

The Economic Returns of Sanitation Interventions in Yunnan Province, People's Republic of China

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INTRODUCTION

The Economics of Sanitation Initiative (ESI) is a multi-country study launched in 2007 as a response by the World Bank's Water and Sanitation Program to address major gaps in evidence among developing countries on the economic aspects of sanitation. Its objective is to provide economic evidence to increase the volumes and efficiency of public and private spending on sanitation. This research brief summarizes the key findings of Study Phase II—cost-benefit analysis of alternative sanitation options—from Yunnan Province.ⁱ

PROBLEM STATEMENT

China has made consistent progress towards the Millennium Development Goal target. Access to basic household sanitation increased from 41 percent (in 1990) to 55 percent of households (in 2008).ⁱⁱ However, this implies more than half a billion people still do not have access to improved sanitation facilities in China. According to provincial statistics, coverage of sanitary latrine in Yunnan Province stood at 54 percent



in 2009; this rate is lower than the national rate of 63 percent recorded by national statistics and using the same definition of improved sanitation. However, these coverage figures do not reflect the proper management of human excreta. When safe excreta disposal is taken into account, the coverage statistics drop to 27 percent coverage for Yunnan Province, compared to 40 percent for the entire China.ⁱⁱⁱ This situation causes health risks and widespread pollution to water resources.

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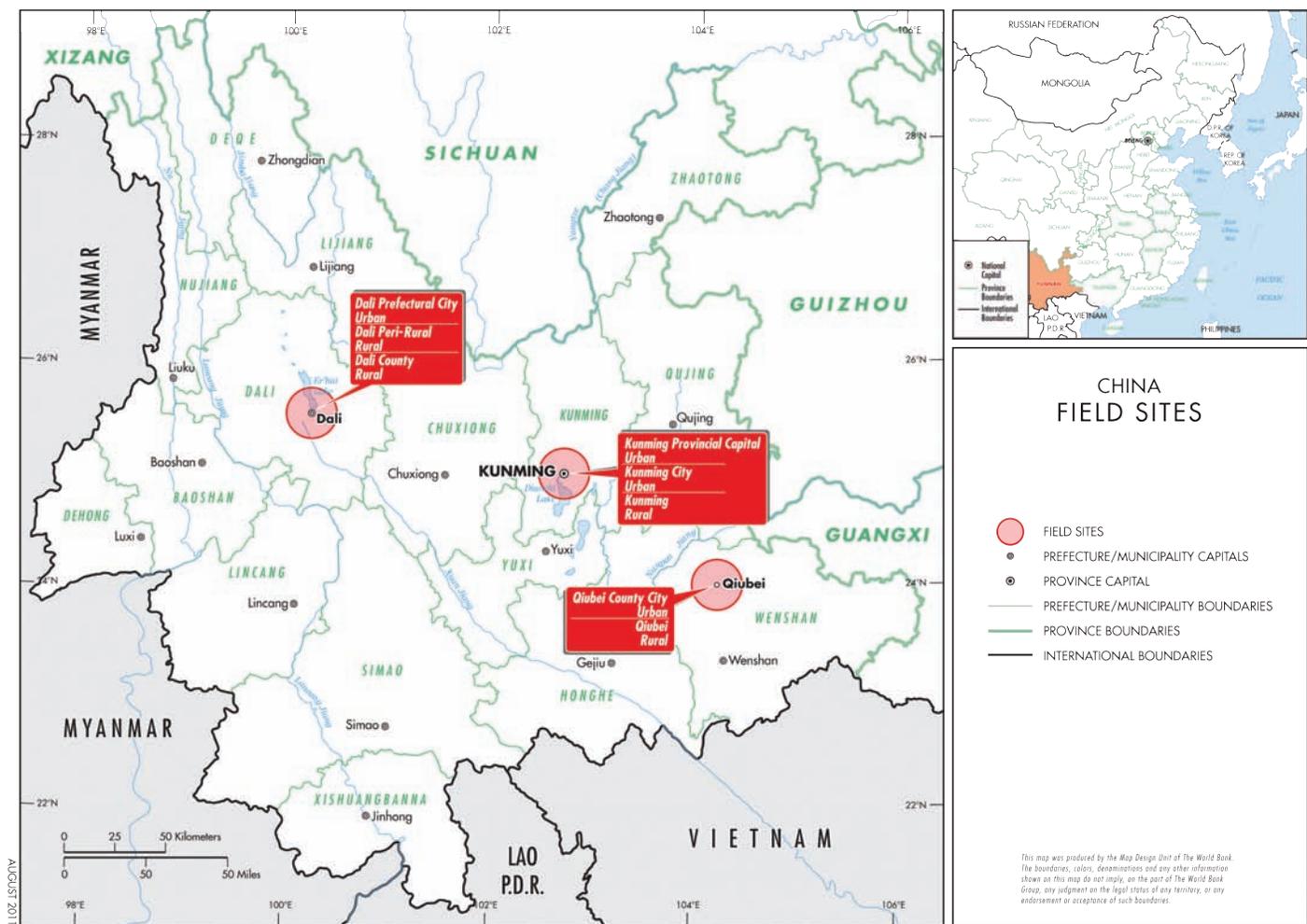
Key messages

- Sanitation interventions have very favorable socio-economic returns to households and society, contributing improved health, clean environment, dignity and quality of life, among many other benefits. Pit latrines in rural areas have an economic return of at least six times the cost, and off-site treatment options in urban areas have an economic return of at least two times the cost.
- Economic efficiency of the improved sanitation can be optimized by making programs more demand-sensitive, which leads to sustained behavior change. More efforts are needed to stimulate demand from populations and deliver sanitation solutions that they wish for. Users should be involved in all the stages of sanitation projects.
- Sanitation options that protect the environment generate significant environmental benefits not fully captured in this study. A cleaner environment and safer water resources are highly valued by households, tourists and businesses. The higher investments needed for the appropriate transport, treatment and disposal of human excreta and wastewater can be justified by the higher income levels and willingness to pay for improved quality of life, especially in urban centers. Monitoring is needed to ensure the environmental benefits are being captured.

Economic analysis measures the broader **welfare** benefits of products and services on populations, such as value of life, time use, environmental and social benefits, as opposed to **financial analysis**, which measures the financial gains only (e.g., changes in income or cash situation).



Figure 1. ESI Field Sites in Yunnan Province



STUDY AIMS AND METHODS

The purpose of the Phase II of the ESI study is to provide sanitation decision makers with improved evidence on the costs and benefits of alternative sanitation options in different contexts in Yunnan Province. The study focuses on human excreta management, covering eight selected field sites.

Surveys were conducted in four rural and four urban^{iv} sites that have recently been the focus of intensified sanitation programs and projects (see Figure 1), involving overall 909 household questionnaires, focus group discussions, physical investigations, water quality assessments, market surveys, and health facility surveys conducted in each site. Primary data were supplemented with data from other surveys.

Sanitation interventions evaluated varied by rural and urban location, comparing open defecation with the range of sanitation facilities currently used by people in Yunnan Prov-

ince: dry pit latrine, urine-diverting dry toilet, wet pit latrine (pour-flush), toilet with biogas digester, toilet with septic tank including septage management, and toilet with sewerage connection and treatment.

Conventional techniques of economic analysis were utilized to generate outputs such as benefit-cost ratio, cost-effectiveness ratio, net present value, internal rate of the return, and payback period of sanitation options.

Economic benefits quantified include impacts on health, drinking water, sanitation access time, and the reuse of human excreta. Environmental and social impacts of poor sanitation were not fully captured in the monetary estimates of benefit. Qualitative analyses were conducted on selected social and broader economic benefits. **Full investment and recurrent costs** were measured for each sanitation option.

STUDY RESULTS

Rural Areas:

Substantial Economic Returns on Pit Latrines

Benefit-cost ratios (economic return per currency unit invested) and annualized costs per household are compiled for the four rural sites in Figure 2 and Figure 3. Among the various sanitation options, the most favorable economic performance was found for urine diverting dry toilets (UDDT), followed by biogas digesters. These interventions have the highest benefit-cost ratios of 9.0 and 7.6, respectively. The next ranked interventions are private pit latrines and community toilets with benefit–cost ratios of 6.2 and 5.5, respectively. The lowest ranked intervention but still with highly favorable economic returns—is the septic tank option, with a benefit-cost ratio of 3.5. All interventions have an annual economic rate of return of more than 100 percent, thus requiring less than one year to recover the economic value of the initial investment costs.

The lowest cost option is the pit latrine, at US\$132 per household. Taking into account the expected 10-year lifespan of a pit latrine, the annual equivalent cost per household, including O&M is around US\$30 per household. Almost half of this value is O&M costs. The annual equivalent cost for UDDT is higher at US\$50. However, this option is assumed to have greater health benefits due to less environmental pollution; and the value of reusing human excreta in home gardening or cropland, thus reducing the need to purchase chemical fertilizers. Septic tanks have a higher initial investment cost at US\$408, but are expected to last for 20 years.

The findings suggest that low-cost technologies, particularly improved pit latrines, are worth pursuing especially for low-income groups. The most important benefits for all options are time savings and health improvements, except community toilets which have less time savings. For UDDT and community toilets, the annual equivalent cost is repaid by the saved health care costs alone.

Under actual program conditions, there is an important decline in performance for all sanitation options. This is due to non-use of the facilities by some households or household members, as they prefer to continue traditional practices such as open defecation or use of old unimproved latrines instead of UDDT. For example, the benefit-cost ratio of pit

Figure 2. Benefit-Cost Ratios in Rural Sites (economic return per unit of currency spent)

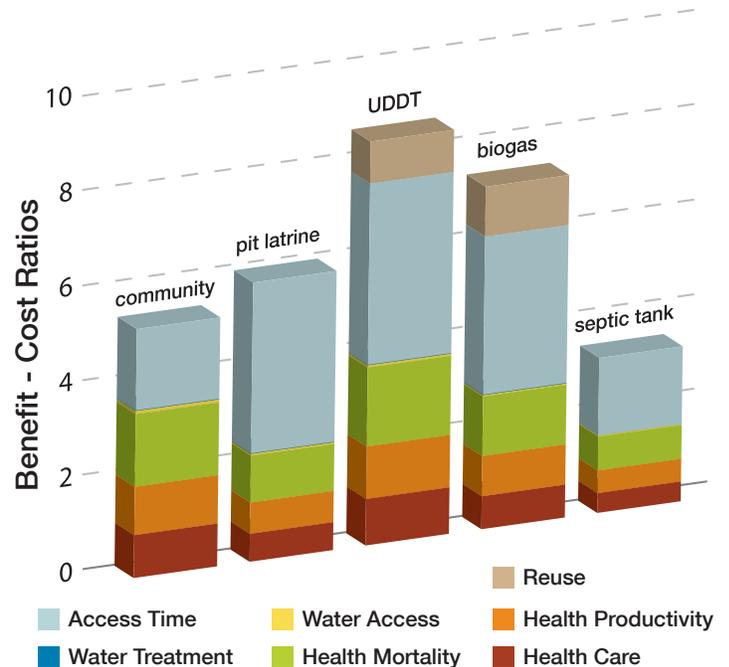
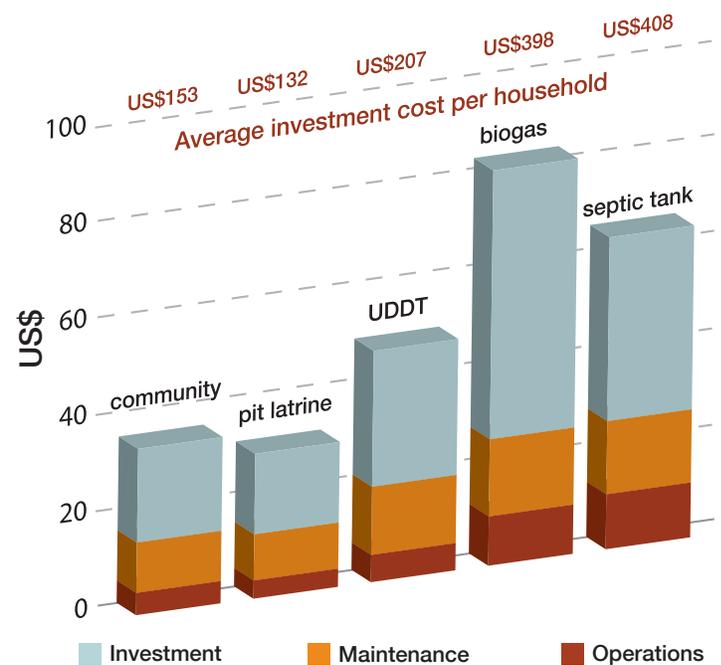


Figure 3. Annual Costs per Household in Rural Sites (2009 prices, using average exchange rate with US\$)



latrines declines from an economic return per currency unit spent of 6.2 to 4.4, for UDDT from 9.0 to 5.8, for biogas from 7.6 to 4.9, and for septic tanks from 3.4 to 2.4.

Urban Areas: Off-Site Treatment Options Deliver High Economic Returns

Benefit-cost ratios and annualized costs per household are compiled for the four urban sites in Figure 4 and Figure 5. The most favorable economic performance was found for pit latrines—with a benefit-cost ratio of 5.2 and an annual return of more than 100 percent—thus requiring less than one year to recover the economic value of the initial investment cost. Community toilets also have a high economic return with a benefit-cost ratio of 4.4, followed by shared latrines (3.1), septic tank with septage management (2.7) and sewerage (1.9).

Private pit latrines have an initial investment cost of US\$187 per household, translating to an equivalent annual cost of US\$43 (taking into account both investment and O&M costs). Due to their higher investment costs of US\$202 per household, community toilets did not perform as well as private pit latrines. While shared latrines had a lower initial investment cost per household than pit latrines of US\$152 per household (or US\$36 per year), the lower time savings meant that the overall economic performance was lower than private pit latrines.

Sanitation options with improved excreta management had the lowest economic performance, shown in Figure 5. While septic tanks with septage management had an initial investment cost of US\$566 per household (or US\$52 per year), and sewerage US\$721 per household (or US\$132 per year), their longer lifespans (20 years) and their higher health benefits still make these interventions highly socially profitable. In addition, the environmental pollution averted due to proper septage management has not been fully valued in this study, hence it is possible that the economic returns, and benefit-cost ratio, are approaching those of lower cost options.

The findings suggest that low-cost technologies, particularly improved pit latrines, are worth pursuing, especially for low-income groups where these options are feasible. However, in densely populated urban centers, with limited options for building UDDT structures and reuse options, the septic tank with septage treatment and sewerage with treatment are both economically attractive options.

Under actual program conditions, there is also a significant

Figure 4. Benefit-Cost Ratios in Urban Sites (economic return per unit of currency spent)

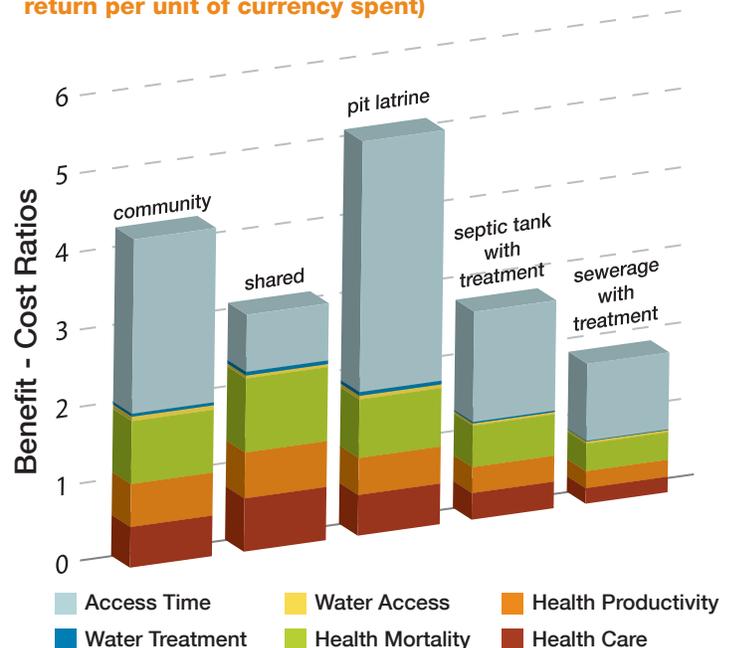
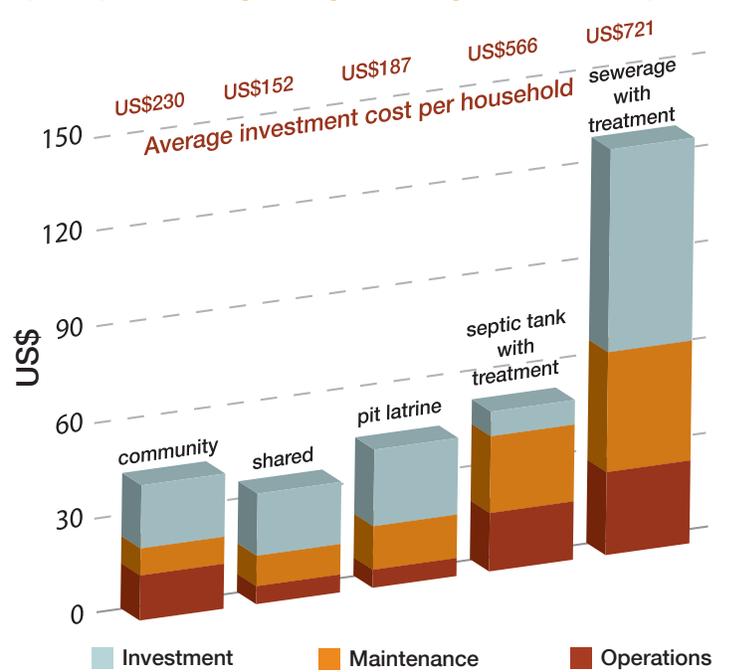


Figure 5. Annual Costs per Household in Urban Sites (2009 prices, using average exchange rate with US\$)



decline in economic performance. Septic tank with septage management reduces from 2.7 to 2.0, sewerage from 1.9 to 1.5, and pit latrines from 5.2 to 3.7. This is due not only to non-use by some households or household members of the facilities, but also to off-site treatment facilities being utilized at well below their engineered capacity.



KEY FINDINGS AND RECOMMENDATIONS

This study finds that all sanitation interventions have benefits that exceed costs, when compared with “no sanitation facility.” The high net benefits from low-cost sanitation options, such as community and private pit latrines in urban areas and all types of private pit latrine in rural areas, suggests these technologies should be considered first for sanitation improvement plans, especially in situations where funds are scarce. However, in densely populated areas, pit latrines have limited feasibility. Also, to improve quality of life in increasingly populous cities, decision makers should be aware of the economic benefits from improved conveyance and treatment options. If they can afford them, populations prefer options that transport waste off-site. However, the recent concerns about water scarcity suggest low water-use options should be increasingly considered, and where gaps in technology exist, to develop pilot programs on low water use options. Based on these findings, four recommendations for decision makers are proposed here:

Recommendations:

1. Intensify efforts to cover the entire Yunnan population with basic improved sanitation access. Sanitation investments are not a sunk cost: major economic benefits can be enjoyed at an affordable cost. With significant reductions in actual economic returns due to non-use of sanitation facilities by the target populations, more efforts are needed to stimulate demand from populations and deliver sanitation solutions that they wish for. It is therefore necessary to involve the users, especially women, in the full project life cycle, from planning, option design selection, construction, education, maintenance, monitoring and evaluation.
2. Go beyond basic sanitation provision. In many municipalities and counties of Yunnan Province, funds are adequate to deliver more sustained and quality services, which better capture the full environmental and health benefits of better sanitation, and respond to the population's wish for a



clean, livable environment. Integrating hygiene awareness and improving hygiene practices in sanitation programs is crucial to capturing the important health benefits.

3. The many agencies involved in sanitation provision suggests that efficiency gains could be made from improved cross-sectoral coordination and cooperation, which will lead to improved planning and choice of

technologies, strengthened mutual learning and resource saving. With continued rapid urbanization and rural development in Yunnan Province, the line between rural and urban solutions will become less clear; therefore, stronger cooperation between the existing separate coordination systems for urban and rural areas is needed, or even an overall coordinating mechanism covering both rural and urban areas.

4. Promote evidence-based sanitation decision making. Variations in economic performance of options suggests a careful consideration of site conditions is needed to select the most appropriate sanitation option and delivery approach. Decisions should take into account not only the measurable economic costs and benefits, but also other key factors for a decision, including intangible impacts and socio-cultural issues that influence demand and behavior change, availability of suppliers and private financing, and actual household willingness and ability to pay for services.

¹ Economic assessment of sanitation interventions in Yunnan Province, People's Republic of China. Chuan, L., Liqiong, Y., Jinming, F., Tiwei, Z., Lin, D., Pu, Z., Ronghuai, L., Hutton, G. World Bank, Water and Sanitation Program. 2011.

² The sanitation part of the combined water and sanitation MDG target was to halve by 2015 the proportion of the global population without access to basic sanitation in 1990. The figures cited are those reported by the WHO/UNICEF Joint Monitoring Programme.

³ Data source: Health Yearbook of China 2003-2010. According to the National Patriotic Health Campaign Committee's "Technical Guideline for Rural Latrine Improvement": (1) 'sanitary latrines' are latrines with walls, roof, a door, storage tank with no leakage, closed, with slab, no worms, no mal-odor, timely emptying of excreta, and safe disposal of excreta separately; and (2) 'sanitary latrines with safe excreta disposal' are sanitary latrines that enable reduction or removal of pathogens in human excreta, therefore avoiding transmission of infectious diseases.

⁴ For the purposes of the presentation, one peri-urban site (Dali) was reclassified as a rural area, while the other peri-urban site was reclassified as an urban area (Kunming).

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About us

The Water and Sanitation Program (WSP) is a multi-donor partnership created in 1978 and administered by the World Bank to support poor people in obtaining affordable, safe, and sustainable access to water and sanitation services. WSP provides technical assistance, facilitates knowledge exchange, and promotes evidence-based advancements in sector dialogue. WSP has offices in 24 countries across Africa, East Asia and the Pacific, Latin America and the Caribbean, South Asia, and in Washington, DC. WSP's donors include Australia, Austria, Canada, Denmark, Finland, France, the Bill and Melinda Gates Foundation, Ireland, Luxembourg, Netherlands, Norway, Sweden, Switzerland, United Kingdom, United States, and the World Bank.

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