been much greater if other impacts had been included, such as: suffering from disease, aesthetics and user preference, time loss from seeking private places to urinate (especially women), losses from marine fisheries, and the losses to wildlife from polluted water resources and an unclean environment, etc.<sup>4</sup>

Sanitation also has socio-economic equity implications. Vulnerable groups (the poor, children, women, the disabled, and the elderly) have suffered the most from the economic impacts of poor sanitation.<sup>4,36,37</sup> In fact, diseases associated with poor sanitation have been closely correlated with poverty and infancy, and alone, account for about 10% of the global burden of disease.<sup>5</sup> A recent paper by Isunju et al (2011) highlighted a lack of recognition of actual drivers for sanitation improvements and the complexities in the provision of sanitation services in the context of urban slums with a mix of tenants and landlords.<sup>38</sup>

Information on the costs of sanitation options is a very important variable for deciding whether or not to invest in interventions. However, the cost figures reported by different studies were quite variable. This could be explained by the differences in research methodologies and assumptions. Different approaches to incremental improvement and on adequate service levels also contributed to the differences.<sup>28</sup> The most recent research has revealed that the spending required in developing countries to meet the MDG sanitation target is US\$142 billion (year 2005).<sup>28</sup> This is, indeed, a considerable amount, but the cost per capita of US\$28 is in fact feasible.

Although sanitation services seem to be expensive, the evidence compiled in this paper has demonstrated that investing in sanitation is socially and economically worthwhile.<sup>15,29</sup> Benefits far outweigh costs when the definition of 'benefits' includes: direct health gains such as averted health care costs; indirect health benefits, productivity gains associate morbidity and mortality; and non-health benefits such as increased convenience time. Furthermore, improved sanitation has great positive impacts on children's health, gender equality, environmental sustainability, and water resources (clean drinking water). Both directly, and through the various pathways to development, improved sanitation will contribute to lifting populations out of poverty, as well as preventing them from slipping back into poverty.<sup>4</sup> The cost-benefit analysis by Hutton et al (2007) also suggested that achieving the MDG sanitation target is economically more favourable than the MDG water target, with a global return of US\$9 for sanitation compared to US\$4 for water, per US\$1 invested.<sup>15,30</sup> The existence of several important but currently unmeasured benefits (such as far-reaching economic gains from higher female education and from the prevention of environmental degradation, etc.) indicates the potential for even greater gains from access to improved sanitation.

## Conclusion

This paper aimed to show that sanitation is fundamental to both good health and social and economic development. Given the current state of knowledge, sanitation is undeniably a profitable investment. It is clear that achieving the MDG sanitation target not only saves lives, but also stimulates gender equality, supports environmental safety, bolsters education, and provides a foundation for economic growth. Policy makers, development partners, as well as the general population, should act now to improve the current sanitation situation, especially in developing countries. As several low-cost sanitation options are available, a good strategy would be to encourage people in poorer areas to start with the most simple types of sanitation and then to progress over time towards higher specification and higher cost ones. Since the evidence that we have at our disposal today is based on a number of assumptions, more detailed studies are needed to produce more



precise estimates on the cost and benefits of these sanitation measures, and how they relate to other relevant factors.

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## Conflict of Interest

None.

## Disclosure

Author(s) have provided signed confirmations to the publisher of their compliance with all applicable legal and ethical obligations in respect to declaration of conflicts of interest, funding, authorship and contributorship, and compliance with ethical requirements in respect to treatment of human and animal test subjects. If this article contains identifiable human subject(s) author(s) were required to supply signed patient consent prior to publication. Author(s) have confirmed that the published article is unique and not under consideration nor published by any other publication and that they have consent to reproduce any copyrighted material. The peer reviewers declared no conflicts of interest.

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