Economic Assessment of Sanitation Interventions in Cambodia

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

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wsp
water and sanitation program

The Water and Sanitation Program is a multi-donor partnership administered by the World Bank to support poor people in obtaining affordable, safe, and sustainable access to water and sanitation services.

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Executive Summary

A. INTRODUCTION

Sanitation improvement has been included among Cambodia's own Millennium Development Goals (CMDG), with the aim of 30% coverage among the rural population and 74% among the urban population by 2015. In rural areas, progress has been slow, with around a 1 percentage point increase annually between 1997 and 2007, reaching little over 20% in 2008. Open defecation is still practiced by about 75% of the rural population. Urban coverage stands at 81.5% in 2008. However, this figure reflects toilet access and not improved management of sewage — in urban areas appropriate wastewater management is still extremely limited. Therefore, given the remaining challenges and limited public and private spending on sanitation, future resources allocated to sanitation must be spent efficiently. This requires improved information on the costs and impacts of alternative sanitation options.

B. STUDY AIMS AND METHODS

The aim of this study is to generate evidence on the costs and benefits of sanitation improvements in different programmatic geographical contexts in Cambodia. The evidence will be useful to inform stakeholders which program approaches are more efficient and likely to lead to more sustainable sanitation interventions and programs. Besides this, the study provides advocacy material to argue for sanitation improvements country-wide as well as supporting appropriate sanitation technology option development.

The aspect of sanitation evaluated in this study is household human excreta management, including both onsite options (e.g., pit latrines) and also in urban areas offsite sewage management options. Also, basic hygiene aspects of sanitation are included, given its importance in improving health.

The study methodology follows a standardized approach developed by WSP in the East Asia and Pacific region under the Economics of Sanitation Initiative (ESI) reflecting a mix of traditional and innovative approaches to valuing and comparing costs and benefits. The study consists of a field component, which enables estimation of quantitative cost-benefit performance, as well as in-depth assessment of qualitative aspects of sanitation. The performance of sanitation programs and technologies in the field are compared under ideal and actual program performance. Other broader benefits of sanitation are also assessed at national level, including tourism, local business development, foreign direct investment, water resources and health.

C. DATA SOURCES AND STUDY SITES

To enable assessment of the best use of society's resources, interventions evaluated should reflect the range of feasible options faced by households, communities and policy makers. The projects selected in this study were implemented by different organizations, promoting different sanitation technology options and using different delivery approaches. Four rural sanitation projects were selected, focusing on dry and wet pit latrines, and one urban project, which involved the construction of a wastewater treatment plant and sewerage system.

For the field-level cost-benefit analysis, data sources included a mixture of information collected from the field sites and, in the case of data gaps, the information was supplemented with data from national surveys and other published literature. ESI survey tools included household questionnaires, focus group discussions, physical location surveys, water quality measurements, market surveys, and health facility surveys. Other data sources included the Cambodia Demographic and Health Survey (2005), the Cambodia Socio-Economic Survey (2004, 2007), the National Census (2008), the ESI Impact Study report (2008), and the Cambodia Statistical Year Book (2008).

TABLE A: BACKGROUND INFORMATION ON SELECTED FIELD SITES

Variable	Sanitation project managed by:				
	ECOSORN (EU)	Plan International	World Vision	ADB/MRD (Tonlé Sap)	ADB/MPWT (Sihanoukville)
PROJECT INFORMATION					
Rural/urban	Rural	Rural	Rural	Rural	Urban
Provinces covered by project	SR, BAT, BMC	SR, KPC	KPT, KCH, KDL, TAK, BAT, KSP, PVR, PLN, PNP	KCH, PUR, BAT, SR and KPT	Sihanoukville
Program approach	Subsidizing pour-flush latrines to households (concrete rings + slab + zinc roof)	CLTS approach	Subsidizing latrines to households (concrete rings + slab without pan)	Subsidizing latrines to households by providing different options from dry to wet pit latrines	Construction of sewerage system and wastewater treatment plant, managed by Government of Cambodia under ADB loan
Main sanitation option compared	Pour-flush latrines (offset)	Dry pit latrines (unlined pit)	Dry pit latrines (concrete-lined pit)	Pour-flush latrines	OD to wet pit latrines (with tank) or flush latrines to sewerage with WWTP
Start year	2006	2006	2006	2006	2003
End year	2010	2010	2008	2010	2006
ESI FIELD SITE INFORMATION					
Provinces covered under ESI survey	SR, BAT, BMC	SR	KPT	BAT, SR	SHV
Number of villages sampled	4 villages	6 villages	3 villages	4 villages	7 villages
Households sampled in villages	230	245	170	250	285
Average household size	4.5	5.3	5.1	4.8	5.1
Average no. of children < 5 per household	0.45	0.50	0.47	0.48	0.29

Key: ADB – Asian Development Bank; MRD – Ministry of Rural Development; MPWT – Ministry of Public Works and Transport; BAT – Battambang; BMC – Banteay Meanchey; KPT – Kampong Thom; SR – Siem Reap; KPS – Kampong Speu, KPC – Kampong Cham, KCH – Kampong Chhnang, TAK – Takeo, KDL – Kandal, PNP – Phnom Penh, PVR – Preah Vihear, PLN – Pailin, PUR – Pursat, CLTS – community-led total sanitation.

D. MAIN ECONOMIC ANALYSIS RESULTS

The cost-benefit analysis is presented under two main scenarios: ideal and actual. The "ideal" scenario is a situation where the sanitation project achieves its aims with the expended resources – i.e. all the targeted households adopt the sanitation options and utilize them appropriately. The "actual" scenario is a less-than-ideal scenario, where sanitation and hygiene interventions are not adopted or fully complied with by household members. In the cost-benefit model, this scenario reflects the proportion of households receiving or investing in a latrine in project areas who actually use it, at the time of the ESI survey. It is also important to note that, although being quantitative, the study only takes a snapshot of the project at one particular point in time which may not necessarily reflect the overall project evolution and improvement over time. The project may also experience different efficiencies over different locations.

Under the ideal scenario in rural areas, the benefit-cost ratio (BCR) of dry pit latrines under the intervention of Plan International using the Community-Led Total Sanitation (CLTS) approach is 1.4, while that of World Vision which does not use the CLTS approach is 2.0 (see Table B and Figure A). A BCR of greater than 1.0 suggests that the sanitation option is economically viable - i.e. the economic returns are greater than the costs. The main factor that contributes to the difference of the BCR between the two projects is the lifetime of the latrine structure under these two types of intervention. The wet pit latrines implemented in the ECOSORN and TSRWSSP sites have a higher BCR due to longer lifetime of the latrine structure. The analysis shows that the BCR for the wet pit latrine of the ECOSORN sites is 2.9 and that of the TSRWSSP sites is 2.3. The lower ratio of the TSRWSSP sites is due to a higher

unit cost of the latrines compared to the ECOSORN sites. The internal rate of return (IRR) of the latrine provided in the World Vision project is 250% and in the Plan International project it is 40%. For latrines delivered in the ECOSORN and TSRWSSP projects, the IRR is 110% and 70% respectively. The reason why the IRR for the World Vision project is so high is due to the relatively short latrine lifetime of three years compared to the wet pit latrines of eight years. Generally, an IRR above the alternative uses of capital would represent a good "buy" - compared to the return on savings of under 10% annually in Cambodia, sanitation reflects a very good investment of public funds.

Under the actual scenario in rural areas, the BCR of dry pit latrines in the Plan International project is 0.84 and that of World Vision is 1.3. The low BCR for dry pit latrines delivered in CLTS areas is largely caused by the fact that only about 15% of households having a latrine use the toilet regularly, while the rest keep going to the bush for defecation, which reduces the benefits gained by households and community. Wet pit latrine intervention in the ECOSORN sites has a BCR of 1.9 and that of the TSRWSSP sites is 1.7. The IRR of latrines provided in the ECOSORN and TSRWSSP projects are 45% and 35% respectively. This difference is explained by two main factors: the lower unit costs and the higher sanitation-related disease incidence in ECOSORN sites, which leads to greater economic benefit. Under the actual scenario the IRR of dry latrines provided in the World Vision project is 60%, which is far below the ideal scenario.

Urban sanitation options were also analyzed under actual and ideal scenarios. Under the ideal scenario, the benefit-cost ratio (BCR) for a latrine connected to a septic tank[1] is 1.8 with an IRR of 27%, while the BCR for a latrine connected to sewerage is only 0.14 and its IRR cannot be calculated because the investment cost is higher than the economic benefits.

TABLE B: RURAL AREA EFFICIENCY MEASURES FOR MAIN GROUPING OF INTERVENTIONS, COMPARED TO NO LATRINE

Efficiency measure	Scenario	Private dry pit		Private wet pit	
Field sites included per option[1]		Plan International	World Vision	Ecosorn	TSRWSSP
Option sub-types included		Unlined dry pit (CLTS)	Concrete-lined dry pit	Wet pit (offset)	Wet pit (offset)
COST-BENEFIT MEASURES					
Benefits per US$1 input ($)	Ideal	1.4	2.0	2.9	2.3
	Actual	0.84	1.3	1.9	1.7
Internal rate of return (%)	Ideal	40	250	110	70
	Actual	-	60	45	35
Payback period (years)	Ideal	1	2	2	3
	Actual	-	3	4	4
Net present value ($)	Ideal	337	622	612	444
	Actual	(613)	204	290	222
COST-EFFECTIVENESS MEASURES					
Cost per DALY averted ($)	Ideal	1,543	1,101	320	534
	Actual	2,572	1,786	432	735
Cost per case averted ($)	Ideal	37	26	11	13
	Actual	62	43	15	18
Cost per death averted ($)	Ideal	48,094	29,347	14,040	18,217
	Actual	80,157	47,587	18,972	25,099

"-" could not be calculated due to one year assumed length of life and the BCR which is 1 or below 1. Note: the explanation of terms is given in the glossary of terms in this report.

[1] In this site, and in Cambodia generally, the term septic tank does not necessarily refer to the well engineered septic tank, but is also used to refer to a simple sedimentation tank. The term 'septic tank' used hereafter refers to both a septic tank and sedimentation tank.

FIGURE A: ACTUAL VERSUS IDEAL BENEFIT-COST RATIOS OF SANITATION OPTIONS IN RURAL AREAS, COMPARED TO "NO TOILET"

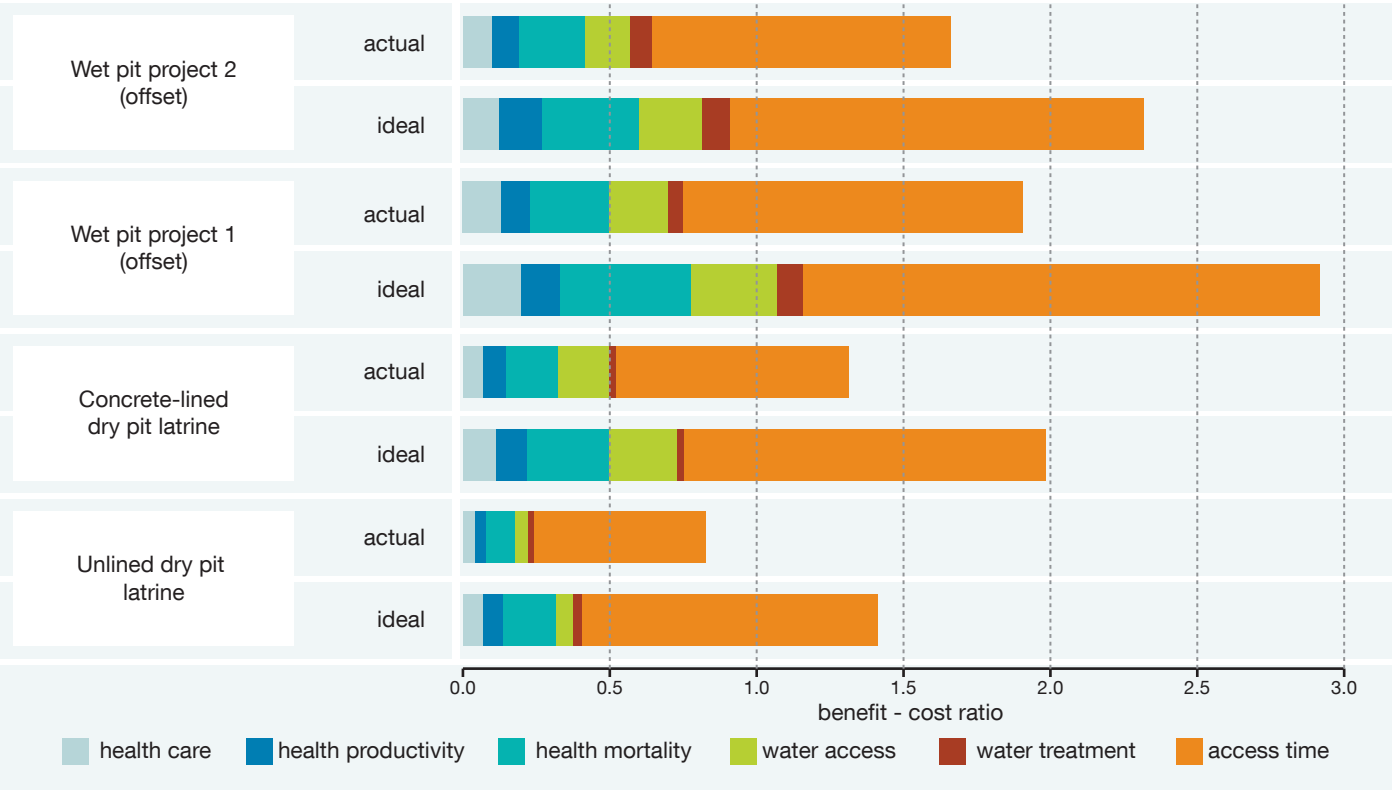


TABLE C: URBAN AREA EFFICIENCY MEASURES FOR MAIN GROUPING OF INTERVENTIONS

Efficiency measure	Scenario	Sanitation option	
			SHV Treatment Plant
Option sub-types included*		Wet pit latrine	Sewerage connection to wastewater treatment plant
COST-BENEFIT MEASURES			
Benefits per US$1 input ($)	Ideal	1.8	0.14
	Actual	1.4	0.03
Internal rate of return (%)	Ideal	27.0	-
	Actual	18.4	-
Payback period (years)	Ideal	2.2	-
	Actual	5.3	-
Net present value ($)	Ideal	275	(4,642)
	Actual	143	(17,560)
COST-EFFECTIVENESS MEASURES			
Cost per DALY averted ($)	Ideal	1,536	8,604
	Actual	2,695	50,297
Cost per case averted ($)	Ideal	36	204
	Actual	63	1,192
Cost per death averted ($)	Ideal	74,357	414,483
	Actual	130,453	2,422,857

* - : not calculated in the study

Under the actual scenario, the benefit-cost ratio for the latrine connected to a tank is 1.4 with an IRR of 18%. This option is the private on-site sanitation solution available in Sihanoukville, and was privately invested in (i.e. there is no program intervention cost). Note that the cost is higher than that of wet pit latrines in rural areas. For the toilets connected to sewerage, the actual BCR is only 0.03, which is significantly lower than the ideal BCR of 0.1. The difference is due to the fact that, at the time of survey, only about 20% of targeted households were actually connected to the sewerage system. Hence the construction costs are spread over fewer households than the planned capacity. However, the environmental benefits – which this study does not attempt to quantify – can be an important justification for urban wastewater management projects. On the other hand, due to the low cost-benefit ratios, alternative lower-cost sewerage systems need to be explored to reduce the investment cost. Before the project, wastewater was discharged directly into the sea, thus reducing the quality of the seawater and harming tourism. It should be noted as well that, despite the existence of sewerage infrastructure, the current reduction of wastewater discharge to the environment has not yet been optimized as the sewerage connection rate in the city is still low.

E. DISAGGREGATED RESULTS

E1. COSTS

Improved sanitation requires investments (i.e. capital and program), as well as operations and maintenance (O&M) costs, which vary in magnitude from one option to another. The costs considered in this study include:

- capital investment for the construction of the latrine,
- program costs for delivering the sanitation program, and
- recurrent costs for the operation and maintenance of the latrine.

According to the study, the total investment cost per latrine (i.e., capital and program costs) implemented in rural areas is US$74 for unlined simple dry pit latrines, US$151 for concrete ring dry pit latrines, and US$168 for wet pit latrines. In urban areas, the total investment cost is US$211 for private latrines, US$5,263 for private latrines connected to a sewerage connection under an ideal scenario (i.e., if the connection rate reaches the designed capacity), and US$17,537 for private latrines connected to a sewerage connection under the actual scenario (with the current connection rate). Most of the intervention costs for all projects is paid for by external projects, in the form of either hardware subsidy or program cost, or both, contributing from 70% to 90% of the total upfront investment cost. The majority of rural projects require the households to contribute their labor, materials or some cash to latrine construction. For interventions in the ECOSORN and TSRWSSP projects, households are responsible for superstructure construction. The World Vision project requires households to pay for the superstructure of the dry pit latrine as only substructure (slab, pan and concrete rings) are provided. However, households under CLTS – implemented by Plan International – are responsible for the financing of all latrine hardware, while Plan contributes the software component (valued at US$54 per household). In the urban sites, households are required to pay for the sewerage connection fees to cover part of the cost of capital investment for the construction of a wastewater treatment plant and sewerage network.

Regarding the annual cost composition by latrine type, the annual economic cost per latrine[2] for the CLTS dry pit latrine is US$76.4 and for the concrete ring dry pit latrine is US$63.2. These costs are much higher than that of wet pit latrines as the lifetime of wet pit latrines is assumed to last seven years longer than the CLTS dry pit[3] and five years longer than the concrete ring dry pit. The average annual economic cost of a wet pit latrine is only US$31 per year based on the sanitation projects included in the study. However, this result needs careful interpretation. First, the program costs in subsequent years for rebuilding collapsed simple pit latrines are likely to decrease drastically from the first year costs of US$54 per household, hence making latrines delivered through CLTS considerably cheaper in terms of annual cost. Second, more expensive options are less financially affordable to the average rural household due to the high up-front capital costs. Therefore, improving the quality of the intervention by making a more affordable and long lasting latrine available to the community would reduce both the up-front cost and the annualized cost.

[2] The annual economic cost is the annual cost incurred to households which is calculated based on the annualized investment cost and the recurrent cost.
[3] The lifetime of the CLTS dry pit latrine is assumed to be one year for this study as this type of latrine normally collapses after 6 months to one year, which requires households to reinvest in reconstruction. See *Formative Evaluation Report for CLTS in Cambodia*, MRD, 2009.

TABLE D: SUMMARY OF AVERAGE COST PER HOUSEHOLD FOR DIFFERENT SANITATION OPTIONS, FULL ECONOMIC COST (US$ 2009)

Cost Items	CLTS dry pit latrine	Concrete ring dry pit latrine	Rural wet pit latrine	Urban wet pit latrine	Urban sewerage (Ideal)	Urban sewerage (Actual)
INVESTMENT COSTS: INITIAL ONE-OFF SPENDING (US$)						
1. Capital	20	86	116	211	5,040	16,794
2. Program	54	65	52	-	223	743
SUB-TOTAL	74	151	168	211	5,263	17,537
RECURRENT COSTS: AVERAGE ANNUAL SPENDING (US$)						
3. Operation	-	1.1	-	-	8	26.7
4. Maintenance	2.4	1.7	1.9	12.9	8	26.8
5. Program	-	1.9	-	-	-	-
SUB-TOTAL	2.4	4.7	1.9	12.9	16.1	53.5
AVERAGE ANNUAL COST CALCULATIONS						
Duration (year)	1	3	8	20	20	20
Cost/household (US$)	76.4	63.2	31.1	34.4	552.1	1,839
Cost/capita	15.5	12.5	6.6	6.7	107.6	358.5
OF WHICH:						
% capital	26%	53%	65%	62%	93%	95%
% program	71%	40%	29%	0%	4%	4%
% recurrent	3%	7%	6%	38%	3%	0%
Observations	165	120	285	114	-	152

For the wet pit latrine in urban areas, the annual economic cost per household is US$34, with annual capital cost comprising 62% and the recurrent cost of 38% of the total cost. For the new sewerage network and treatment plant, the annual cost per household connected to sewerage under an ideal scenario is US$552 (i.e., when the WWTP is operating at designed capacity) while under the actual scenario of a household connection it is US$1,839.

E2. HEALTH BENEFITS

Improved sanitation is very important for population health. Many diseases related to poor sanitation bring about losses to households in many forms through health care costs, productivity losses, and premature mortality. On average, a rural household bears the annual health-related cost of US$65.7 (8.9% of per capita GDP) due to poor sanitation and hygiene conditions while an urban household loses about US$39.2 (5.3% of per capita GDP). Table E shows that the economic loss due to premature death shares more than 50% of total health related loss in both rural and urban areas, followed by costs incurred due to health care and productivity costs. Health-related costs can be averted when sanitation conditions and hygiene practice are improved. Costs averted can vary by geographical areas, by type of intervention, by the baseline coverage, and by health status in the areas. A rural household who stops practicing open defecation (OD) and adopts basic sanitation can reduce the health cost by US$21.1 per year for a wet pit latrine and US$26.7 per year for a dry pit latrine[4]. In urban areas, a household who has basic improved sanitation and hygiene could reduce the cost by US$22.4, and would expect to gain an additional US$8.0 from connecting their toilet to the sewerage system. Cost saving is largely attributed to the avoided deaths due to improved sanitation conditions.

[4] Savings are higher for dry pit latrines because the specific input variables vary from site to site, leading to higher than average savings for the World Vision project site (dry pit) and lower than average savings for the TSRWSS ptoject (wet pit).

TABLE E: ANNUAL COSTS PER HOUSEHOLD OF POOR SANITATION AND HYGIENE AND ANNUAL COSTS AVERTED OF IMPROVED SANITATION (US$, 2008)

Costs	Costs (baseline risk)		Costs averted			
	Rural	Urban	Rural (OD to basic sanitation wet latrine)	Rural (OD to basic sanitation dry latrine)	Urban (OD to wet pit latrine)	Urban (Private wet pit to sewerage)
Health care	16.9	9.5	5.3	6.9	5.3	1.9
Productivity	12.4	9.9	4.2	5.0	5.9	2.1
Death	36.3	19.8	11.5	14.8	11.2	4.0
TOTAL	**65.7**	**39.2**	**21.1**	**26.7**	**22.4**	**8.0**

TABLE F: WATER ACCESS AND HOUSEHOLD TREATMENT COSTS INCURRED AND AVERTED

Variable	Annual average costs per household		Annual average costs saved per household following 100% sanitation coverage	
	Rural	Urban	Rural	Urban
Water source access	128.1	167.5	9.0	1.5
Water treatment	5.2	12.7	1.8	0.6
TOTAL	**133.4**	**180.2**	**10.8**	**2.0**

E3. WATER BENEFITS

In rural areas, water sources are not widely available in some locations and some people have to travel far to fetch water for household uses, including for drinking purposes. This will result in spending more time accessing water, which will be translated into an economic loss taking into account that time gains have value to the population, whether for directly productive uses or otherwise. In some cases, time saving may translate into a financial gain, due to the use of time to generate income. Also, water that is collected needs to be treated before consumption, thus incurring some costs to households. For urban households, the financial cost in accessing clean water is higher than that of rural households. Annually, it costs rural households US$133.4 to access water sources and treat water compared to US$180.2 for urban households. This cost, however, depends very much on the volume of water consumed by households.

Assuming that 100% improved sanitation coverage will increase access to cleaner water sources and reduce travel time and treatment cost, a proportion of these costs could be averted. A significant proportion of Cambodian households treat their water for drinking by boiling, using collected or purchased biomass fuel. However, in practice, even if sanitation coverage is improved, only a small proportion of households would actually change their water source or resort to cheaper water treatment methods. Using realistic assumptions, it is estimated a rural household can save US$10.8 per year, and for urban households US$2.0 per year, from having access to cleaner water sources.

E4. ACCESS TIME SAVING

Households without latrines and going to the bush for defecation bear hidden costs of spending more time to find a place to defecate. This time loss can be averted and translated into value of time saved in monetary terms if sanitation is improved. As rural household members lose more time than urban counterparts in accessing sanitation, their savings would be higher once sanitation is improved. With improved sanitation facilities located within the premises, women in rural areas can save time worth an estimated US$8.8 per year, while women in urban areas can save an estimated US$7.9. Also, men can save US$12.4 and US$7.9 a year due to the proximity of improved sanitation facilities, in rural and urban areas respectively. This indicates that rural households without latrines currently bear more losses than urban households in accessing a place to defecate.

Regarding the daily time spent for accessing the latrine, rural women without latrines would spend around 10.6 minutes while it would take only two minutes for urban women. Similarly, rural men spend 11 minutes, which is longer than urban men who take only four minutes. The difference for both rural and urban men is the distance of going to find a place to defecate, which generally takes rural people longer than their urban counterparts. It is shown that annually, the time lost among women and men in rural areas who do not have an improved latrine amounts to 87 hours and 123 hours, respectively. In urban areas, women and men without a toilet lose about 79 hours annually to access a sanitation facility. Thus, having a latrine for each household can save a considerable amount of time, which can be spent on other productive activities. From the survey, if household members have 30 minutes free per day, they prefer to use it for entertainment, sleeping, and doing business. Moreover, they also wish to do other work with the time gains, such as washing, homework and going to school.

E5. INTANGIBLE BENEFITS OF SANITATION OPTIONS

In addition to financial and monetized economic gains from improved sanitation, there are many other intangible benefits, which are perceived by both those with and without a latrine. Having a toilet could provide many benefits for households such as a healthier life for household members, better personal safety especially at night, cleaner surroundings and environment, more convenience, and improved privacy and dignity. More importantly, while latrine owners mention comfort as another benefit to having a latrine, it is not apparent among non-latrine owners. This may be due to the fact that latrine owners have already experienced how comfortable a private latrine is, unlike non-latrine owners. It is also observed that the perceived benefits of having a latrine at home are not much different between men and women in rural areas (see Table G).

TABLE G: HOUSEHOLD PERCEPTION OF BENEFITS FROM IMPROVED SANITATION (IN DESCENDING ORDER OF IMPORTANCE)

Areas	With latrine		Without latrine	
	Men	Women	Men	Women
Rural	• Time and money saving • Environmental cleanliness • Improved health • Comfortable defecation • Safe disposal of excreta • Good sanitation • Safe for humans	• Time and money saving • Environmental cleanliness • No smell affecting environment • Easy for hand washing after defecation • No insects that cause infectious diseases • Easy to defecate or urinate • Safety, privacy and dignity	• Time and money saving • Easy to defecate or urinate • Safe disposal of excreta • Reduced infectious diseases • Reduced environmental pollution • Safety, privacy and dignity • Good sanitation	• Time saving • Improved health • No smell affecting environment • Reduced infectious diseases • No insects that cause infectious diseases • No need to accompany children to defecate • Environmental cleanliness • Defecate easily without getting wet in rainy season • Safety, privacy and dignity
Urban	• Time and money saving • Easy to defecate or urinate • No infectious diseases • Environmental cleanliness • No insects that cause infectious diseases • Safety	• Time and money saving • No infectious diseases • Easy to defecate or urinate • Feel comfortable • Safety and good sanitation	• Time saving • Easy to defecate and urinate • No smell affecting environment • No sickness and infectious diseases • Environmental cleanliness and good sanitation	• Time and money saving • Improved health • Easy to defecate and urinate • Environmental cleanliness and good sanitation • No sickness and infectious diseases • No smell affecting environment

E6. EXTERNAL ENVIRONMENT

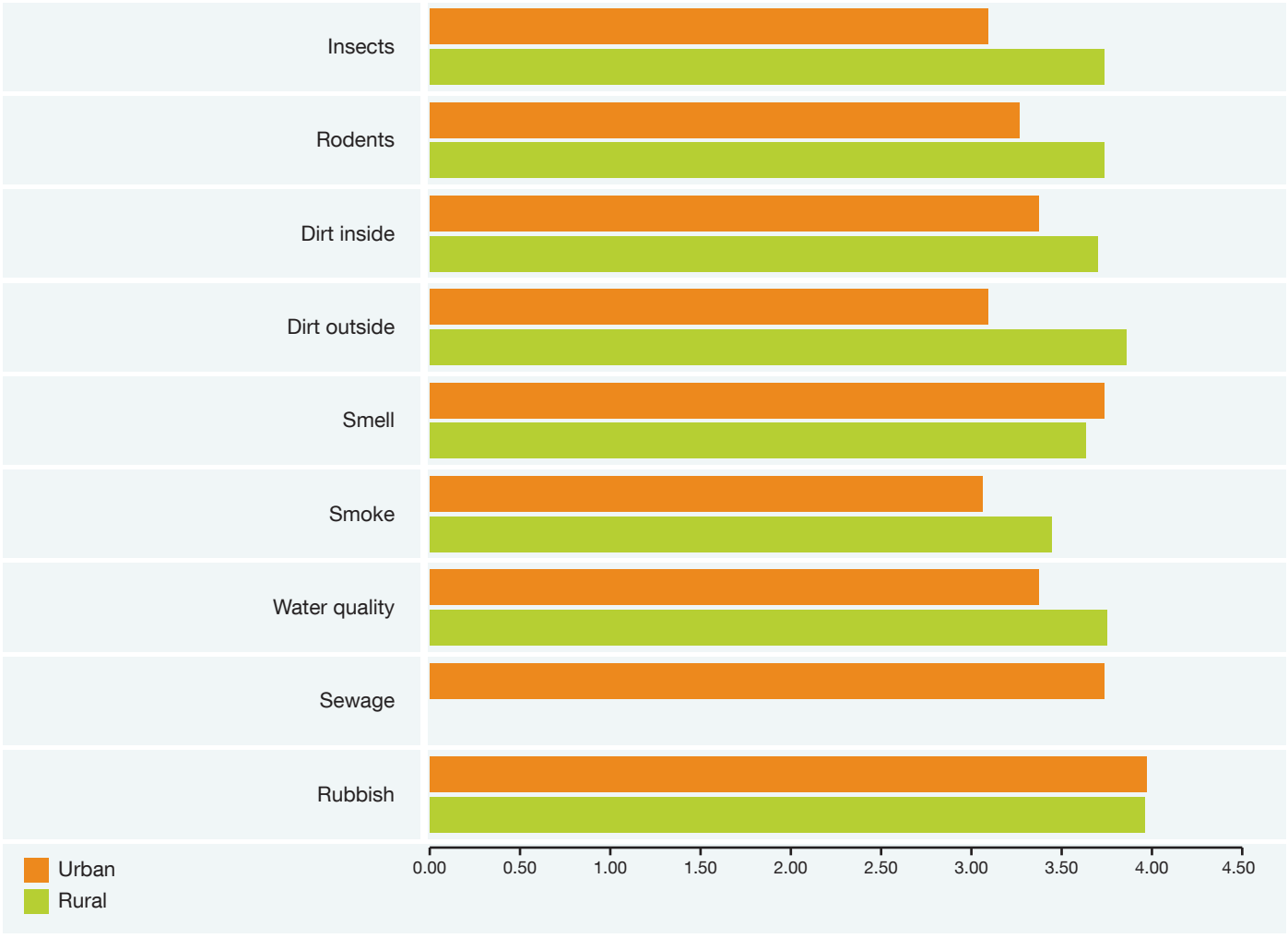
External environment refers to the area outside the latrine itself and can include the household living area, public or community areas, and private land, which can be affected by open defecation and unimproved sanitation practices. The impact of poor sanitation on the external environment is considered important in both rural and urban areas, although there are different concerns.

Households without latrines were found to understand well the importance of improved sanitation in their households and communities. They paid attention to a wide range of issues that affect their environment as those problems can affect their daily life and health. Rubbish is one of the most important issues for households in both rural and urban areas. Water, smoke, dirt inside and outside the house, rodents, and insects are rated as higher concerns for rural than for urban people (see Figure B below). However, sewerage and smell are more problematic for urban people as the urban areas are more densely populated and the environment is often not as clean as in rural areas. Therefore, good management of the external environment would provide more intangible benefits to improve the quality of life.

E7. TOURISM BENEFITS

Sanitation is a sensitive issue for the tourism sector. Improved hygienic and sanitary conditions in Cambodia would benefit the tourism sector to some extent. Tourists interviewed at Phnom Penh and Siem Reap International Airports, and on the beach in Sihanoukville, rate the general sanitation conditions in Cambodia at an average score of 2.7 out of a maximum of 5 points. Business visitors rate it lower at an average of 2.3 out of 5. However, they rate the sanitation conditions differently for different locations.

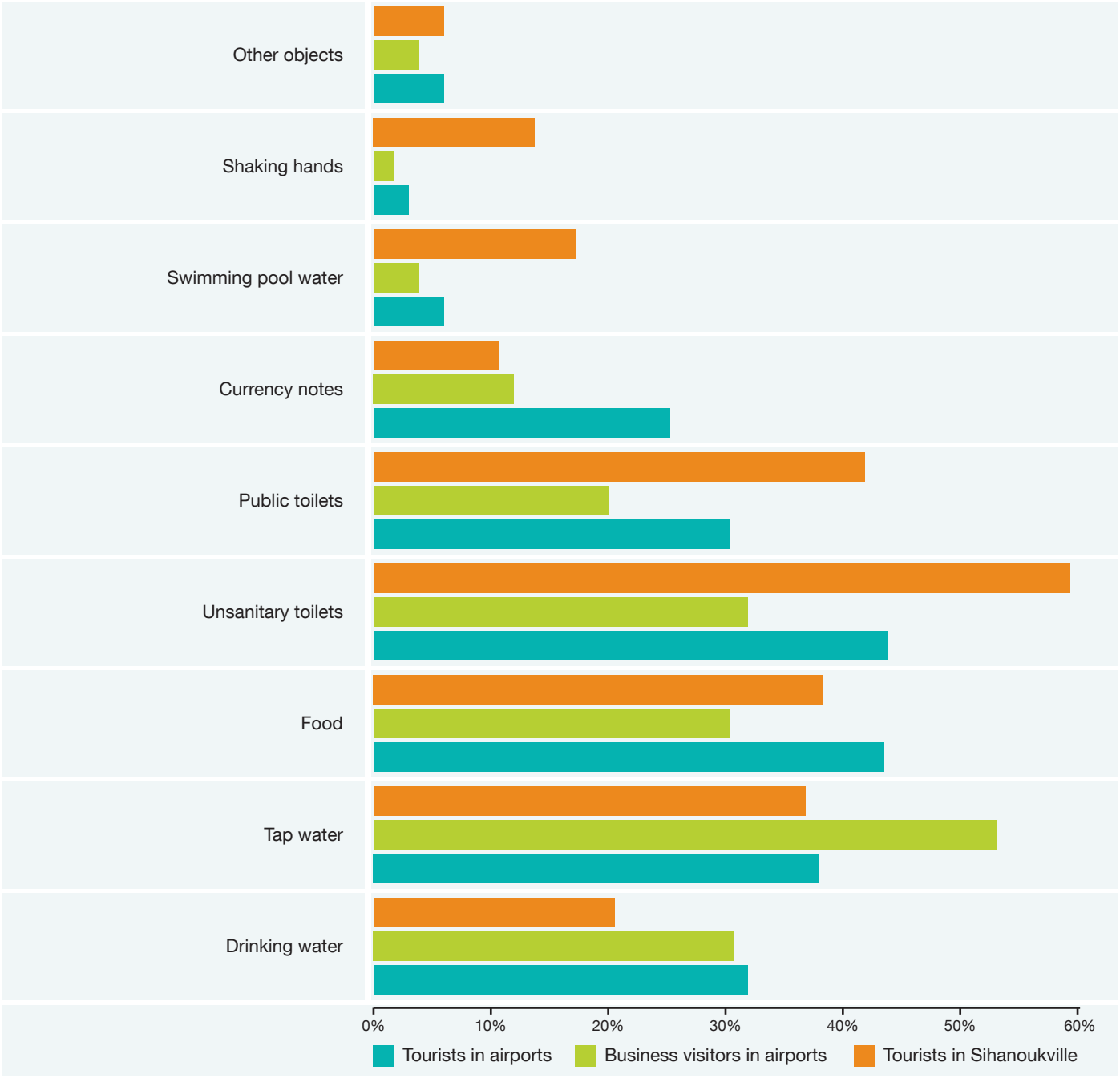
FIGURE B: DEGREE OF PERCEIVED ENVIRONMENTAL DEGRADATION IN THEIR NEIGHBORHOODS - HIGHER SCORE DENOTES GREATER CONCERN (MAXIMUM SCORE 5)



Generally, the sanitation conditions in hotels, restaurants, and swimming pools are rated good by tourists and business visitors, at a score of above 3.5. The sanitary conditions of open water and other cities are rated above average. Regarding the sanitary experience of toilet and hand washing, tourists and business visitors rate the sanitary facilities in hotels and restaurants at above 3.0. In contrast, the sanitary facilities in the bus stations and the city are rated below average, which indicates the need for more attention to toilets in public places.

Respondents were asked what aspects of hygiene concerned them the most during their stay in Cambodia (see Figure C). Tap water, food, drinking water, and unsanitary toilets are the main concerns among tourists and business visitors. Over 30% of tourists and businessmen interviewed at the

FIGURE C: FACTORS OF MOST CONCERN TO TOURISTS AND BUSINESSMEN - % OF RESPONDENTS MENTIONING THE ISSUES THAT CONCERNED THEM (MAXIMUM OF 3 CHOICES PER RESPONDENT)



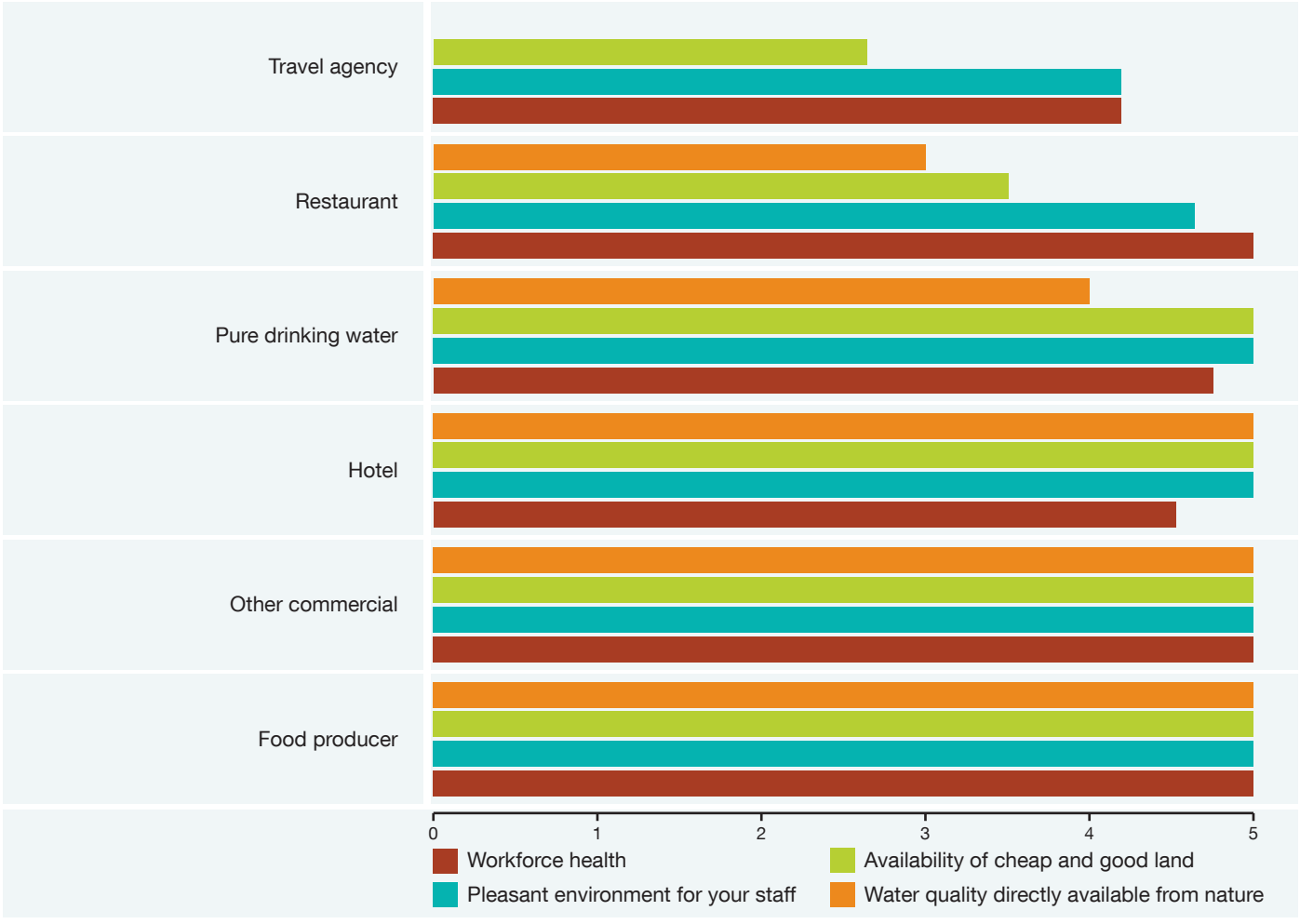
airports are concerned about the quality of bottled drinking water, food, unsanitary toilets, public toilets, and tap water. Also, tourists interviewed at Sihanoukville are concerned about bottled drinking water, tap water, food, unsanitary toilets, and public toilets. This can reflect the importance of sanitation improvement for the tourism sector, as a more sanitary environment would be a factor to attract more tourists to come to Cambodia.

E8. BUSINESS BENEFITS

Businesses in Cambodia have admitted that poor sanitation conditions have a negative impact on their businesses, although few think it is a critical criterion for their investment or location decisions (see Figure D). Moreover, businesses admit the importance of water quality and a pleasant environment for selecting the sites where they are located, especially for hotels, restaurants, food producers, and pure drinking water factories. Businesses also have to spend some amount of money to keep the environment clean around their location, especially tourism-related businesses such as hotels (US$450 per month) and restaurants (US$537 per month). Private firms also acknowledge that poor sanitation conditions affect their customers, workers, and other stakeholders within the business. Therefore, improved sanitation conditions would – to some extent – help reduce the costs of doing business.

The relationship between business expansion and sanitation is strong for some businesses. If sanitation is improved, 67% of restaurants and 60% of interviewed travel agencies would expand their business operations, and 50% of hotels would do so. In fact, businesses believe that they will gain by improved sanitation through increased productivity of staff, reduced costs associated with poor sanitation, improved quality of products and services, more tourist arrivals and new markets.

FIGURE D: IMPORTANCE OF ENVIRONMENTAL SANITATION CONDITIONS FOR LOCATING THE COMPANY (1 = UNIMPORTANT; 5 = VERY IMPORTANT)



E9. PROGRAM PERFORMANCE

The sanitation interventions implemented by each project are considered effective for improving the sanitation conditions in Cambodia. However, the performance of each project varies. Although they have a private latrine at home, some household members still defecate in the field. Eighty-five percent of the total number of households with a dry pit latrine under the CLTS intervention (Plan International's site) continued practicing open defecation (OD) as their dry pit collapsed after operating less than one year. In the urban site of Sihanoukville, where a wastewater management project was recently completed, the OD rate is still 7%. Unlike in rural areas, not many people in urban areas with latrines available practice open defecation, as in urban areas there is less available space and it is not convenient to go far away from home. Of the rural sanitation projects, the ECOSORN and TSRWSSP sites have the lowest rate of people with latrines but still practicing open defecation, at 26.3% and 27% respectively. The World Vision site had 38%.

Hand washing is another part of the sanitation projects, involving campaigns to raise people's awareness of sanitation and hygiene before and during the project implementation. Among rural projects, ECOSORN sites had the highest rate of 80% of people who wash their hands after defecation while only 54% of those in the CLTS approach do so. In the urban sites, around 95% of households wash their hands after defecation.

TABLE H: SUMMARY TABLE OF OVERALL PROGRAM EFFECTIVENESS

Variable	Rural sites				Urban site	All
	ECOSORN	Plan International	World Vision	TSRWSSP	SHV Wastewater management project	
Households interviewed	230	245	170	250	285	1,180
Years of program	5	5	3	5	4	
Toilets received	6,223	3,942	748	34,888	1,010	
Toilets/year	1,245	788	249	6,978	253	
Approx. cost/HH (US$)[1]	167	76	156	173	17,590	
Pit/toilet type	Wet pit	CLTS dry pit	Concrete ring dry pit	Wet pit	Flush to WWTP	
% HH contribution to cost	19	29	11	16	2	
% improved sanitation households, with members sometimes or often:						
Using bush for defecation	26	85	38	27	7	37
Using bush for urination	68	94	88	73	17	68
Children using latrine	44	40	32	33	54	41
Children seen defecating in yard	55	78	69	62	29	59
Washed hands with soap yesterday	80	68	58	79	98	76
Washing hands after defecation	80	54	57	66	95	70
% improved sanitation households, observed:						
Using well which is not covered	74	43	59	14	29	44
Using bucket to withdraw water from well	87	84	83	44	32	66
Signs of feces/waste around toilet	2	nd	nd	7	3	2
Signs of insects in toilet	63	100	nd	79	71	62
Running water in or near toilet	8	nd	nd	12	57	15
Soap available for washing hands	43	0	33	35	94	41

[1] This cost only takes into account the basic latrine component without additional accessories added by households such as water trough, tiles, toilet room expansion, etc.
nd = no data recorded.

F. CONCLUSIONS AND RECOMMENDATIONS

This study aimed to assess the economic performance of sanitation interventions in Cambodia, with a focus on different latrine types and program delivery approaches in rural areas. Based on the study findings summarized below, six recommendations are made to improve the selection and implementation of sanitation interventions in the future.

Finding 1: Sanitation interventions have very favorable socio-economic returns to households and society, contributing improved health, a clean environment, dignity and quality of life, among many other benefits. Economic returns are potentially high – in excess of US$2 return per dollar invested – especially in rural areas where low-cost on-site solutions are feasible. However, the selection of appropriate technology and implementation delivery mechanisms (e.g. demand raising) are key for economic gains to be enjoyed at affordable cost and sustained over time.

Recommendation 1: The Royal Government of Cambodia and development partners should scale up sanitation coverage throughout rural Cambodia, using low-cost and proven effective and sustainable approaches to household sanitation improvement. Community-led approaches should be combined with sanitation marketing and development of the private sector to supply sanitation hardware and support latrine construction in rural areas.

Finding 2: New suitable latrine technologies and designs at a lower cost are very important to the success of sanitation projects in rural areas. According to the study findings, rural people prefer wet pit latrines to dry pit latrines because they perceive the wet pit one will last longer and is more hygienic, comfortable and convenient. However, the cost of wet pit latrines is higher and many rural households cannot afford the full hardware cost in one installment. People are reluctant to invest in a dry pit latrine as they believe it will not last long and will need to be rebuilt in the near future. For instance, some projects have offered a wide choice of latrine options to households, ranging from simple dry pit to wet pit latrines, but mostly wet pit latrines are selected by households, as they are heavily subsidized and they are willing to pay for the difference in hardware cost. However, with the right messages, other projects have shown that households can become convinced that they can start off with a low-cost dry pit latrine. Either way, it is critical that sanitation projects deliver solutions that are affordable and do not rely on high subsidies which may make it harder for the household to sustain coverage levels after project withdrawal.

Recommendation 2: To improve people's first experience of their own latrine and ensure sustained behavior change, the technology and design of latrines offered to them should be carefully selected to make it last long enough and respond to people's expectations of sanitation. A better but affordable latrine structure and design, particularly the slab and underground components, is key to the success of rural sanitation improvement in Cambodia. For scaling up throughout Cambodia, this requires development of the private sector to produce the latrine components and make them available for purchase in a location that can be accessed in all rural areas of the country, as well as supporting households to construct their latrines.

Finding 3: Community-led sanitation approaches need proper technical support and follow up on latrine construction for poor rural households. Community-led approaches without proper technical support on the construction of latrines, and that lack continued follow-up, have resulted in low effectiveness and efficiency of the projects, as the self-made latrines usually collapse within a short period of time, people are reluctant to rebuild a new one, and hence most people return to open defecation. As found in the sites adopting community-led approaches – and corroborated by other evidence – the rate of people having their own latrine climbed to close to full coverage at first but then dropped sharply shortly thereafter when the latrine they built collapsed.

Recommendation 3: Technical guidance for latrine construction in the community should be incorporated into the community-led approaches so that latrines last longer. Also, there should be training held locally on latrine construction, and local resource people should be utilized so that people can go to them when their latrine collapses. Regular follow-up of activities in the communities is also crucial to sustaining latrine uptake.

Finding 4: Project "software" costs to deliver interventions are relatively high for the Cambodian context (at least US$50 per household), and furthermore, the optimal impact and efficiency were not achieved due to people returning to open defecation. This was true for all rural projects evaluated. If limited subsidies from external partners are channeled to a small number of households to obtain a superior latrine type than the average rural Cambodian household can afford, then it will still be a long time before universal sanitation coverage will be achieved in Cambodia.

Recommendation 4: To be more effective and efficient, future sanitation projects should carefully plan and implement activities cost-effectively, and closely monitor project costs and impacts, to ensure that the project resources are being appropriately utilized to contribute to universal sanitation coverage in Cambodia. Projects should ensure that the benefits of every aspect be maximized so that local communities would get higher benefits from the projects in the long run. In many cases, this means delivering integrated water, sanitation and hygiene interventions to reduce development transaction costs to efficiently deliver improved health and quality of life. Sanitation projects should focus more on hygiene behavior change, carrying out campaigns more frequently and throughout the project cycle to increase the rate of sustained behavior change. Furthermore, to obtain the full health benefits and improve equity in the distribution of project resources and enjoyment of the benefits, sanitation projects and programs should also aim to improve sanitation in the entire community, and not just a selected number of households who can afford to pay the household contribution. Donor efforts and subsidies would therefore need to be more thinly spread over the country, channeled through a proven low cost but effective means to deliver improved sanitation at scale.

Finding 5: Large-scale urban infrastructure projects have a very high cost per household covered, especially when targeted households do not connect to the sewerage network. The quantified economic benefits are insufficient to give a positive net present value or a benefit-cost ratio above unity. However, non-quantified benefits such as an improved urban environment and reduced water pollution can be significant enough to warrant investments in networked urban sanitation solutions, especially when a city's revenues are closely linked to environmental quality, such as the tourism industry.

Recommendation 5: Decision makers in urban areas, including not only government but also donors and development partners, should consider a range of urban technologies including low cost options, and select options that are appropriate given the finances and implementation capacity available. Civil society and the community must be involved in the decision making process on sanitation option selection, given that the finances will need to be raised from tariffs as well as tax. In circumstances where high cost networked solutions are the most feasible solution, then financing, regulatory, legal and institutional measures must be taken to ensure a high connection rate to deliver the full economic benefits of the intervention.

Finding 6: Improved hygiene and sanitation conditions in institutions, public places and tourist sites are important to attract more businesses and tourists to Cambodia. The sanitation conditions in places frequented by tourists in Cambodia have been reported to be poor, especially water resources and toilets/hand washing facilities in public places and restaurants. Moreover, foreign tourists in Cambodia have major concerns related to food preparation and drinking water. Also, the small sample of businesses interviewed felt that poor environmental sanitation affects their profitability in several ways. Hence, to make Cambodia a more attractive place for tourists and businesses, broader definitions of improved sanitation than just household sanitation need to be utilized and implemented by Cambodia's public agencies.

Recommendation 6: More measures should be taken to improve the sanitation and hygienic conditions in public places, transport routes and business areas as well as at household level. These measures are most important in tourist sites and thriving business districts (e.g. downtowns, markets). This recommendation is key to promoting Cambodia as an international tourist destination and in attracting more foreign business investment to the country, which will both strongly support the alleviation of poverty.

Foreword

In its recognition of sanitation as a key aspect of human development, target 10 of the Millennium Development Goals includes access to safe sanitation: "to reduce by half between 1990 and 2015 the proportion of people without access to improved sanitation." This reflects the fact that access to improved sanitation is a basic need: at home as well as at the workplace or school, people appreciate and value a clean, safe, private and convenient place to urinate and defecate. Good sanitation also contributes importantly to achieving other development goals such as child mortality reduction, school enrollment, nutritional status, gender equality, clean drinking water, environmental sustainability and quality of life of slum dwellers.

Despite its recognized importance, sanitation continues to lose ground to other development targets when it comes to priority setting by governments, households, the private sector and donors. This fact is hardly surprising given that sanitation remains a largely taboo subject, neither is it an "attractive" subject for media or politicians to promote as a worthy cause. Furthermore, limited data exist on the tangible development benefits for decision makers to justify making sanitation a priority in government or private spending plans.

Based on this premise, the World Bank's Water and Sanitation Program (WSP) is leading the "Economics of Sani-

tation Initiative" (ESI) to compile existing evidence and to generate new evidence on the socio-economic aspects of sanitation. The aim of ESI is to assist decision makers at different levels to make informed choices on sanitation policies and resource allocations.

Phase 1 of the Economics of Sanitation Initiative in 2007-8 conducted and published a "sanitation impact" study, which estimated the economic and social impacts of unimproved sanitation on the populations and economies of Cambodia and other countries of Southeast Asia. This study showed that the economic impacts of poor sanitation are US$448 million per year for Cambodia, or US$32.4 per capita. This is equivalent to 7.2% of annual GDP in 2007. These and other results were disseminated widely to national policy makers, sector partners, and decentralized levels of Cambodia.

The current volume reports the second major activity of ESI, which examines in greater depth the costs and benefits of specific sanitation interventions in a range of field settings in Cambodia. The purpose is to provide information to decision makers on the impact of their decisions relating to sanitation – i.e. to understand the costs and benefits of improved sanitation in selected rural and urban locations, as well as to enable a better understanding of the overall national level impacts of improving sanitation coverage in Cambodia. On the cost side, decision makers and stakeholders need to understand more about the timing and size of costs (e.g. investment, operation, maintenance), as well as financial versus non-financial costs, in order to make the appropriate investment decisions that increase intervention effectiveness and sustainability. On the benefit side, the monetary as well as non-monetary impacts need to be more fully understood in advocating for improved sanitation as well as making the optimal sanitation choice. For cost-benefit estimations, a sample of sites representing different contexts of Cambodia was selected to assess efficiency of sanitation interventions, and thus illustrate the range and sizes of sanitation costs and benefits.

The research under this program is being conducted in Cambodia, China, Indonesia, Lao PDR, the Philippines, and Vietnam. Similar studies are also ongoing in selected South Asian, African and Latin American countries.

While WSP has supported the development of this study, it is an "initiative" in the broadest sense, which includes the active contributions of many people and institutions (see Acknowledgment).

Abbreviations and Acronyms

ADB	Asian Development Bank
ALOS	Average length of stay
ALRI	Acute lower respiratory infection
BCR	Benefit-cost ratio
BOD	Biochemical oxygen demand
CBA	Cost-benefit analysis
COD	Chemical oxygen demand
DHS	Demographic and Health Survey
DO	Dissolved oxygen
Ecosan	Ecological sanitation
ESI	Economics of Sanitation Initiative
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FY	Financial year
GDP	Gross Domestic Product
GNP	Gross National Product
HCA	Human capital approach
I.E.	Income elasticity
IRR	Internal rate of return
JMP	Joint Monitoring Programme (WHO, UNICEF)
Kg	Kilograms

MDG	Millennium Development Goal
Mg/l	Milligrams per liter
NGO	Non-governmental organization
NPV	Net present value
OECD	Organization of Economic Cooperation and Development
OER	Official exchange rate
PBP	Payback period
PEM	Protein energy malnutrition
RGC	Royal Government of Cambodia
SEAR-B	WHO Southeast Asia region epidemiological strata B
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VSL	Value of a statistical life
WB	World Bank
WHO	World Health Organization
W&S	Water Supply and Sanitation
WPR-B	WHO Western-Pacific Region epidemiological strata B
WSP	Water and Sanitation Program
WTP	Willingness to pay

Glossary of Terms

Benefit-cost ratio (BCR): the ratio of the present value of the stream of benefits to the present value of the stream of costs. Calculated as the benefits divided by the costs. The higher the BCR the more efficient the intervention.

Cost per case averted: the present value of the costs for each case of a disease that is avoided because of an intervention. Calculated as the costs divided by the number of cases averted. The lower the ratio the more efficient the intervention.

Cost per DALY averted: the present value of the costs for each DALY that is avoided because of an intervention. Calculated as the costs divided by the number of DALYs averted. The lower the ratio the more efficient the intervention.

Cost per death averted: the discounted value of the costs for each death that is avoided because of an intervention. Calculated as the costs divided by the number of deaths averted. The lower the ratio the more efficient the intervention.

Cost-effectiveness ratio (CER): the ratio of the present value of the future costs to the present value of the future health benefits in non-monetary units (cases, deaths, disability-adjusted life-years). The lower the CER the more efficient the intervention.

Disability-Adjusted Life-Year (DALY): a measurement of the gap between the current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability. One DALY can be thought of as one lost year of "healthy" life (WHO, 2010).

Ecological sanitation (Ecosan): a paradigm in sanitation that recognizes human excreta and used water from households not as waste but as resources that can be recovered, treated where necessary and safely used again. It is based on the systematic implementation of reuse and recycling of nutrients and water as a hygienically safe, closed-loop and holistic alternative to conventional sanitation solutions (GTZ 2009).

Externality: a cost or benefit that is incurred or received by any agent other than the individual or household receiving or paying for an intervention. In the case of sanitation, increasing coverage of sanitation facilities that treat or isolate human excreta will have benefits to those households receiving facilities (counted as "private" benefits) but also other community members due to less risk exposure and disease transmission (counted as external benefits). In the same way, less open defecation and less sewage discharge to water bodies improves the external environment and water resources for all.

Improved sanitation: the use of the following facilities in home compound: flush/pour-flush to piped sewer system/septic tank/pit latrine, ventilated improved pit (VIP) latrine, pit latrine with slab, or composting toilet (JMP 2008).

Open defecation: the practice of disposing human feces in fields, forests, bushes, open bodies of water, beaches or other open spaces or disposed of with solid waste (JMP 2008).

Intangible benefits: Benefits of improved sanitation which are difficult to quantify and monetize, and hence usually not included in cost-benefit analysis. These benefits include impacts on the quality of life, comfort, security, dignity, personal and cultural preferences, among others.

Internal rate of return (IRR): the discount rate for which the present value of the stream of net benefits is zero. In other words, the discount rate for which the benefit-cost ratio equals unity (1.0). In this study, the IRR reflects the economic (i.e., wider social) value and not just financial value. The IRR for projects can be compared with alternative uses of development funds, to conclude which are the most socially efficient.

Net present value (NPV): the difference between present values of the stream of benefits to the present value of the stream of costs. Calculated as the benefits minus the costs.

Payback period (PBP): represents the length of period (e.g. years) that is required to recover the costs incurred to that time point (investment plus recurrent costs). In other words, the time after which the present value of accumulated benefits exceeds the present value of accumulated costs.

Shared sanitation facility: sanitation facilities of an otherwise acceptable type shared between two or more households. Shared and public toilet facilities are not considered improved by the UNICEF/WHO Joint Monitoring Programme (JMP 2008).

Unimproved sanitation: the use of the following sanitation facilities: flush/pour-flush without isolation or treatment, pit latrine without slab/open pit, bucket, hanging toilet/hanging latrine, wrap and throw, use of a public facility or sharing any improved facility, no facilities, bush or field (JMP 2008).

Value-of-statistical-life (VSL): the economic value assigned to life. The VSL is most commonly used in public decision making, through cost-benefit analysis. While putting an economic price tag on life may appear inhumane, it is in fact impossible to save every life with a limited supply of resources, and so some trade-off must be made. Given the difficulty in estimating the value attached to the life of specific individuals, the VSL is estimated from observations of behavior in relation to the risk of death, or from stated preferences.

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The current study was conducted in Cambodia, China, Indonesia, Lao PDR, the Philippines and Vietnam. The study was led by the World Bank's Water and Sanitation Program (WSP), with the contribution of WSP teams and consultants in each of the participating countries. The study took two years to complete, and has undergone several major peer review processes.

Guy Hutton (WSP Senior Water and Sanitation Economist and Task Team Leader) led the development of the concept and methodology for the ESI, the management and coordination of the country teams, provision of regional tools and templates, and report writing. Björn Larsen contributed to the development of generic data collection tools and the health methodology. The study benefited from the continuous support of other WSP staff: Almud Weitz, Isabel Blackett, Yosa Yuliarsa, Irvan Tjondronegoro and WSP support staff.

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Economic assessment of sanitation interventions in Indonesia. Asep Winara, Guy Hutton, Oktarinda, Edi Purnomo, Koderi Hadiwardoyo, Indon Merdykasari, Takdir Nurmadi, Bert Bruinsma, Dedek Gunawan, Dadang Fadilah, Martin Albrecht. World Bank, Water and Sanitation Program 2011.

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Full research reports as well as summary reports are available for each country, in both English and in local languages. All country reports are accessible from http://www.wsp.org.

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Selected Development Indicators For Cambodia

Variables	Value
Population	
Total population (2008)	13.4 million
Rural population (%)	80.5 %
Urban population (%)	19.5 %
Annual population growth (%) (2008)	1.54 %
Under 5 population (% of total) (2008)	10.3 %
Under 5 mortality rate (deaths per 1,000 live births) (CDHS 2005)	83
Female population (% of total) (2008)	51.4 %
Population below poverty line (%) (2007)	30.1 %
Economic	
Currency name	Cambodian Riel (KHR)
Year of cost data presented	2008
Currency exchange with USD (average 2009)	4143[1]
GDP per capita (USD) (2008)	USD 739
GDP per capita in International $, adjusted for purchasing power (2006)[2]	I$1,633
Sanitation	
Improved total[3] (%) (2007)	27.6 %
Improved rural (%) (2007)	19.6 %
Improved urban (%) (2007)	50.9 %
Sewerage connection in Phnom Penh (2007) (%)	62.8 %

Sources (unless otherwise stated): National Institute of Statistics, Statistical Year Book 2008

[1] Reflects currency exchange of converting Riel into US Dollars.

[2] ADB, Key Indicator for Asia and Pacific 2008.

[3] Cambodian Socio-Economic Survey 2007.

I. Introduction

Sanitation remains one of the key development challenges in Cambodia. Recognized in Cambodia's own Millennium Development Goals (CMDG), the Royal Government of Cambodia has set 30% target coverage with improved sanitation in rural areas and 74% in urban areas, by the year 2015. Table 1 compares sanitation coverage for the years 1997 and 2007. The absolute percentage points increase has been quite impressive – 18% in Phnom Penh, 15% in other urban areas, and 11% in rural areas. However, in 2007, 80% of the rural population remained without improved sanitation. To reach the CMDG in rural areas, a further 10 percentage points are needed from 2008 to 2015, which is feasible given the progress in the past 10 years. The most recent nationally representative data set, from the Cambodia Census conducted in 2008, suggests higher rural coverage figures at 23%. According to definitions and data used by the WHO/UNICEF Joint Monitoring Programme (JMP), the rural coverage is lower at 18%.

In urban households, a large discrepancy exists between the capital Phnom Penh and other urban areas, comparing 97% and 51% improved coverage, respectively. Nationwide, the sanitation coverage for urban areas is up to 79%, thus the CMDG target of 74% has been met. This is further confirmed by the Cambodia Census 2008, which put urban coverage at 81.5%. According to definitions and data used by the JMP, the urban coverage in 2008 is 67%. Hence according to international standards, a gain of 7 percentage points is needed until 2015 to meet the CMDG for urban sanitation.

However, to meet the internationally-set MDG target of reducing by half, between the years 1990 and 2015, the proportion of the population without access to basic sanitation, significantly greater progress is needed. One may note that Cambodia has one of the lowest rural coverage rates in Asia. Furthermore, in urban areas outside the capital city Phnom Penh, 48% of households do not have basic improved sanitation (36% open defecation).

Figure 1 illustrates the variation in sanitation coverage by strata in Cambodia, using data from available national surveys in 1997 and 2007.

TABLE 1: BASIC SANITATION COVERAGE IN CAMBODIA - 1997 AND 2007

Coverage type	Phnom Penh		Other Urban		Rural		Cambodia	
	1997	2007	1997	2007	1997	2007	1997	2007
Improved	**79%**	**97%**	**36%**	**51%**	**9%**	**20%**	**19%**	**28%**
1. Pour-flush connected to sewerage	51%	63%	4%	7%	0%	2%	5%	7%
2. Pour-flush connected to septic tank/pit	27%	34%	26%	43%	8%	16%	11%	20%
3. Pit latrines with slab	2%	0%	6%	1%	1%	1%	2%	1%
Unimproved	**21%**	**3%**	**64%**	**48%**	**91%**	**80%**	**82%**	**72%**
1. Pit latrines without slab or open pit	2%	0%	2%	3%	0%	2%	1%	2%
2. Latrines overhanging field or water	0%	0%	0%	5%	0%	3%	0%	3%
3. Public toilets, pit latrines, or latrines	2%	0%	5%	3%	3%	1%	3%	2%
4. Open land	15%	1%	58%	36%	86%	69%	76%	62%
5. Others	1%	2%	0%	2%	2%	4%	1%	4%

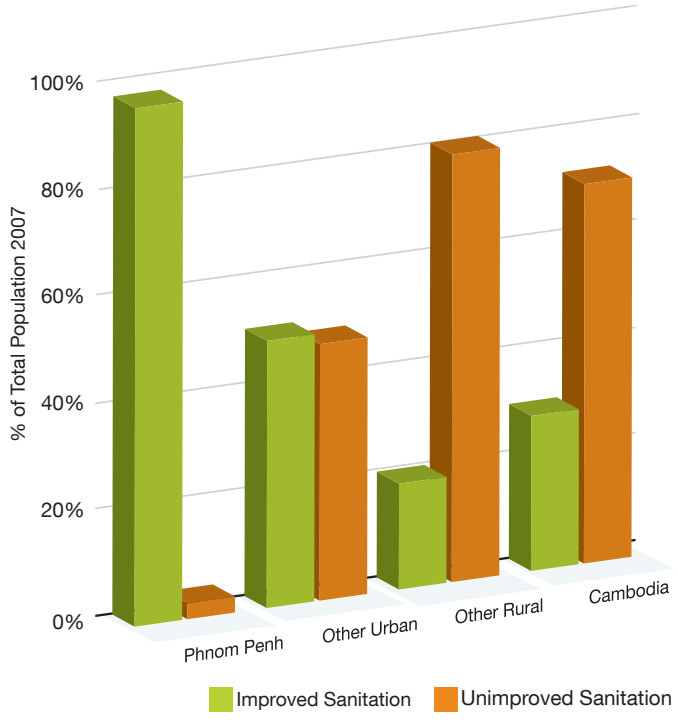
Source: Statistical Year Book 2008, and Cambodia Socio-Economic Survey 1997

The Royal Government of Cambodia is already looking beyond the MDG target year of 2015, and has set ambitious development targets. The Cambodia 2025 Vision outlines these. The sanitation target is that 100% of Cambodian households will have access to improved sanitation. Hence, progress needs to accelerate to achieve this goal.

Having access to an improved latrine or toilet that delivers health benefits as well as dignity and convenience is a key first step on the sanitation ladder. However, there are many more benefits to be gained from having more advanced sanitation coverage. In rural areas, for example, latrines should be built to last longer and larger toilet rooms can provide the necessary space for showering. Latrines should be set away from ground or surface water sources, and excreta must be properly isolated. This may mean setting the latrine well above the ground to avoid pit flooding and hence environmental contamination.

In urban areas, especially densely populated neighborhoods, pit latrines are no longer feasible. While households may have toilets, the lack of collection and treatment is causing a degraded environment in many urban areas. Even in the capital city, open canals serve as sewers and spoil the living environment. The waste flushes largely untreated to rivers, thus degrading water resources and causing health problems downstream. Such solutions also discourage tourism. Community solutions need to be found, which means either septic tanks with emptying service and treatment, or sewerage with treatment. These systems can be organized at different levels (either large scale and centralized, or smaller scale and decentralized).

FIGURE 1: VARIATION IN SANITATION COVERAGE BY STRATA (2007)



To solve these many problems, a variety of players need to collectively work on a solution. Government provides policy and financing to leverage other resources. The private sector has a role in supplying quality services and promoting demand for those services. Households express their demand and preferences, and contribute cash and labor. In order for all this to happen, information is needed. First, the various stakeholders need to feel that it is a significant problem that needs solving. What is the cost of inaction? Second, they need to feel that they are part of the solution. For example, the private sector needs to assess whether there is a market for its products and it can make a return. Third, the various alternative solutions need to be assessed and compared based on explicit criteria for performance assessment. This can be done at various levels of government, private sector suppliers as well as communities and households. Fourth, the selected solutions need to be implemented effectively and sustainably, with appropriate guidance from the available evidence or knowledge bases. With many players involved and many different types of decision being made, the process is not straightforward. However, some kind of overarching framework for assessment and decision making is essential.

This current study is such an attempt to provide improved evidence for the sanitation sector in Cambodia, presented within a framework that is broadly accepted by the development community. This framework is economic analysis – which incorporates both cost-effectiveness and cost-benefit analysis (see Glossary). The logic of economic analysis is that decision makers from the government level down to households need to better understand the costs and benefits of their actions, as well as the costs of no action, and hence make improved decisions. Economic analysis should be conducted with an understanding of the many factors that influence decision making, but also that quantitative analyses cannot be expected to perfectly reflect reality or future

scenarios. Data collected are not always accurate, neither do they reflect well other contexts where the decision is being made. Furthermore, efficiency is not the only goal. The "efficient" solution may not be distributionally sound (i.e. it does not reflect who gains and who loses), it may not be feasible from a resource angle (such as who will finance the intervention) nor from a cultural perspective (preferences of the beneficiaries). Therefore these issues must be borne in mind when interpreting the results of economic analysis.

This current report presents the results of the second phase of the Economics of Sanitation Initiative (ESI). The first phase assessed the economic impacts of poor sanitation in Cambodia, finding that economic losses amounting to US$448 million per year are affecting Cambodia, equivalent to 7.2% of the annual Gross Domestic Product. The results indicate the importance of improving access to sanitation. The second phase study assesses the alternative options for improving sanitation in Cambodia. It compares the sanitation choices in selected field sites, to make conclusions and recommendations of general relevance for the entire country.

The report is divided into the following chapters:

- Chapter 2 presents the study aims, including the overall purpose of the study, specific use of the study, and research questions.
- Chapter 3 presents the methodology, which includes the selection of costs and benefits to be evaluated and the methodologies to estimate costs and benefits (sample sizes, data sources and data analysis techniques).
- Chapter 4 presents the field-level benefits of improved sanitation and hygiene, including the community-level impacts of improved sanitation and hygiene on health, water, access time, intangibles, and external environment.
- Chapter 5 presents the national benefits of improved sanitation and hygiene, focusing on the impacts of improved sanitation and hygiene on tourism and businesses.
- Chapter 6 presents cost results, including the aggregate and disaggregated costs - cost component (investment/recurrent), financier, and economic versus financial costs.
- Chapter 7 presents the performance of sanitation programs, comparing selected key indicators for each project.
- Chapter 8 presents the overall efficiency of improved sanitation and hygiene options, synthesizing evidence presented in chapters 4 to 7.
- Chapter 9 discusses the results and interprets the findings.
- Chapter 10 recommends a range of action points based on the study findings.

II. Study Aims

2.1 OVERALL PURPOSE

The purpose of the Economics of Sanitation Initiative (ESI) is to promote evidence-based decision making using improved economic methodologies and data sets, thus increasing the effectiveness and sustainability of sanitation spending by both the public and private sectors.

Better decision making techniques and increased availability of economic evidence are also expected to stimulate additional spending on sanitation to meet and surpass national coverage targets in Cambodia.

2.2 STUDY AIMS

The aim of this current study is to generate robust evidence on the costs and benefits of sanitation improvements in different programmatic and geographic contexts in Cambodia, leading to selection of the most efficient and sustainable sanitation interventions and programs. Basic hygiene aspects are also included, insofar as they affect health outcomes.

The evidence is presented in simplified form and distilled into key recommendations to increase uptake by a range of sanitation financiers and implementers in Cambodia, including different levels of government and sanitation sector partners, as well as households and the private sector.

Standard outputs of cost-benefit analysis include benefit-cost ratios, internal rate of return, payback period, and net benefits (see Glossary). Cost-effectiveness measures relevant to health impacts will provide information on the costs of achieving health improvements. In addition, intangible and environmental impacts of sanitation not quantified in monetary units are highlighted as being crucial to the optimal choice of sanitation interventions in Cambodia.

This study also contributes to the debate on approaches to sanitation financing and ways of scaling up sanitation improvements to meet Cambodia's national targets.

2.3 SPECIFIC STUDY USES

By providing hard evidence on the costs and benefits of improved sanitation, the study will:

- Provide **advocacy material** for increased spending on sanitation, and to prompt greater attention of sector stakeholders to efficient implementation and scaling up of improved sanitation throughout Cambodia.
- Enable the inclusion of **efficiency criteria** in the selection of sanitation options in government and donor strategic planning documents, and in specific sanitation projects and programs.
- Bring greater focus on **appropriate technology** through increased understanding of the marginal costs and benefits of moving up the "sanitation ladder" from dry to wet pit latrines, to septic tanks and to sewerage connection.
- Contribute to the design of **feasible financing options** through identification of the beneficiaries as well as cost incidence of sanitation programs.

2.4 RESEARCH QUESTIONS

In order to fulfill the overall purpose of the study, research questions were defined that have a direct bearing on sanitation policies and decisions in Cambodia, distinguished for overall efficiency questions (i.e. cost versus benefit), and for costs and benefits separately[1]. Listed in Boxes 1-4 below are a range of research questions which were considered in this study; some though were outside the scope of this study to answer.

[1] "Costs" and "benefits" refer simultaneously to financial and economic costs, unless otherwise specified.

The major concern in economic evaluation is to understand economic and/or financial efficiency – in terms of return on investment and recurrent expenditure. Hence the focus of economic evaluation is on what it costs to deliver an intervention and what the returns are. Several different efficiency measures allow examination of the question from different angles, such as number of times by which benefits exceed costs, the annual equivalent returns, and the time to repay costs and start generating net benefits (see Box 1). Also, as sanitation and hygiene improvement fall within the health domain, economic arguments can be made for investment in sanitation and hygiene interventions with the health budget, if the health return per unit cost invested is comparable or more favorable than other uses of the same health budget. This study attempts to answer these questions to the extent possible, according to the data collected.

As well as overall efficiency questions, it is useful from decision making, planning and advocacy perspectives in Cambodia to better understand the nature and timing of costs and benefits, as well as how non-economic aspects affect the implementation of sanitation interventions, hence affecting their eventual efficiency (see Boxes 2 to 4 below). Furthermore, given that several impacts of improved sanitation cannot easily be quantified in monetary terms, this study attempts to give greater emphasis to these impacts in the overall cost-benefit assessment.

BOX 1. RESEARCH QUESTIONS ON SANITATION EFFICIENCY (⇒ CHAPTER 8)

i. Are benefits greater than the costs of sanitation interventions? By what proportion do benefits exceed costs (benefit-cost ratio – BCR)?
ii. What is the annual internal rate of return (IRR) of sanitation spending? How does the IRR compare to national or international standards for investments of public and private funds? How does the IRR compare to other non-sanitation development interventions?
iii. How long does it take for a household to recover its initial investment costs, at different levels of cost sharing (payback period – PBP)?
iv. What is the net gain of each sanitation intervention (net present value – NPV)?
v. What is the cost of achieving standard health gains such as averted death, cases and disability-adjusted life-years (DALY)?
vi. How does economic performance vary across sanitation options, program approaches, and locations? What factors explain performance?

BOX 2. RESEARCH QUESTIONS ON SANITATION COSTS (⇒ CHAPTER 6)

i. What is the range of costs for each technology option in different field settings? What factors determine cost levels (e.g. quality, duration of hardware and software services)?
ii. What proportion of costs are capital, program and recurrent costs, for different interventions? What are necessary maintenance and repair interventions, and costs, to extend the life of hardware and increase sustainability?
iii. What proportion of total (economic) cost is financial in nature? How are financial and economic costs financed in each field location?
iv. What is the average cost per sanitation option as a percent of annual household cash income, by income quintile?
v. What are the incremental costs of moving from one sanitation improvement to another - i.e. up the sanitation ladder – for specified populations to meet sanitation targets?

BOX 3. RESEARCH QUESTIONS ON SANITATION BENEFITS (⇒ CHAPTERS 4 AND 5)

i. What local evidence exists for the links between sanitation and the following impacts: health impact, water quality, time use, welfare, tourism, and the business environment (including Foreign Direct Investment)?

ii. What are the size of financial and economic benefits related to health expenditure, health-related productivity and premature mortality; household water uses; time savings; property value; and other welfare impacts?

iii. What proportion of the benefits are pecuniary benefits (financial gains) and what proportion are non-pecuniary benefits?

iv. What proportion of each benefit accrues to households who invest in sanitation and what proportion is external to the investor?

v. What is the actual or likely willingness to pay of households and other agencies for improved sanitation? What is up-front versus annual recurrent willingness to pay?

vi. How do benefits accrue or vary over time?

vii. How is improved sanitation – and the related costs and benefits – tangibly linked with poverty reduction? What is the potential impact on national income and economic growth?

viii. What is the overall household and community demand (expressed and latent demand) for improved sanitation?

BOX 4. OTHER RESEARCH QUESTIONS (⇒ CHAPTERS 7 AND 9)

i. How do program design and program implementation affect costs and benefits? In practice, (how) can sanitation programs be delivered more efficiently – i.e. reducing costs without reducing benefits?

ii. How to leverage grants to incentivize investments in sanitation?

iii. What factors determine program performance? What are the key factors of success and constraint, covering contextual, institutional, financial, social and technical aspects?

iv. Which program approaches are best suited to which technical options?

v. What is the cultural acceptability of different sanitation options and program approaches?

vi. What other issues determine intervention choice and program design in relation to local constraints: energy use, water use, polluting substance discharge, and option robustness/durability/maintenance requirements?

vii. Based on research findings, what other key issues enter into sanitation option decisions?

In addition, other research questions are crucial to an appropriate interpretation and use of information on sanitation costs and benefits. Most importantly, the full benefits of a sanitation intervention may not be received due to factors in the field that affect the uptake and compliance with the intervention. These factors need to be better understood to advise future program design. Also, the ESI study touches on many financing issues, related to who is paying for the interventions and who is benefiting from the interventions (and thus who may be willing to pay). Given that scale-up cannot be achieved with full subsidization of sanitation interventions by government or other sector partners in Cambodia, it will be key to better understanding how public money and subsidies can be used to leverage further investments from the private sector and from households themselves.

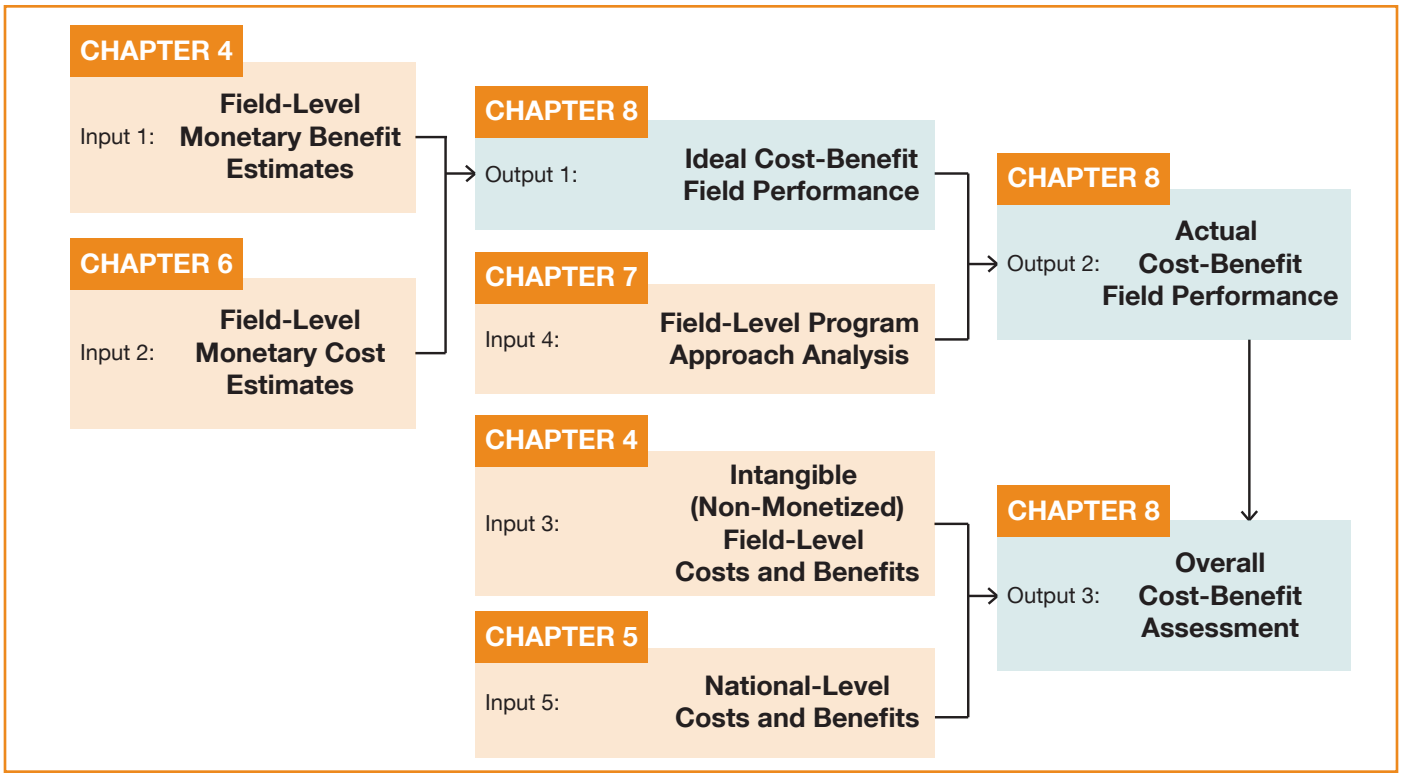
III. Methods

The study methodology in Cambodia follows a standard methodology developed at the regional level reflecting established cost-benefit techniques, which have been adapted to sanitation interventions and the Cambodia field study based on specific research needs and opportunities. As shown in Figure 2, the study consists of a field component that generates quantitative cost-benefit estimates as well as an in-depth study of the qualitative aspects of sanitation. Two types of field-level cost-benefit performance are presented: Output 1 reflects **ideal performance** assuming the intervention is delivered, maintained and used appropriately, and Output 2 reflects **actual performance** based on observed levels of intervention effectiveness in the field sites. However, both these analyses are partial, given that intangible benefits of sanitation improvements as well as other benefits that may accrue outside the sanitation improvement site are excluded. Hence Output 3, **overall cost-benefit assessment**, takes these into account.

3.1 TECHNICAL SANITATION INTERVENTIONS EVALUATED

The type of sanitation evaluated in this study is *household human excreta management*. Interventions to improve human excreta management in households focus on both onsite and offsite sanitation options. Indeed, one of the key aims of this study, where possible, is to compare the relative efficiency of different sanitation technologies. Basic hygiene aspects of sanitation are also included, insofar as they affect health outcomes and intangible aspects.

FIGURE 2: FLOW OF DATA COLLECTED (INPUTS) AND EVENTUAL COST-BENEFIT ASSESSMENTS (OUTPUTS)



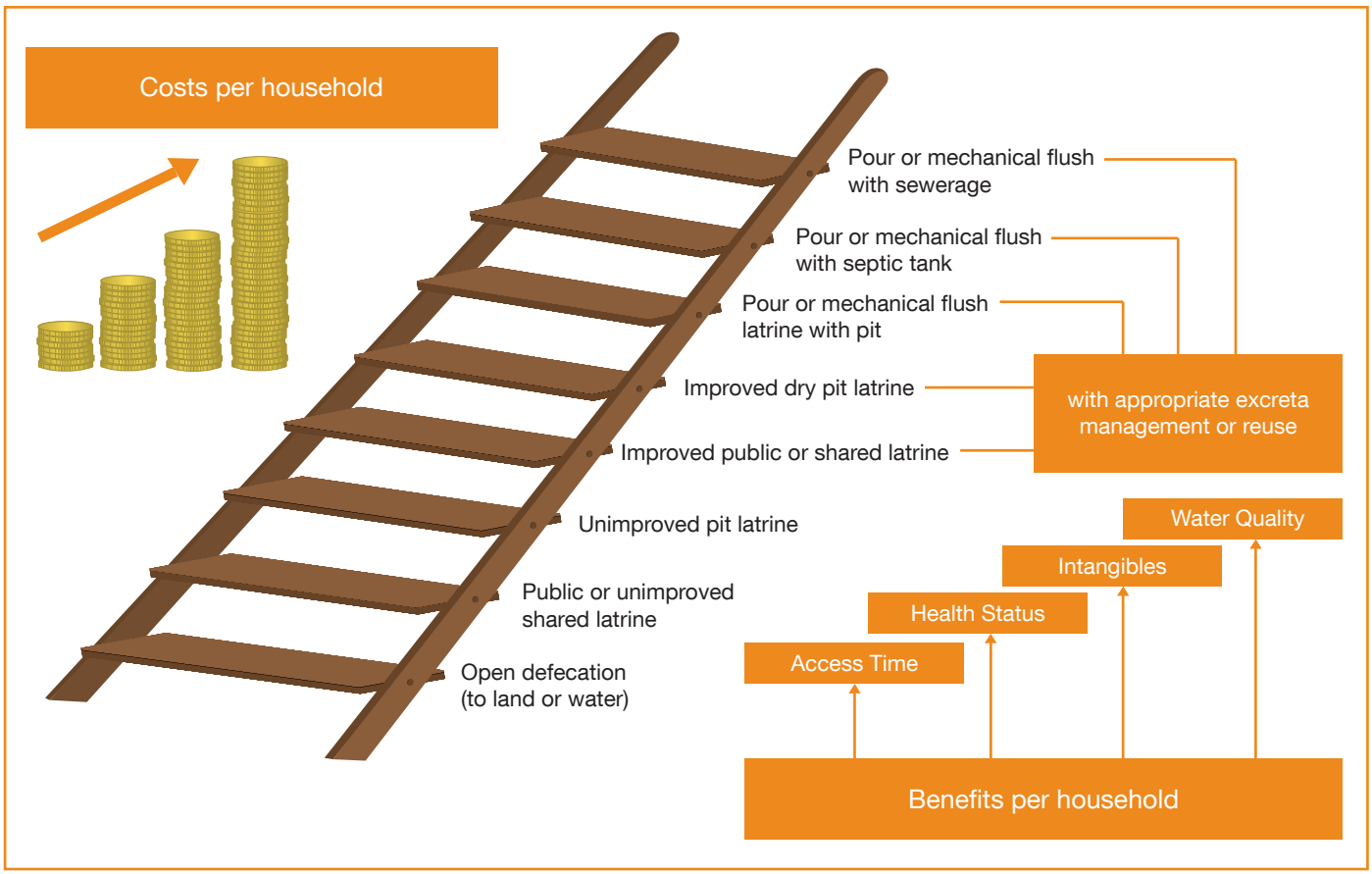
As well as human excreta management, interventions are considered that jointly address human waste with domestic wastewater management (especially in urban areas).

To qualify as an economic evaluation study, cost-benefit analysis compares at least two alternative intervention options. It usually includes comparison with the baseline of "do nothing." However, comparing two sanitation options will rarely be enough: ideally the analysis should compare all sanitation options that are feasible for each setting – in terms of affordable, technically feasible, and culturally acceptable options – so that a clear policy recommendation can be made based on efficiency of a range of sanitation options, among other factors.

Technical sanitation options include all those interventions that move households up the sanitation ladder and thus bring benefits. Figure 3 presents a generalized sanitation ladder. The upward slope of the ladder reflects the assumption of greater benefits higher up the ladder, but (generally) with higher costs. The progression shown in Figure 3 is not necessarily true in all settings and hence needs to be altered based on setting-specific features (e.g. rural or urban, different physical/climatic environments such as soil type or water scarcity).

While the study proposes to conduct analyses of the costs and benefits of achieving the MDG targets and beyond, sanitation options will not be restricted by "unimproved" and "improved" sanitation as defined by the JMP. For example, some households or governments will be interested in upgrading from one type of improved sanitation to another type, such as from private wet pit to sewerage. Other households are faced with a decision whether to replace a facility that has reached the end of its useful life. And under some program approaches (e.g. Community-led Total Sanitation (CLTS)), households are encouraged to move up the ladder, even if it does not imply a full move to JMP-defined "improved" sanitation.

FIGURE 3: REPRESENTATION OF THE SANITATION "LADDER"



Cautionary note: versions and interpretations of the sanitation ladder vary. This Figure is for illustrative purposes only.

TABLE 2: GENERAL CLASSIFICATION OF SANITATION OPTIONS

Categories (JMP definition)		Sub-categories	
0	Open defecation	0.1	In house – wrap and throw
		0.2	On plot
		0.3	On land outside plot
		0.4	Next to or directly in waterway/body
1	Private latrine, unimproved	2.1	No slab
		2.2	No superstructure
		2.3	Inadequate sub-structure
		2.4	More than one of the above
2	Private dry latrine, improved	2.1	Simple dry pit
3	Private wet latrine, improved	3.1	Pour-flush toilet + non-watertight pit and/or dumping of sludge and/or flow directly to waterway/body
4	Private toilet, septic tank	4.1	Non-watertight septic tank and/or dumping of sludge and/or flow directly to waterway/body
		4.3	Improved septic tank with sludge removal & sludge drying bed or constructed wetland
5	Private toilet, separate sewerage[1]	5.1	Decentralized conventional treatment[2]
		5.2	Decentralized natural treatment
		5.3	Centralized conventional treatment[2]
		5.4	Centralized natural treatment
		5.5	Combined conventional and natural treatment[2]

[1] Can be simplified or normal sewerage.
[2] Includes primary, secondary and tertiary treatment options.

Based on the ladder in Figure 3 as a starting point, Table 2 shows different types of intervention (i.e. sub-category) within the more broadly defined sanitation options. This classification provides an overview to allow a framework for interpretation of the specific options evaluated in the field settings (shown in 3.2.2), given that option sub-categories may have different associated costs and benefits. Categories 0, 1 and 3 are found in both rural and urban areas, while option 2 is found in rural areas only.

3.2 COSTS AND BENEFITS EVALUATED

Sanitation costs are the denominator in the calculations to estimate the cost-benefit and cost-effectiveness ratios, and thus crucial to the evaluation of sanitation option efficiency. Summary cost measures include the total annual and lifetime costs, cost per household and cost per capita. For financing and planning purposes, this study disaggregates costs for each sanitation option by capital, program and recurrent costs; by financial and economic costs; and by financier. The incremental costs of moving up the ladder are only assessed for urban areas where people move from private wet pit to sewer connection. In rural areas, such analysis was not done as most people just move from OD to certain types of latrines.

To maximize the usefulness of economic analysis for diverse audiences, benefits of improved sanitation and hygiene are divided into three categories.

1. **Household direct benefits**: these are received by the households who are making the sanitation improvement. These actual or perceived benefits will drive the decision by the household to invest in sanitation, and will also guide the type of sanitation option chosen. These benefits may include: health impacts related to household sanitation and hygiene, local water resource impacts, access time, and intangible impacts.
2. **Local level external benefits**: these are potentially incurred by all households living in the setting where there are household sanitation improvements. However, some of these benefits may not be sub-

stantial until a critical mass of households has improved their sanitation. These benefits may include: health impacts related to environmental exposure to pathogens (e.g. water sources, open defecation practices on land), aesthetics of environmental quality, and usability of local water resources for drinking, household, and productive activities. Given the challenges in designing studies to distinguish these benefits from household direct benefits (in 1.), this study groups together local level external benefits and household direct benefits.

3. **Wider scale external benefits**: these result from improved sanitation at the macro-level. Benefits may include: water quality for productive uses, tourism, local business impact, and foreign direct investment. They can either be linked to coverage in specific areas or zones (e.g. tourist area or industrial zone), or the country generally (e.g. investment climate). As well as improved management of human excreta, other contributors to environmental improvement such as solid waste management and wastewater treatment need to be considered.

Therefore, this study distinguishes the economic analysis results between household and local community impacts where household sanitation is improved, and national level impacts. Table 3 shows the impacts included in the current study, distinguishing between those impacts that are expressed in monetary units and those that are expressed in non-monetary units.

While the focus of this study is on household sanitation, the importance of institutional sanitation also needs to be highlighted. For example, improved school sanitation affects decisions for children (especially girls) to start or stay in school until the end of secondary level education, and workplace sanitation affects decisions of the workforce (especially women) to take or continue work with a particular employer. These impacts are incremental over and above the first three above. However, these impacts are outside the scope of this present study.

The next sections describe the study methods for the three major study components: the field level cost-benefit assessment (3.3), the assessment of program effectiveness (3.4) and national level impacts (3.5).

3.3 FIELD STUDIES

3.3.1 PROJECT SELECTION AND DESCRIPTION

According to good economic evaluation practice, interventions evaluated should reflect the range of feasible options faced by households, communities and policy makers. Therefore, project interventions should be selected which: contain a range of sanitation options, are typically available in Cambodia, and cover both urban and rural projects. By selecting a range of sanitation interventions in the country and by sampling a range of locations within the intervention areas, the study results can be generalized outside the study settings, and hence be more useful for national and local level planning purposes.

TABLE 3: BENEFITS OF IMPROVED SANITATION INCLUDED IN THIS STUDY

Level	Impact	Socio-economic impacts evaluated in	
		Monetary terms ($ values)	Non-monetary terms (non-$)
Local benefits	Health	• Health care costs • Health-related productivity • Premature death	• Disease and mortality rates • Quality of life impacts • Gender impacts
	Domestic water	• Water sourcing • Household treatment	• Qualitative link between poor sanitation, water quality and water treatment practices
	Other welfare	• Access time and time use	• Convenience, comfort, privacy, status, security, gender issues
	Environmental quality		• Aesthetics of household and community environment
National benefits	Tourism		• Sanitation-tourism link: potential impact of poor sanitation on tourist numbers
	Business		• Sanitation-business link: potential impact of poor sanitation on local business and foreign direct investment

The principal criterion for project selection applied in this study is that there has been a sanitation project or program implemented in the past five years, and at some level of scale that allows minimum sample sizes of 30 households to be collected per sanitation option per project. These criteria left few projects. Projects that met these criteria were approached to assess collaboration potential and logistical feasibility for research to be conducted in the field sites. The final five projects selected are presented in Table 4. In rural areas, these include projects implemented by various external partners in partnership with the Ministry of Rural Development (MRD): ECOSORN the European Union (EU), Plan International, World Vision and the Tonlé Sap Rural Water Supply and Sanitation project (TSRWSSP) supported by the Asian Development Bank (ADB). At the time of project selection (2007), rural sanitation projects not included was a UNICEF project[2] supporting MRD to scale up CLTS in six provinces, and a Swiss Red Cross project in Takeo province. Given the lack of options, only one urban sanitation project was selected – a project financed by ADB and implemented by the Ministry of Public Works and Transport (MPWT) in Sihanoukville.

TABLE 4: BACKGROUND INFORMATION ON SELECTED FIELD SITES

Variable	Sanitation project managed by:				
	ECOSORN (EU)	**Plan International**	**World Vision**	**ADB/MRD (Tonlé Sap)**	**ADB/MPWT (Sihanoukville)**
PROJECT INFORMATION					
Rural/urban	Rural	Rural	Rural	Rural	Urban
Provinces covered by project	SR, BAT, BMC	SR, KPC	KPT, KCH, KDL, TAK, BAT, KSP, PVR, PLN, PNP	KCH, PUR, BAT, SR and KPT	Sihanoukville
Program approach	Subsidizing pour-flush latrines to households (concrete rings + slab + zinc roof)	CLTS approach	Subsidizing latrines to households (concrete rings + slab without pan)	Subsidizing latrines to households by providing different options from dry to wet pit latrines	Construction of sewerage system and wastewater treatment plant, managed by Government of Cambodia under ADB loan
Main sanitation options compared	Pour-flush latrines (offset)	Dry pit latrines (unlined pit)	Dry pit latrines (concrete-lined pit)	Pour-flush latrines	OD to septic tank[1], or flush latrines to sewerage with WWTP
Start year	2006	2006	2006	2006	2003
End year	2010	2010	2008	2010	2006
ESI FIELD SITE INFORMATION					
Provinces covered under ESI survey	SR, BAT, BMC	SR	KPT	BAT, SR	SHV
Number of villages sampled	4 villages	6 villages	3 villages	4 villages	7 villages
Households sampled in villages	230	245	170	250	285
Average household size	4.5	5.3	5.1	4.8	5.1
Average no. of children < 5 per household	0.45	0.50	0.47	0.48	0.29

Data source: ESI survey.
Key: ADB – Asian Development Bank; MRD – Ministry of Rural Development; MPWT – Ministry of Public Works and Transport; BAT – Battambang; BMC – Banteay Meanchey; KPT – Kampong Thom; SR – Siem Reap; KPS – Kampong Speu, KPC – Kampong Cham, KCH – Kampong Chhnang, TAK – Takeo, KDL – Kandal, PNP – Phnom Penh, PVR – Preah Vihear, PLN – Pailin, PUR – Pursat, CLTS – community-led total sanitation
[1] In this site, and in Cambodia generally, the term septic tank does not necessarily refer to the well engineered septic tank, but is also used to refer to a simple sedimentation tank. The term 'septic tank' used hereafter refers to both a septic tank and sedimentation tank.

[2] UNICEF at that time supported MRD to conduct the formative evaluation of CLTS. The project is thus excluded to avoid survey repetition.

In the study, the rural project sanitation options are mainly onsite sanitation such as simple dry pit and pour-flush latrine. Plan International utilizes the CLTS approach where mainly dry pits are chosen to be built by households, while the World Vision actively promotes and provides longer lasting dry pit latrines with concrete rings. ECOSORN promotes one main option of pour-flush latrines. The TSRWSS project in five provinces offers a wide range of latrine options from simple dry pit to wet pit latrine to households. The ESI Study chooses the pour-flush latrine option of this project for evaluation purposes. The sanitation baseline for these rural projects is almost exclusively open defecation, with very limited, if any, upgrading (due to the very high rate of OD in the selected villages).

The urban sanitation project selected for the ESI study is in the tourist coastal city of Sihanoukville, related to the improvement of wastewater management. Before the project, most households in the city were connected to an old sewerage system which discharged wastewater directly to the sea without treatment; many households also had no connection, using either a septic tank or wet pit latrine. The project provided a new expanded sewerage network, as well as construction of a wastewater treatment plant.

3.3.2 COST ESTIMATION METHODOLOGY

This study estimates comprehensive costs of different sanitation options, including program management costs as well as onsite and offsite costs. Cost estimation was based on information from three data sources (i.e., sanitation program or project documents, the provider or supplier of sanitation services, and the ESI household questionnaire, described in 3.3.4). Data from these three sources were compiled, compared, and adjusted, and finally entered into standardized sheets. Annual equivalent costs of different sanitation options were calculated based on annualized investment cost (taking into account the estimated length of life of hardware and software components) and adding annual maintenance and operational costs. For data analysis and interpretation, financial costs were distinguished from non-financial costs, and costs were broken down by financier. Information from documents of sanitation projects and providers as well as market prices was supplemented with interviews with key resource people to ensure correctness of interpretation, and to enable adjustment where necessary.

3.3.3 BENEFIT ESTIMATION METHODOLOGY

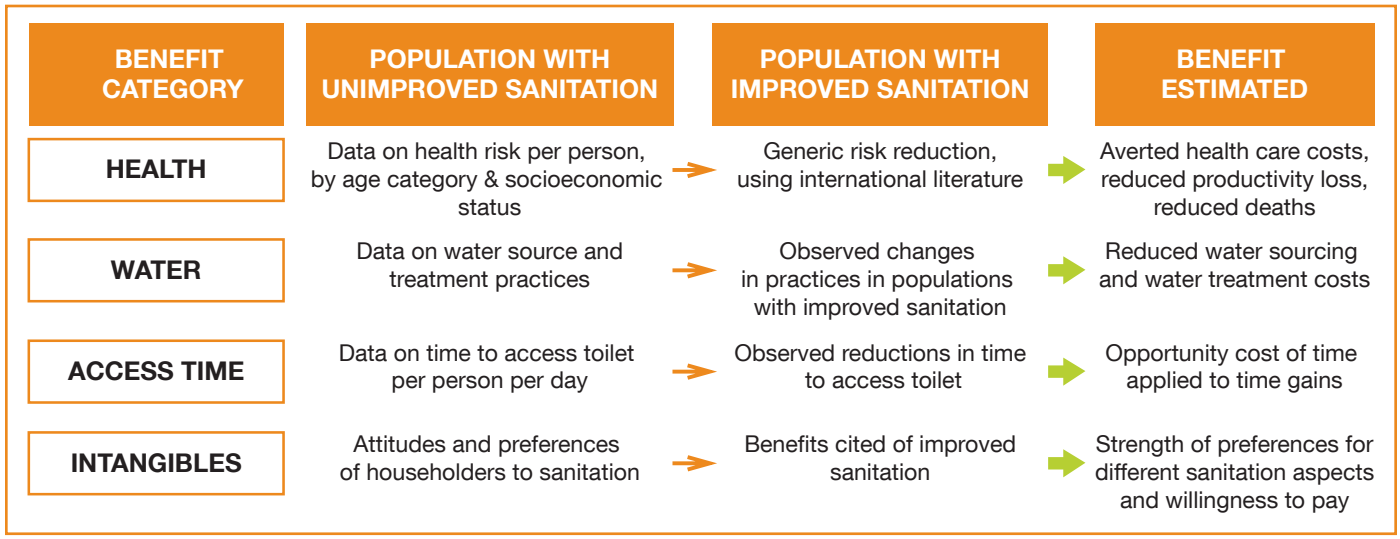
Economic evaluation of sanitation interventions should be based on sufficient evidence of impact, thus giving unbiased estimates of economic efficiency. Hence the appropriate attribution of causality of impact is crucial, requiring a robust study design. Annex Table A2 presents alternative study designs for conducting economic evaluation studies, starting at the top with the most valid scientific approaches, down to the least valid at the bottom. Given that the most valid scientific approach (a randomized time-series intervention study) was not possible within the time frame and resources of this study, the most valid remaining option was to construct an economic model for assessment of the cost-benefit of providing sanitation interventions and of moving from one sanitation coverage category to the next. A range of data was used in this model, reflecting both households with and without improved sanitation, to ensure that before and after intervention scenarios were most appropriately captured. This included capturing the current situation in each type of household (e.g. health status and health seeking, water practices, time use), as well as understanding attitudes towards poor and improved sanitation, and the factors driving decisions. These data were supplemented with evidence from other local, national and international surveys and data sets on variables that could not be scientifically captured in the field surveys (e.g. behavior and risk factors for health assessment).

Figure 4 shows an overview of the methods for estimating the benefits of moving up the sanitation ladder. The actual size of the benefit will depend on the specific sub-type of sanitation intervention implemented.

Below the specific methods for the sanitation benefits are described.

Health: For the purposes of cost-benefit and cost-effectiveness analysis, three types of disease burden are evaluated: numbers of cases (incidence or prevalence), numbers of deaths, and disability-adjusted life-years (DALYs). Diseases included are all types of diarrheal disease, helminthes, hepatitis A and E, trachoma, scabies, malnutrition and diseases related to malnutrition (e.g. malaria, acute lower respiratory infection (ALRI), measles) (see Annex Table A3). Health costs averted through improved sanitation are calculated by multiplying overall health costs per household by the

FIGURE 4: OVERVIEW OF METHODS FOR ESTIMATING FIELD-LEVEL BENEFITS OF IMPROVED SANITATION



relative risk health reduction from the improved sanitation and/or hygiene measures. Health costs are made up of disease treatment costs, productivity losses and premature mortality losses. For cost-effectiveness analysis, DALYs are calculated by combining the morbidity element (made up of disease rate, disability weight and illness duration) and the mortality element (mortality rate and life expectancy). Standard weights and disease duration are sourced from the WHO Global Burden of Disease study, and average life expectancy for Cambodia of 59 for males and 65 for females is used[3].

- Rates of morbidity and mortality are sourced from various data sets for three age groups (0-4 years, 5-14 years, 15+ years), and compared and adjusted to reflect local variations in those rates. National disease and mortality rates were adjusted to rates used for the field sites based on socio-economic characteristics of sampled populations. Since there is poor availability of data at the local level and on other diseases, the adjustment is limited to the provincial level and based on data on diarrhea and malnutrition rates to estimate other sanitation-related diseases. As not all fecal-oral diseases have a pathway from human excreta, an attribution fraction of 0.88 is applied for these diseases. Fifty percent of skin diseases are attributed to poor hygiene. Methods for the estimation of disease and mortality rates from indirect diseases via malnutrition are provided in the ESI Impact Study report (Kov et al, 2008).

- Health care costs are calculated by applying treatment seeking rates for different health care providers to the disease rates, per population age group. The calculations also take into account hospital admission rates for severe cases. Unit costs of services and patient travel and sundry costs are applied based on treatment seeking. The data are from the various sources and interviews with health staff to get the total cost, mainly detailed in the ESI Impact Study report (Kov et al, 2008).

- Health-related productivity costs are calculated by applying time off work or school to the disease rates, per population age group. The time taken off work was collected from the ESI household survey, and averaged across all field sites (rural and urban separate). Outlying values above 30 days were excluded from the average. The economic cost of time lost due to illness reflects an opportunity cost of time or an actual financial loss for adults with paid work. The unit cost values are based on the average wages, distinguished by rural and urban sites. For adults a rate of 30% of the average income is applied, reflecting a conservative estimate of the value of time lost. For children 5-14 years, sick time reflects lost time at school which has an opportunity cost, valued at 15% of the average income. For children under five, the duration of the child's care is applied at 15% of the average income to reflect the time of the child's carer.

[3] Cambodia WHO website, http://www.who.int/countries/khm/en/.

- Premature death costs are calculated by multiplying the mortality rate by the unit value of a death. Although premature death imposes many costs on societies, it is difficult to value precisely. The method employed by this study – the human capital approach (HCA) – approximates economic loss by estimating the future discounted income stream from a productive person, from the time of death until the end of (what would have been) their productive life. Source of value is average wage, rural and urban separated. While this value may undervalue premature loss of life, as there is a value to human life beyond the productive worth of the workforce, the study faced limited alternative sources of value due to a lack of studies (e.g. value-of-a-statistical-life (VSL)[4]). Values are provided in Table 5 including the benefits-transfer method for adjusting the VSL to Cambodia from developed country studies.

- Risk reductions of illness and death associated with improved sanitation and hygiene interventions are assessed from the international literature, and are applied and adjusted to reflect risk reduction in local settings based on baseline health risks and interventions applied. Risk reductions depended on whether the intervention provided a safe place to defecate without full isolation or treatment (basic sanitation), or whether a high degree of isolation and/or treatment was achieved (basic sanitation + wastewater management). The reductions in diarrheal disease, other fecal-oral disease and diseases related to resulting malnutrition are as follows: basic sanitation alone (36%[5]), basic sanitation with hygiene (50%[6]), basic sanitation + wastewater management (56%[7]), and basic sanitation + wastewater management with hygiene (65%[8]). For soil-transmitted helminthes, fewer primary studies were available to estimate risk reductions; the following was assumed: basic sanitation alone (50%), basic sanitation with hygiene (70%), basic sanitation + wastewater management (80%), basic sanitation + wastewater management with hygiene (100%).

TABLE 5: UNIT VALUES FOR ECONOMIC COST OF TIME PER DAY AND OF LOSS OF LIFE (KHR AND US$, 2008)

Technique		Daily value of time			Value of life		
		0-4 years	5-14 years	15+ years	0-4 years	5-14 years	15+ years
RURAL							
Human capital approach[1]	US$	0.6	0.6	1.2	7,499	11,737	12,300
	KHR	2,505	2,505	5,010	31,070,337	48,625,149	50,957,356
VSL[2]	US$				39,443	39,443	39,443
	KHR				163,410,785	163,410,785	163,410,785
URBAN							
Human capital approach[1]	US$	0.6	0.6	1.2	7,499	11,737	12,300
	KHR	2,505	2,505	5,010	31,070,337	48,625,149	50,957,356
VSL[2]	US$				39,443	39,443	39,443
	KHR				163,410,785	163,410,785	163,410,785

[1] 2% real GDP or wage growth per year, discount rate = 8%.
[2] The VSL of US$2 million is transferred to the study countries by adjusting downwards by the ratio of GDP per capita in each country to GDP per capita in the USA. The calculation is made using official exchange rates, assuming an income elasticity of 1.0. Direct exchange from higher to lower income countries implies an income elasticity assumption of 1.0, which may not be true in practice.

[4] See Glossary. VSL studies attempt to value what individuals are willing to pay to reduce the risk of death (e.g. safety measures) and willing to accept for an increase in the risk of death. These values are extracted either from observations of actual market and individual behavior ("hedonic pricing") or from what individuals stated in relation to their preferences from interviews or written tests ("contingent valuation"). Both these approaches estimate directly the willingness to pay of individuals, or society, for a reduction in the risk of death, and hence are more closely associated with actual welfare loss compared with the HCA. No VSL studies have been conducted in Cambodia.
[5] 36% reflects the average of Waddington 2009, Fewtrell 2005, Esrey 1991 and Esrey 1996.
[6] 50% reflects the sanitation interventions alone of 36% plus 14% add-on for hygiene.
[7] 56% reflects the average for the two Brazilian studies which found 43% and 69% risk reduction for high risk populations, and is also close to the 57% which is half way risk reduction from scenario IV (or Vb) to scenario II (Prüss, 2002).
[8] 65% reflects 56% reduction from sanitation plus hygiene add-on which brings 9% marginal impact.

Water: While water has many uses at community level as well as for larger-scale productive purposes (e.g. industry), the focus of the field study is the use for domestic purposes, in particular drinking water. The most specific link between poor management of human excreta and water quality is the safety aspect, which causes communities to take mitigating actions to avoid consuming unsafe water. These include reducing reliance on surface water and more use of wells or treated piped water supply. It even involves the need to rely less on shallow dug wells, which are more easily contaminated with pathogens, and to drill deeper wells. As well as from sewage, water sources which communities traditionally rely on for their other domestic needs (such as cooking, washing, and showering) are changed in favor of cleaner, but more expensive, water sources. The water quality measurement is conducted as part of this study in representative field sites, to enable a detailed analysis of the impacts of improved sanitation on local water quality (see Annex Table A4). This study measures the actual or potential economic impacts of improving sanitation on two sets of mitigating measures:

- Accessing water from the source. Because households pay more or walk further to access water from cleaner sources such as drilled wells, or they pay more for piped water, the costs can be reduced if sanitation is improved. For example, traditionally people prefer the taste of water from shallow wells to deeper wells, and hence would likely return to the use of shallow wells if they could guarantee cleaner and safer water. Also, providers of piped water have to treat water less if it is less contaminated, thus saving costs. Hence expected percentage cost reductions from 5% to 25% for each water source are applied to current costs of clean water access to estimate cost savings from improved sanitation.

- Household treatment of water. Traditionally many households treat their water due to concerns about safety and appearance. This is commonly true even for piped treated water supplies. Boiling is the most popular method in Cambodia because it is perceived to guarantee water to be safe for drinking. However, boiling water can require considerable cash outlays or it consumes their time for collecting biomass fuel. Furthermore, boiling water for drinking purposes is more costly to the environment due to the use of wood, charcoal or electricity, with correspondingly higher carbon dioxide (CO_2) emissions than other treatment methods. If sanitation is improved and the pathogens in the environment reduced to low levels, then households would feel more ready to use a simple and less costly household treatment method such as filtration or chlorination. Hence based on observations and expected future household treatment practices under improved sanitation, the cost savings associated with alternative water treatment practices are calculated. It should be noted that it is assumed that there will be a shift in treatment practice methods when the sanitation improves, e.g. a decrease in the boiling method. The annual cost of boiling water by each type of boiling method is estimated based on the annual fuel consumption, unit fuel cost, unit fuel collection time, and the percentage of energy source. All the values are from the ESI survey questionnaire and some assumptions. The annual cost of filtering is calculated through a combination of the annual maintenance costs and depreciation cost of the water filter.

Access time: When households have their own private latrine, many of them will save time every day, compared to the alternative of going to the bush or using a shared facility for their toilet needs. The time used for each sanitation option will vary from household to household, and from person to person, as children, men, women, and the elderly all have different sanitation preferences and practices. Therefore, this study calculates the time savings for different population groups of improving sanitation, based on household practices both with and without improved sanitation. The economic value of time is based on the same values as health-related time savings (see above).

Intangibles: Intangibles are major determinants of personal and community welfare, and include comfort, privacy, convenience, safety, status and prestige. Due to their often very private nature, intangibles are difficult to elicit reliable responses from individuals, and some may vary considerably from one individual and social group to another. Intangibles are therefore difficult to quantify and summarize from a population perspective, and are even more difficult to value in monetary terms for a cost-benefit analysis. Eco-

nomic tools do exist for quantitative assessment and valuation of intangible benefits such as the contingent valuation method, and willingness to pay surveys are commonly used to value environmental goods. However, there are many challenges to the application of these methods in field settings, which affect their reliability and validity, and ultimately may reduce confidence in the quantitative results. Furthermore, willingness to pay often captures more than just the intangible variables being examined, but also captures preferences that have been valued elsewhere (e.g. health and water benefits). This current study therefore attempts only to understand and measure sanitation knowledge, practices and preferences in terms of ranking scales. This enables a separate set of results to be provided alongside the monetary-based efficiency measures.

External environment: Likewise, the impacts of poor sanitation practices on the external environment are also difficult to quantify in monetary terms. Hence, this study attempts only to understand and measure practices and preferences in relation to the broader environment, in terms of ranking scales. Given human-related sanitation is only one of several factors in environmental quality, other aspects – sources of water pollution, solid waste management, and animal waste – are also addressed to understand human excreta management within the overall picture of environmental quality.

3.3.4 DATA SOURCES

Given the multiple costs and benefits estimated in this study, a range of data sources was used including both up-to-date evidence from the field sites as well as evidence from other databases or studies. Given the limitations of the field study, some elements of selected benefits needed to be sourced from other more reliable sources. Routine data systems such as the health information system are often of poor quality or incomplete, while larger, more reliable nationwide or local surveys may be out of date, or were not conducted in the ESI field locations.

Once the projects were selected, the actual survey sites (villages) were chosen after consultation with the project staff. Before the survey team arrived, field site visits were undertaken by senior research team members to check site appropriateness, request collaboration and sensitize the community leaders and local project staff. The data collection was achieved with five teams of 10 people each, consisting of one team supervisor, one team assistant and eight interviewers. Each site was completed in between one and two weeks each.

The contents of the field tools applied are introduced briefly below (the tools applied in Cambodia are available from WSP).

Field tool 1: Household questionnaire. Household questionnaires consisted of two main parts: the first was asked to household representatives (the senior male and/or female household member, based on availability at time of interview), while the second was a shorter observational component covering mainly physical water, sanitation and hygiene features of the household. The interview part consisted of sections on:

- Socio-economic and demographic information, and household features
- Current and past household sanitation options and practices, and mode of receipt
- Perceived benefits of sanitation, and preferences related to external environment
- Household water supply sources, treatment and storage practices
- Health events and health treatment seeking
- Hygiene practices
- Household solid waste practices

The household questionnaire was applied to a total of 1,180 households over the five sanitation projects, or roughly 236 households per project. In most study sites, control sites were also established for comparison with intervention sites within the project areas. Annex Table A5 presents the sample sizes per sanitation option and per field site. The sample selected in rural sites included households who have simple pit latrines or pour-flush latrines, as well as households practicing open defecation. In the urban site, the sample included households with septic tank and households connected to sewerage network, as well as a small sample of households without toilets (i.e. using shared or community toilets, and some practicing open defecation). Households were randomly selected until the target sample size was reached per sanitation option.

TABLE 6: SAMPLE SIZE BY PROJECTS INCLUDED IN THE STUDY

Project	Sample sizes (no. of households)			Number of villages covered	Intervention type
	OD	Intervention	Total		
ECOSORN	113	123	236	4	Wet pit
Plan International	80	165	245	6	Unlined dry pit
World Vision	50	120	170	3	Concrete ring dry pit
TSRWSSP	123	124	247	4	Wet pit
SHV Treatment Plant	19	266	285	7	Sewerage connection; wet pit (tank)

Table 6 shows the sample size used for the study in each project and the type of intervention by each project. For each project evaluated, one additional village served as the "control" village, where most people practice open defecation and where there exists no sanitation project. Out of the total households interviewed, 17% were female heads of households. Less than half (40%) of the interviewees were the heads of households.

Field tool 2: Focus group discussion. The purpose of the focus group discussion (FGD) was to elicit behavior and preferences in relation to water, sanitation and hygiene from different population groups, with main distinctions by sanitation coverage (with versus without) and gender (male and female). The topics covered in the FGDs followed a generic template of discussion topics, but the depth of discussion was dictated by the readiness of the participants to discuss the topics. The added advantage of the FGD approach is to discuss aspects of sanitation and hygiene that may not otherwise be revealed by face-to-face household interviews, and to either arrive at a consensus or otherwise to reflect the diversity of opinions and preferences for sanitation and hygiene among the population. FGDs were led by two researchers and notes taken by two research assistants. Annex Table A6 shows the number of FGDs held per group per location. In total, 20 FGDs were conducted in all projects, of which four FGDs were conducted in each project. In each of the five projects evaluated, separate FGDs were held for those with and those without latrines, and for men and women. The average number of FGD participants was around eight and the average duration for each FGD was one-and-a-half hours.

Field tool 3: Physical location survey. A survey of the physical environment was conducted in all field locations – given that there were several locations per project this gave 14 physical location surveys applied. The main purpose was to identify important variables in relation to water, sanitation and hygiene in the general environment, covering land use, water sources, and environmental quality. This information was triangulated with the household surveys and FGDs as well as the water quality measurement survey, to enable appropriate conclusions about the extent of poor sanitation and its impacts. This survey was conducted by survey team supervisors, who visited the commune councils and other agencies to get the related information.

Field tool 4: Water quality measurement. Given one of the major detrimental impacts of poor sanitation is the impact on surface as well as ground water quality, special attention was paid to identifying the relationship between the type and coverage of toilets in the selected field sites, and the quality of local water bodies. Given the time scale of this present study, it was not possible to measure water quality variables before the project or program was implemented; neither was it possible to compare wet season and dry season measurements. The water quality measurement survey was contracted to Resource Development International-Cambodia (RDIC) and carried out in May 2009. The study enabled assessment of the impact of specific local sanitation features on water quality. It also enabled a broader comparison of water quality between study sites with different sanitation coverage levels. Water sources tested in each site included ground water (dug shallow wells, deeper drilled wells), standing water (ponds, lakes, canals), and flowing water (river, wastewater channels). Annex Table C1 shows the type of test and location per parameter, and the number and type of water sources tested. For cost reasons, water testing was conducted in 10 out of the 23 sampled villages. Parameters measured varied per water source, but generally

included Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Escherichia Coli (E.coli), Total Coliform, Potentiometric Hydrogen (pH), Turbidity, Conductivity, Ammonia, Nitrate, Chlorine (Cl) and Temperature.

Field tool 5: Market survey. For economic evaluation, local prices are required to value the impacts of improved sanitation and hygiene. Selected resource prices, and in some cases resource quantities, were recorded from the most appropriate local source: labor prices (i.e. average wage, minimum wage) and employment rate, water prices by a different source, water treatment filter prices, fuel prices, sanitation improvement costs, soap costs and pharmacy drug costs.

Field tool 6: Health facility survey. Given the importance of health impacts, a separate survey was conducted in two to three health facilities serving each field site. Variables collected include numbers of patients with different types of WSH-related disease, and the types and cost of treatment provided by the facility. These facility-based data were supplemented by data collected or compiled at higher levels of the health system such as the commune or district level, and at the national level.

Other data sources: As well as collection of data from field sites, data and information were collected from other sources to support the field-level cost-benefit study, such as reports, interviews, and data sets. These include Demographic and Health Survey (2005): Annual Health Statistics of the Ministry of Health (2008), Cambodia Statistical Year Book 2008, Cambodia Socio Economic Survey 2007 (CSES) and the Economics of Sanitation Initiative Phase 1 report (Economic Impact Study).

3.3.5 DATA ANALYSIS

The types of costs and benefits included in the study are listed in Section 3.2. This section describes how costs, benefits and other relevant data are analyzed to arrive at overall estimates of cost-benefits.

The field level cost-benefit analysis generates a set of efficiency measures from site-specific field studies, focusing on actual implemented sanitation improvements, including household and community costs and benefits (see Table 3). The costs and benefits are estimated in economic terms for a 20-year period for each field site, using average values based on the field surveys and supplemented with other data or assumptions. Annex Table A7 shows the calculation methodology details. Five major efficiency measures are presented:

1. The benefit-cost ratio (BCR) is the present value of the future benefits divided by the present value of the future costs, for a 20-year period. Future costs and benefits (i.e. beyond year 1) are discounted to present value using a discount rate of 8%.
2. The cost-effectiveness ratio (CER) is the present value of the future health benefits in non-monetary units (cases, deaths, disability-adjusted life-years) divided by the present value of the future costs, for a 20-year period. Future costs and health benefits (i.e. beyond year 1) are discounted to present value using a discount rate (see above).
3. The internal rate of return (IRR) is the discount rate at which the present value equals zero – that is, the costs equal the benefits – for a 20-year period.
4. The payback period (PBP) is the time after which benefits have been paid back, assuming initial costs exceed benefits (due to capital cost) and over time benefits exceed costs, thus leading to a point that is break even.
5. The net present value (NPV) is the net discounted benefits minus the net discounted costs.

Results are presented by project and for each sanitation improvement option compared with no sanitation option (i.e. open defecation). Also, the steps up the sanitation ladder from private wet pit latrine to sewerage connection is presented in the study for urban areas while the moving from OD to dry pit or wet pit latrines is only evaluated in rural areas. The efficiency ratios are presented both under conditions of well-delivered sanitation programs which lead to well-functioning sustainable sanitation systems, as well as sanitation systems and practices under actual conditions, extracted from the program approach analysis (Section 3.4). Given that not all sanitation benefits have been valued in monetary units, these benefits are described and presented in non-monetary units alongside the efficiency measures. Gender issues are particularly important in the presentation of intangible benefits.

3.4 PROGRAM APPROACH ANALYSIS

The aim of the program approach analysis (PAA) is to show the levels and determinants of performance of sanitation programs. It evaluates the link between different program approaches and eventual efficiency and impact of the sanitation options. The study uses the performance indicators of the projects to adjust the ideal efficiency to actual efficiency. The adjustment is for the health cost, water access time, water treatment, and time cost. The indicator for the adjustment is the percentage of households using their latrine regularly, percentage of household members washing their hands after defecation, households using non-boiling methods for water treatment, and percentage of household members using own latrine instead of off-plot options.

3.5 NATIONAL STUDIES

National level studies served two main purposes: (a) to assess the impacts of improved sanitation outside field sites to enable a more comprehensive cost-benefit analysis (tourism, and business); and (b) to complement or supplement data collected at field level to enable better assessment of local level impacts (health and water resources).

3.5.1 TOURIST AND VISITOR SURVEY

There exists an arguable link between sanitation and tourism, but for which, to-date, very little hard evidence exists. Poor sanitation and hygiene affect tourists in two ways:

1. **Short-term welfare loss and expenses.** Tourists get sick from diarrhea, intestinal worms, hepatitis, etc, which have direct health care costs, and tourists are exposed to environments with poor sanitation, thus resulting in a reduction in holiday enjoyment.
2. **Reduced tourist numbers.** In the longer term, tourists stay away from tourist locations which are deemed to be unsafe (from a health perspective) or unpleasant, due to factors such as unclean water, smelly environment or without proper toilets. Tourists may stay away either because they already had an unpleasant experience themselves in a tourist site and choose not to come back; or they have been recommended not to visit a location due, among other things, to poor sanitation.

This present study attempts to explore these two impacts via a survey of non-resident foreign visitors. As well as holiday tourists, business visitors were also included to get personal views of business visitors and hence make an important link with the business survey (Section 3.5.2). Table 7 presents the sample by origin and type of tourist. A total of 298 holiday tourists and 36 business visitors were interviewed in Siem Reap and Phnom Penh international airports. Respondents were approached in the departure lounge before their flights departed Cambodia. In addition, 51 holiday tourists at a tourist beach in Sihanoukville were interviewed.

In Siem Reap and Phnom Penh International airports, the survey was applied in English. It took five days to reach the sample number for each airport. In Sihanoukville, it required two days to achieve the sample size. In most cases, tourists were approached and the purpose of the questionnaire was explained, and if they agreed, they were given the form to fill out. Survey staff were on call to answer any questions they had in filling out the form. In some cases, tourists preferred to be interviewed. On average, the survey

TABLE 7: SAMPLE SIZES FOR TOURIST SURVEY, BY MAIN ORIGIN OF TOURIST

Tourist nationality	Siem Reap and Phnom Penh International Airport						Sihanoukville			Business and tourist total
	Holiday tourists			Business visitors			Holiday tourists			
	First time visitors	Repeat visitors	Total	First time visitors	Repeat visitors	Total	First time visitors	Repeat visitors	Total	
Europe	87	55	142	1	6	7	19	18	37	186
North America	46	23	69	0	1	1	3	2	5	75
Australia and New Zealand	28	13	41	0	3	3	2	3	5	49
South Asia	10	15	25	1	11	12	3	1	4	41
South & East Asia	7	9	16	0	12	12	0	0	0	28
Other	3	2	5	0	1	1	0	0	0	6
Total	**181**	**117**	**298**	**2**	**34**	**36**	**27**	**24**	**51**	**385**

took 10 to 15 minutes to be completed. The survey form included questions on the following topics:

- Length of trip, places stayed and price category of hotel
- Level of enjoyment of different locations visited, and reasons
- Sanitary conditions of places visited, and availability of toilets
- Water and sanitation-related sicknesses suffered, perceived sources, days of sickness, and type and cost of treatment sought
- Major sources of concern for the holiday stay in Cambodia
- Intention to return to Cambodia, recommendation to friends, and reasons

3.5.2 BUSINESS SURVEY

As well as tourism, poor sanitation has the potential to affect businesses. Two types of impacts are relevant, the local-level "micro" impact, and the higher-level "macro" impact:

1. Businesses located in areas with poor sanitation may pay higher costs (e.g. having to pay more to access clean water) or lose income (due to customers being unwilling to visit the location). It should be noted, though, that the customer losses assessed here are not necessarily absolute losses to the country, as customers may have the choice to go elsewhere – i.e. to other businesses located in other areas.
2. Foreign businesses who decide not to locate in Cambodia. Among the many reasons for deciding whether to locate a business in Cambodia, sanitation may be one of them. There are several pathways through which poor sanitation may affect a business' decision to locate in Cambodia: (a) health of the workforce, due to actual statistics or business leader perceptions of poor health of a nation's workers; (b) poor (perceived) quality of water for use by the business, and the related costs; (c) general poor environment (e.g. solid waste, unsightliness) which affects the ability to do business; and (d) undesirability for foreign staff to be located in Cambodia due to the poor sanitary conditions, among other things.

In order to assess both of these hypothesized effects, a total of 19 businesses were surveyed through face-to-face interviews to fill out a survey questionnaire, and in some cases this led to further discussion. Table 8 shows the number of firms, by sector, and by ownership (local or foreign). These firms were selected based on the link between sanitation and their business, and the importance of the sector and specific firm to the economy of Cambodia. Naturally, the survey of foreign firms was of those firms that have already located in Cambodia, and hence a key category of the firms – those that had decided against locating in Cambodia – did not form part of the sample. However, foreign firms were asked about the factors affecting their decision to locate in Cambodia, and their experiences of the country.

TABLE 8: SAMPLE SIZE FOR BUSINESS SURVEY, BY MAIN SECTORS OF LOCAL AND FOREIGN FIRMS

Main business or sector of firm	Local business	Foreign firm	Total
Travel agency	3	2	5
Hotel	0	2	2
Restaurant	2	1	3
Trading company	1	1	2
Pure drinking water	4	0	4
Food producer	3	0	3
Total	**13**	**6**	**19**

The survey form included questions on the following topics:

- Ownership, sector, activities, employees and location of firm (production, sales, etc)
- Perceptions of sanitation at company location
- Factors affecting decision to locate in country or area, and intention to relocate
- The production and sales costs related to different aspects of poor sanitation (health, water, environment)
- Potential costs and benefits of improved sanitation related to the business

IV. Local Benefits of Improved Sanitation and Hygiene

This chapter presents the following local impacts of improved sanitation and hygiene:

- Health (section 4.1)
- Water (section 4.2)
- Access time (section 4.3)
- Intangibles (section 4.4)
- External environment (section 4.5)

4.1 HEALTH

Poor sanitation and hygiene are an underlying cause of many diseases, which can be viral, bacterial, parasitic, protozoal, helminth and fungal in nature. There are several transmission pathways: fecal-oral, urine-oral, and fecal-eye, of which the most important is fecal-oral. Poor sanitation and hygiene increase the risk of disease transmission from human excreta, summarized in the F-diagram (transmission of pathogens from feces via fingers, fields, fluids and flies, to food, and finally ingested by another person). Poor sanitation and hygiene in relation to human excreta management can mean unsanitary toilet areas, poor personal hygiene practices following toilet going, open defecation, and a lack of latrines and water source protection in flood-prone areas. Latrines that do not have a cover to provide privacy and that are not near the house are also considered unimproved.

Diseases directly caused by poor sanitation and hygiene included in the study are diarrheal diseases, helminthes, scabies, and trachoma, while "indirect" diseases (which result from diarrhea) include malnutrition, malaria, measles and acute lower respiratory infection (ALRI). It should be noted that indirect diseases only measured for children under five years old, as they are especially vulnerable to becoming malnourished due to diarrhea and suffering from sequelae diseases.

According to the ESI Phase 1 study "Economic impacts of sanitation in Cambodia," an estimated 10 million cases of diseases were attributed to poor sanitation and hygiene in 2005. This confirms improved sanitation and hygiene as a key component of development policy, and can lead to major health gains and cost savings and contribute to poverty reduction, especially in Cambodia's rural areas.

4.1.1 DISEASES FROM POOR SANITATION AND HYGIENE

In rural areas, it is estimated there are annually 2.30 cases of disease per person and an annual risk of death per person of 0.005 (five per thousand) due to poor sanitation and hygiene. When weighting the disease cases by the length of time someone spends being ill per disease case and the impact on quality of life, this is equivalent to 0.084 disability-adjusted life-years (DALY) per person per year. In other words, compared to a completely healthy state of 1.0, a person living with unimproved sanitation and hygiene has a health-related quality of life reduced to 0.916. In urban areas, the annual case of disease per person is slightly lower at 1.69 and the annual risk of death per person is 0.004 due to poor sanitation and hygiene. Also, the DALY per person per year is at 0.069.

To some extent, quality of life impacts associated with morbidity are reflected in the DALY calculations above, and in the estimates of health care and productivity costs (see later sections). The disability weight is 0.105 for diarrhea, as in the study the mild diarrhea data are conservatively used to represent general diarrhea. Also, the quality of life weight is 0.006 for helminthes, 0.056 for scabies, 0.581 for trachoma, 0.002 for malnutrition, 0.191 for malaria, and 0.275 for ALRI. The length of disability is assumed to be 5 days per case for diarrhea, scabies, ALRI and malaria; 182 days per case of malnutrition; and 365 days per year (i.e., continual) for helminthes and trachoma. While some diseases such as trachoma have a higher impact on quality of life, and some diseases have a longer duration (e.g. trachoma and helminthes), diarrheal disease contributes the most to the DALY burden due to its high incidence.

TABLE 9: DISEASE RATES ATTRIBUTABLE TO POOR SANITATION AND HYGIENE, 2008

Disease	Rural sites			Urban sites		
	Cases/person	Deaths/1000 people	DALYs/ person	Cases/person	Deaths/1000 people	DALYs/ person
DIRECT DISEASES						
Diarrhea (under 5)	3.58	5.92	0.0806	1.83	3.02	0.0427
Diarrhea (5-14)	0.52	0.13	0.0007	0.52	0.13	0.0007
Diarrhea (15+)	0.26	0.13	0.0055	0.26	0.13	0.0004
Helminthes (under 5)	0.30	0.20	0.0043	0.30	0.20	0.0043
Scabies (all ages)	0.02	-	0.0000	0.02	-	0.0000
Trachoma (all ages)	0.03	0.02	0.0144	0.03	0.02	0.0144
INDIRECT DISEASES ATTRIBUTED TO POOR SANITATION (ONLY CHILDREN UNDER 5)						
Malnutrition	0.20	-	0.0002	0.18	-	0.0002
Malaria	0.00	0.65	0.0079	0.00	0.61	0.0074
ALRI	0.11	1.13	0.0143	0.11	1.07	0.0134
Measles	-	0.25	0.0030	-	0.25	0.0030
Other indirect	-	0.90	0.0110	-	0.90	0.0110
All (average for all age groups)	**2.31**	**5.21**	**0.0842**	**1.695**	**4.14**	**0.0686**

4.1.2 HEALTH CARE COSTS

Health care costs are estimated based on disease cases, the proportion of illnesses treated by each provider, and the unit costs associated with each provider.

Table 10 shows treatment seeking for diarrheal diseases from the 2004 and 2007 Cambodia Socio-Economic Surveys (CSES). In 2007, 66% of diarrhea patients sought treatment from various providers, 21% performed self treatment, while another 13% did not seek treatment. The data suggest that 37% of people with diarrheal cases seek care from public providers and private clinics, while 13% seek informal care. Annex Table B4 shows treatment seeking behavior for other sanitation- and hygiene-related diseases. For diarrheal disease, 34% of cases either self-treat or do not treat at all. This reflects the nature of diarrheal disease; that people often prefer to treat themselves with their own medication at home, or just wait for the symptoms to go away. Regarding the inpatient admission rate, the percentage of admissions of children under five with diarrheal disease is 10.8%, 2.5% for those between five and 14 years old, and 3.0% for those aged 15+. For malaria, the rate is 31.8% for children under five, while the rate for ALRI is 10.3%[9].

Unit costs for treatment of diarrheal disease are provided in Table 11, by health care provider. In Cambodia, government subsidies to health care mean that out-of-pocket payments from the patient is lower than the full cost of the service. However, in this study, the cost for public health care includes all costs, including staff salary, building, drugs, and other costs, which are combined to amount to the full cost of treating a disease.

For outpatients, the public providers cost is US$2.1 per patient for diarrheal diseases (the average of mild and severe cases) while the formal private providers cost is US$3.1. The cost of informal treatment is around US$1.8 per patient. Inpatient cost of diarrheal disease for public providers is US$6.3 per patient day, which is considerably lower than for formal private providers at US$16.0. Annex Tables B5, B6, B7 and B8 also show the unit cost of treatment of other non-diarrheal sanitation- and hygiene-related diseases by different health providers.

[9] The calculation is based on the data from the National Health Statistic Report 2008.

TABLE 10: TREATMENT SEEKING BEHAVIOR FOR DIARRHEAL DISEASE FOR ALL AGE GROUPS

Data source	% seeking treatment from					No treatment	Total
	Public provider	Private formal clinic	Informal care	Pharmacy	Self-treatment		
CSES 2007	21%	16%	13%	15%	21%	13%	100%
CSES 2004	11%	9%	16%	n/a	35%*	29%	100%

* This category includes other forms of treatment (pharmacy and others). Note: categories of CSES 2004 are different from CSES 2007.

TABLE 11: UNIT COSTS ASSOCIATED WITH TREATMENT OF DIARRHEA BY HEALTH CARE PROVIDER (US$, 2008)

Health provider	Outpatient cost (US$)		Inpatient cost (US$)		
	Health care	Incidentals[1]	Average length of stay (days)	Health care (per day)	Incidentals[1]
PUBLIC/NGO					
Rural	2.1	1.2	3.5	6.3	1.2
Urban	2.1	0.7	3.5	6.3	0.7
PRIVATE FORMAL					
Rural	3.1	1.2	3.5	16.0	1.2
Urban	3.1	0.7	3.5	16.0	0.7
INFORMAL					
Rural	1.8	1.2	-	-	-
Urban	1.8	0.7	-	-	-

Source: ESI-1 report & ESI-2 survey, WHO Choice website (http://www.who.int/choice/country/khm/cost/en/index.html) and report by Ministry of Health and USAID "Cost and Funding Projections for the Minimum Package of Activities for Health Centers".
[1] Incidentals include non-health patient costs such as transport, food, and incidental expenses, per outpatient visit and per inpatient stay.

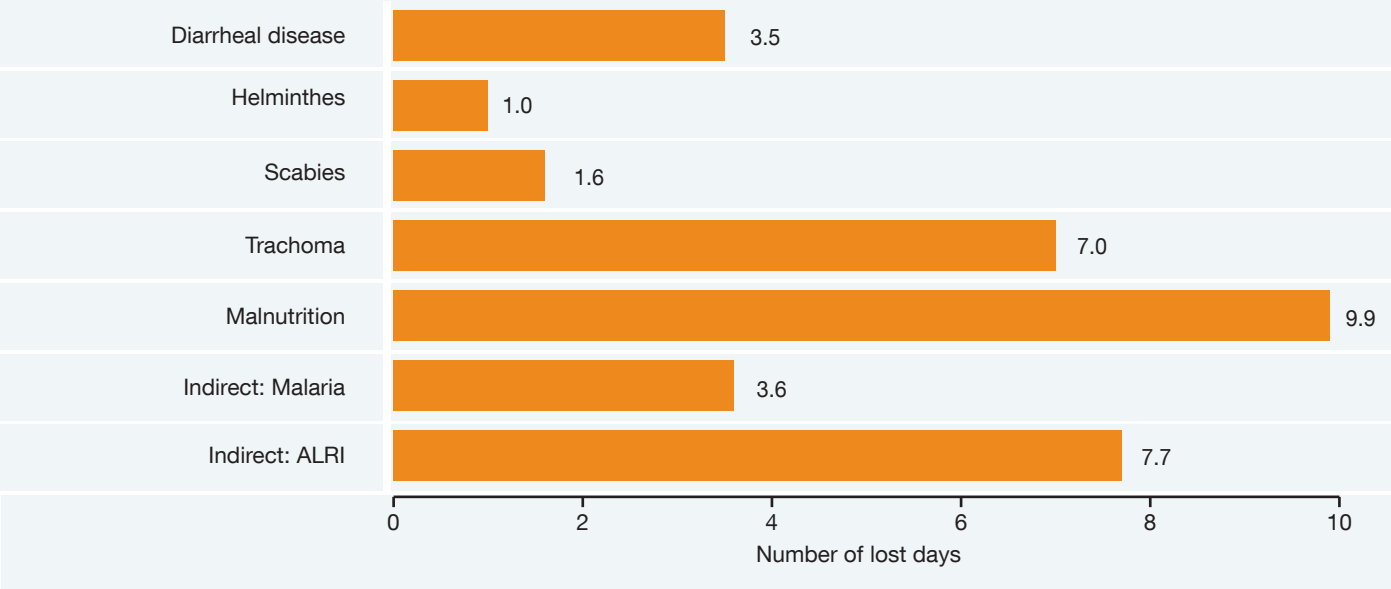
TABLE 12: AVERAGE HEALTH CARE COST PER PERSON PER YEAR IN RURAL/URBAN FIELD SITES, BY DISEASE AND AGE GROUP (US$, 2008)

Disease	Rural			Urban		
	0-4 yrs	5-14 yrs	15+ yrs	0-4 yrs	5-14 yrs	15+ yrs
Diarrheal disease	19.3	2.0	1.0	8.8	1.8	0.9
Helminthes	0.1	0.2	0.1	0.1	0.1	0.1
Scabies	0.1	0.1	0.0	0.1	0.0	0.0
Trachoma	0.1	0.1	0.1	0.1	0.1	0.1
Malnutrition	0.7	-	-	0.5	-	-
Malaria	0.1	-	-	0.0	-	-
ALRI	1.0	-	-	0.8	-	-
Total	**21.4**	**2.3**	**1.3**	**10.5**	**2.0**	**1.2**

Source: Authors' calculations.

Table 12 shows the annual average health care costs per person attributed to poor sanitation and hygiene in Cambodia, by disease and age group. Diarrheal disease is the costliest sanitation-related disease for people of all ages, especially children under five years old. In general, the costs of health care in both rural and urban projects are very similar for many diseases, except diarrhea. Children under five bear the highest economic cost. In rural areas, the cost of diarrhea treatment for children under five is US$19.3 per year compared to US$8.8 in urban areas. For other diseases, the costs of health care for children under five are always higher than those of other age groups as they are more vulnerable to sanitation-related diseases and have more incidences.

FIGURE 5: NUMBER OF ILLNESS DAYS, BY TYPE OF DISEASE FOR CHILDREN UNDER FIVE



Note: For diseases where incidence is measured, the chart shows the days lost per case. For the diseases where prevalence is measured (i.e. helminthes and malnutrition), the chart reflects the average days lost per year.
Source: ESI-1 report, ESI-2 household survey.

TABLE 13: AVERAGE PRODUCTIVITY COST PER PERSON PER YEAR IN FIELD SITES, BY DISEASE, AGE GROUP AND RURAL/URBAN LOCATION (US$, 2008)

Disease	Rural			Urban		
	0-4 yrs	5-14 yrs	15+ yrs	0-4 yrs	5-14 yrs	15+ yrs
Diarrheal disease	7.7	1.1	1.1	3.9	1.1	1.1
Helminthes	0.2	0.2	0.3	0.2	0.2	0.3
Scabies	0.0	0.0	0.0	0.0	0.0	0.0
Trachoma	0.1	0.1	0.2	0.1	0.1	0.2
Malnutrition	2.4	0.0	0.0	2.2	0.0	0.0
ALRI	0.5	0.0	0.0	0.5	0.0	0.0
Total	**10.9**	**1.4**	**1.7**	**7.0**	**1.4**	**1.7**

4.1.3 PRODUCTIVITY COSTS

Depending on the type and severity of a health condition, poor health can lead to lost productive time. The loss of productive time is not only for the patient but also for the care taker, who spends time taking care of the patient at home as well as visiting the hospital. The value of time spent sick will vary by case, depending on the activities that have to be canceled or postponed, and in the case of productive workers, whether someone else is available to temporarily substitute for them. This is more possible in subsistence agricultural work than in paid or salaried work. Figure 5 illustrates the loss of productive time per case, by disease.

According to Figure 5, malnutrition causes the most number of lost days, affecting children under 5 and thus the productive time available for their caretakers. It is also noted from the ESI household survey that it takes around four hours per day for caregivers to take care of children with acute diseases such as malaria and diarrhea. The productive days lost due to diarrheal diseases are about 3.5 days per case (for both diarrhea and malaria). Therefore, the loss of time from sanitation-related diseases shows that poor sanitation does not only cause financial losses but non-financial ones.

TABLE 14: AVERAGE MORTALITY COST PER PERSON PER YEAR IN FIELD SITES FOR EACH DISEASE AND AGE GROUP AND RURAL/URBAN LOCATION (US$, 2008)

Disease	Rural			Urban		
	0-4 yrs	5-14 yrs	15+ yrs	0-4 yrs	5-14 yrs	15+ yrs
Diarrheal disease	44.4	1.5	1.6	22.7	1.5	1.6
Helminthes	1.5	0.0	0.0	1.5	0.0	0.0
Trachoma	0.2	0.2	0.3	0.2	0.2	0.3
Malaria	4.9	-	-	4.6	-	-
ALRI	8.5	-	-	8.0	-	-
Total	**59.5**	**1.7**	**1.9**	**37.0**	**1.7**	**1.9**

Table 13 shows the average cost per person per year due to the loss of productive days for each disease. In rural areas, diarrheal disease costs an average US$7.7 in caregiver time loss per year for caring for children under five, while it is US$3.9 in urban areas. Since children under five are considered not yet having productive activities and they need people to take care of them, the cost due to time loss would be borne by their carers. Malnutrition in children under five years leads to caregiver time losses which are valued at US$2.4 per year in rural areas and US$2.2 in urban areas, while ALRI costs US$0.5 in both rural and urban areas. The losses are higher for children under five years due to the higher rates of disease in this age group.

4.1.4 MORTALITY COSTS

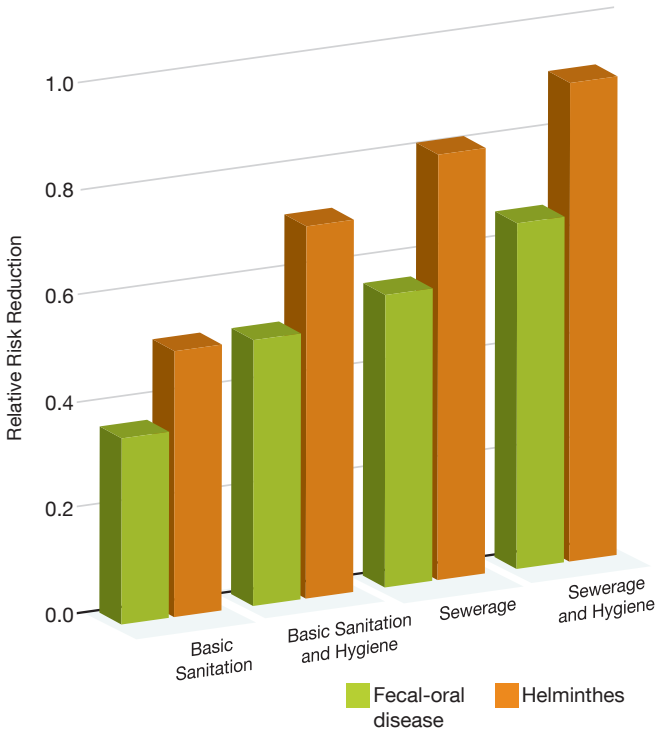
Table 14 gives the mortality cost per person per year by disease and age group. The result shows that in rural areas, diarrheal diseases are still observed to be the costliest disease for all age groups, especially children under five, followed by ALRI and malaria. However, in urban areas, the costs are slightly lower than those in rural areas for all diseases. It should be noted that the mortality cost from poor sanitation and hygiene conditions is mainly incurred by children under five for every disease.

In rural areas, the loss from premature death of children under five amounts to US$44.4 per person per year for diarrheal disease, and US$22.7 in urban areas. For the age group of 5-14 years, this falls to US$1.5, and for the above 15 age group it is US$1.6 for both urban and rural areas. The lower premature death cost for other age groups is due to the lower probability of death from the disease for other age groups. With attribution to poor sanitation and hygiene, ALRI mortality cost among children under five is about US$8.5 per person per year in rural areas and US$8.0 in urban areas, and malaria costs US$4.9 and US$4.6 per person per year for rural and urban areas, respectively.

4.1.5 AVOIDED HEALTH COSTS

Central to the arguments of improving sanitation and hygiene are the health benefits. Limited evidence exists on the actual impact of sanitation or hygiene programs on health outcomes in Cambodia and this study draws on international evidence. Figure 6 below shows the risk reduction associated with different sanitation and hygiene interventions for fecal-oral diseases and helminthes, compared to a baseline of no improved sanitation (either open defecation

FIGURE 6: RELATIVE RISK REDUCTION OF FECAL-ORAL DISEASES AND HELMINTHES OF DIFFERENT RISK EXPOSURE SCENARIOS



or unimproved sanitation). Two sanitation interventions are modeled in this study: basic sanitation, which is relevant for mainly rural areas; and sewerage, which is relevant exclusively for urban areas. Hand washing is added to each sanitation intervention, leading to an incremental health gain. In this study, basic sanitation is assumed to reduce fecal-oral diseases by 36%, and also with hand washing by 50%. Well functioning sewerage and wastewater treatment systems reduce fecal-oral diseases by 55%, and also with hand washing by 65%. Given the lack of evidence on the specific determinants of health effects (whether at the level of individual behavior change or community behavior change), the health efficiency of different program approaches cannot be compared in this study[10].

While the ESI-2 survey was not structured and did not have sufficient sample size to estimate the health impacts of the sanitation projects, households were asked if they had noticed a change in diarrheal disease rates since installation of their latrine. For households with dry pit latrines, 53% reported a drop in diarrheal disease after they installed pit latrines in their houses, while 47% reported no change. In contrast, 89% of households with wet pit latrines in rural areas reported a perceived reduction in diarrheal disease cases. In rural areas, the response "Probably less" on the diarrheal disease impact was reported more commonly than the response "A lot less."

For households with toilets in urban areas, the reporting of a decrease in diarrheal disease was 77.5% with septic tanks alone and 80.7% with sewerage. Contrary to rural areas, the response "A lot less" was reported more than "Probably less." Although the result suggests about one in five urban households did not observe a change in diarrheal incidence, other disease determinants should be noted, such as environmental sanitation and hygiene practices. What is also interesting is that while in theory there is little or no impact on diarrheal reduction by upgrading wet pit latrines to a sewer connection, households' reported perception suggests that the diarrhea incidence is a lot less when they upgrade

TABLE 15: PERCEIVED DIFFERENCE IN DIARRHEAL INCIDENCE SINCE IMPROVED SANITATION, IN ALL FIELD SITES

Sanitation coverage	Households in sample	Answer to question "have you noticed an observable change in diarrheal disease rates in any household members since you received the new latrine?"				
		A lot less	Probably less	No	Probably more	A lot more
RURAL						
From OD to dry pit	254	17.7%	35.4%	46.9%	0.0%	0.0%
From OD to wet pit	252	37.3%	52.0%	10.3%	0.4%	0.0%
URBAN						
From OD to latrine connected to septic tank/wet pit	151	54.3%	23.2%	22.5%	0.0%	0.0%
From private wet pit to sewerage connection	114	44.7%	36.0%	19.3%	0.0%	0.0%

TABLE 16: ANNUAL HEALTH-RELATED COSTS PER HOUSEHOLD OF POOR SANITATION AND HYGIENE, AND ANNUAL COSTS AVERTED OF IMPROVED SANITATION (US$, 2008)

Costs	Costs (baseline risk)		Costs averted			
	Rural	Urban	Rural (OD to basic sanitation wet latrine)	Rural (OD to basic sanitation dry latrine)	Urban (OD to basic sanitation with septic tank)	Urban (Private wet pit to sewerage)
Health care	16.9	9.5	5.3	6.9	5.3	1.9
Productivity	12.4	9.9	4.2	5.0	5.9	2.1
Death	36.3	19.8	11.5	14.8	11.2	4.0
Total	**65.7**	**39.2**	**21.1**	**26.7**	**22.4**	**8.0**

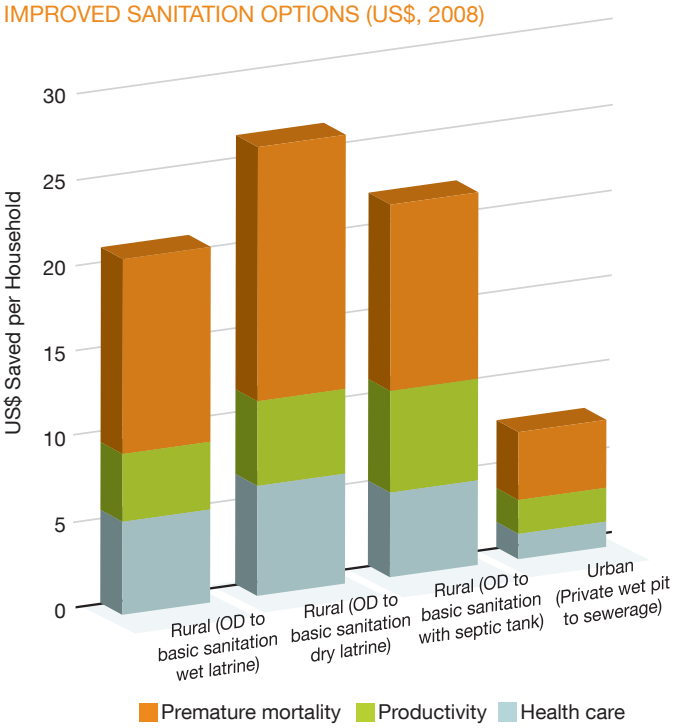
[10] For example, some projects – most notably CLTS – aim for greater community coverage, but with households often using traditional pit latrines – while other projects provide fewer households with higher ladder sanitation options.

the latrine system. Nearly 45% of respondents said that they have a lot less diarrhea after upgrading their latrine. This may indicate the preference of people toward a sewage connection rather than actual diarrheal disease reduction actually experienced. However, these findings are inconclusive due to small sample sizes, and for the calculations on averted health costs the relative risk reductions from the international literature are used.

Table 16 summarizes annual health-related costs of poor sanitation and hygiene per household and costs averted through improving sanitation and hygiene in field sites. The costs are related to health care cost, productivity loss, and premature death. Due to poor sanitation and hygiene, a household in a rural area would spend around US$17.0 on health care which is nearly twice as high as in urban areas. Regarding productivity loss, it would cost a household in rural areas about US$12.4 and US$10.0 in urban areas. Also, the cost of premature death, which is the largest part of the health-related costs, costs a rural household US$36.3 compared to only US$19.8 in an urban household due to the better pre-existing connditions and hygiene conditions of the urban sites. In total, poor sanitation and hygiene cost a rural household US$65.7 per year and an urban household US$39.2.

The costs averted from improving sanitation and hygiene vary depending on the location, the baseline sanitation, and the health status in the area, presented in Figure 7. A rural household moving from practicing OD to basic sanitation would enjoy an average saving of US$21.1 per year for wet latrines and US$26.7 per year for dry pit latrines, while for an urban household the annual cost reduction is US$22.4. For an urban household already having basic sanitation and hygiene and moving to a sewerage connection, the cost reduction is US$8.0 per year. The average saving for a rural household is US$23.9 for both dry and wet pit latrines. Therefore, improving sanitation in rural areas brings greater average benefits than urban areas due to the lower baseline (starting) coverage, and worse health statistics – and hence greater potential for gain. More importantly, improving sanitation from OD to a basic sanitation facility such as dry latrines in rural areas brings about greater health benefits than improving from OD to a wet latrine. The greater health benefit of adopting a dry latrine is mainly attributed

FIGURE 7: HEALTH COST AVERTED PER HOUSEHOLD OF IMPROVED SANITATION OPTIONS (US$, 2008)



to the fact that the adoption of a dry latrine is pervasive in the study areas (CLTS under Plan International and subsidized hardware and full coverage under World Vision) which normally have high sanitation coverage reflecting the benefit of collective action on sanitation improvement in the community. So, regardless of the toilet system the health benefit is more or less the same as long as coverage rates increase towards full coverage. It is also interesting to note that improving sanitation from OD to basic sanitation reduces health-related costs much more than connecting households already having a private toilet to a sewerage system. The huge additional benefit for a sewerage connection is, however, related to convenience, status and environmental improvement that are not quantified in this study.

4.2 WATER

Cambodia is relatively "water rich." In 2008, internal freshwater resources per capita were 8,282 m^3, which is significantly higher than other, larger, Asian countries such as India (1,105 m^3) and China (2,124 m^3)[11]. The Mekong River is the major water source for the country at 540 km long with a flow of 66,700 m^3 per second in the wet season and 1,250 m^3 in the dry season, and Tonle Sap Lake has a total volume of 70 billion m^3 with a surface area of 1,300 km^2 in the dry season and 2,500 km^2 in the wet season.

[11] Source: World Bank website: http://data.worldbank.org/indicator/ER.H2O.INTR.PC.

Biological oxygen demand in many of these inland water resources is high, from agriculture, industry and domestic sources. The ESI Phase 1 study estimated that, in 2005, domestic sources contributed 497 tons per day of BOD to inland water sources, from an estimated 234 tons of feces, 2,335 m^3 of urine, and at least 8,154 m^3 of gray water (mainly urban populations). As well as BOD, there is bacteriological and pharmaceutical contamination of water resources.

With small populations and abundant water resources, pollutants would be diluted naturally. However, given the high density of population in many parts of Cambodia – i.e., 261 persons/km^2 in the plain region in 2008, 64 persons/km^2 in the Tonle Sap lake region, – sufficient dilution is not guaranteed, and water quality indicators presented below suggest that significant pollution is taking place. Furthermore, over-extraction of some rivers and water sources for irrigation purposes leads to greater pollution of the water resources. Indeed, there is increasing evidence of pollution in surface, ground and coastal waters.

4.2.1 WATER RESOURCES

Table 17 summarizes water resources in the five field sites. These water sources are currently accessed by populations living in those locations. Generally speaking, for urban and rural areas, the available water sources are canals, lakes, and wells. In addition to these water sources, rural areas have rivers, which have a greater volume of water availability. In particular, some communes of the studied locations that have more than 300 wells are Rom Chek, Kok Dong commune of Siem Reap province, and Sangkat II of Sihanoukville.

4.2.2 WATER QUALITY AND ITS DETERMINANTS

To highlight the water quality of various water sources tested in the rural projects, Figure 8 compares a number of dug wells tested in three rural projects and boreholes in the fourth rural project, for two indicators of water quality: Escherichia coli (E.coli) and turbidity. Full results are shown in Annex C. It is interesting to note that dug wells have only a low level of turbidity but they have a significant amount of E.coli. For instance, the second dug well has 100 colony-forming units (CFU) per 100 milliliters of water. Most turbidity levels do not exceed the national standard of five.

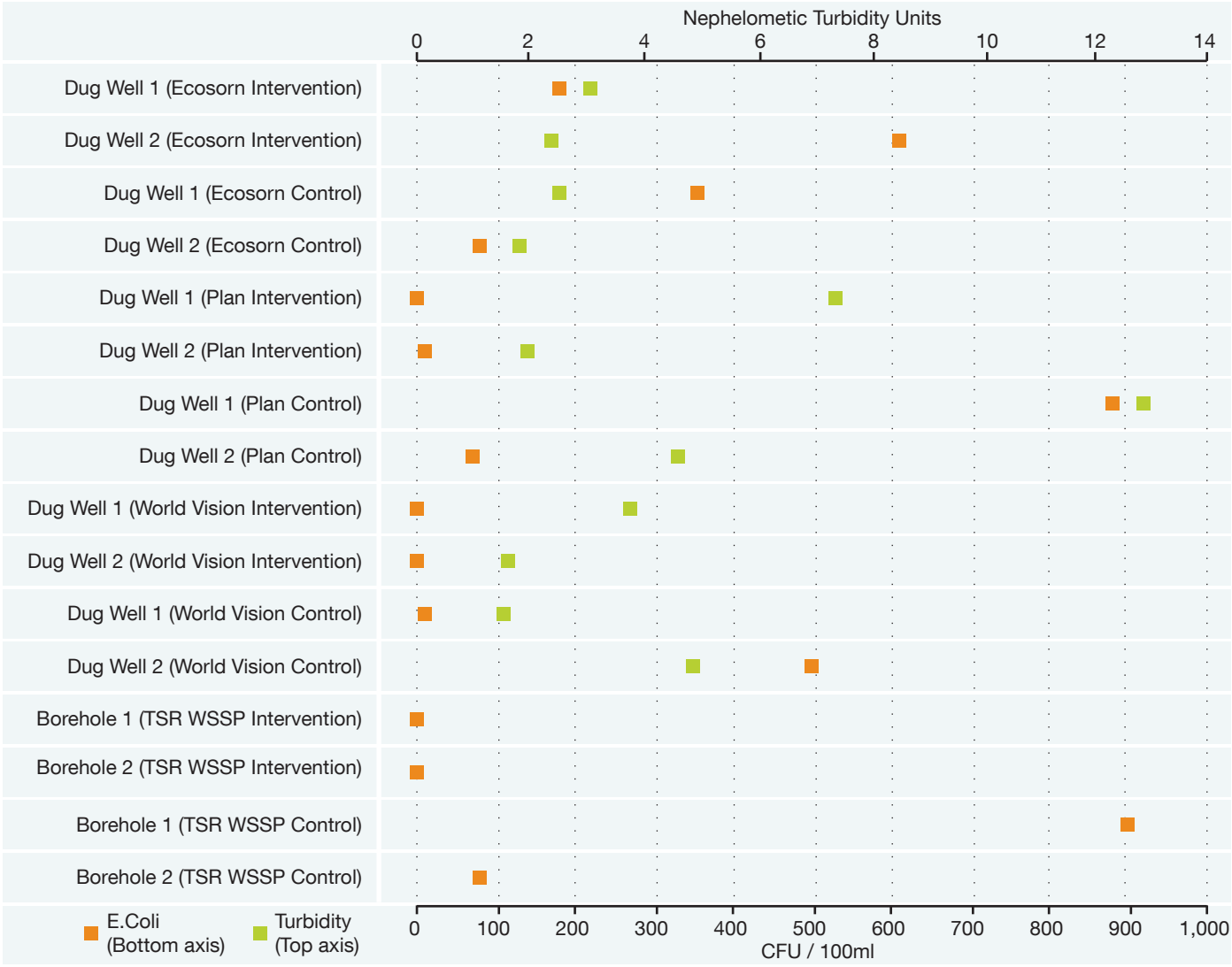
The E.coli reading in field sites of each project is shown in Figure 9. One intervention village and one control village were tested for their water quality and only dug wells are presented here. In control villages there is no sanitation project activity and rates of open defecation are signficantly higher than intervention villages. Generally, dug wells in control villages have more E.coli than those in interven-

TABLE 17: WATER RESOURCES IN SELECTED LOCATIONS OF FIELD SITES

Field sites	Location (village/commune)	Water source			
		River	Canal	Lake	Well
ECOSORN (rural)	Andeuk Heap village	1	0	0	47
Plan International (rural)	Chobtatrav commune	0	2	1	130
	Rom Chek commune	1	2	0	350
	Don Peng commune	1	0	4	120
World Vision (rural)	Kon Kaek village	0	0	2	n/a
	Veal Veng village	0	0	1	29
	Char village	0	1	1	23
TSRWSSP (rural)	Prey Chrok village	1	0	2	35
	Kok Dong commune	0	1	2	305
	Ta Los commune	0	1	3	267
SHV treatment plant (urban)	Sangkat II	0	1	0	372
	Sangkat IV	0	5	0	n/a
	Sangkat III	0	2	1	57

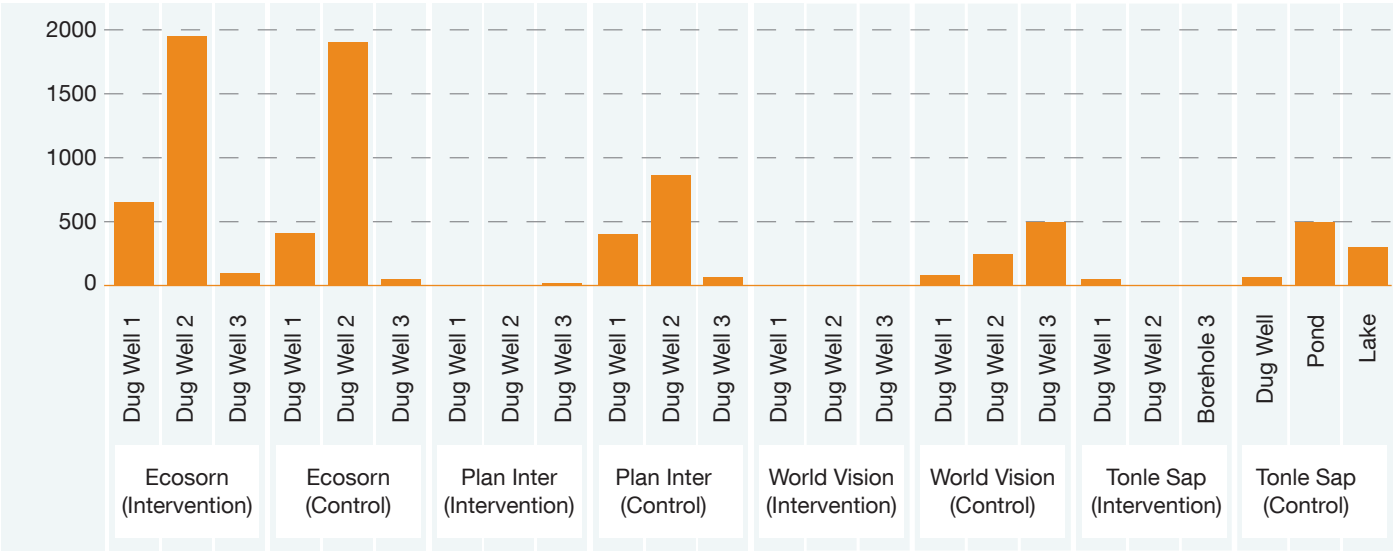
n/a - information not available

FIGURE 8: SELECTED WATER QUALITY READINGS, TSRWSSP SITE



Note: the turbidity in tube wells is not measured here.

FIGURE 9: E.COLI READINGS IN FIELD SITES, BY SANITATION COVERAGE

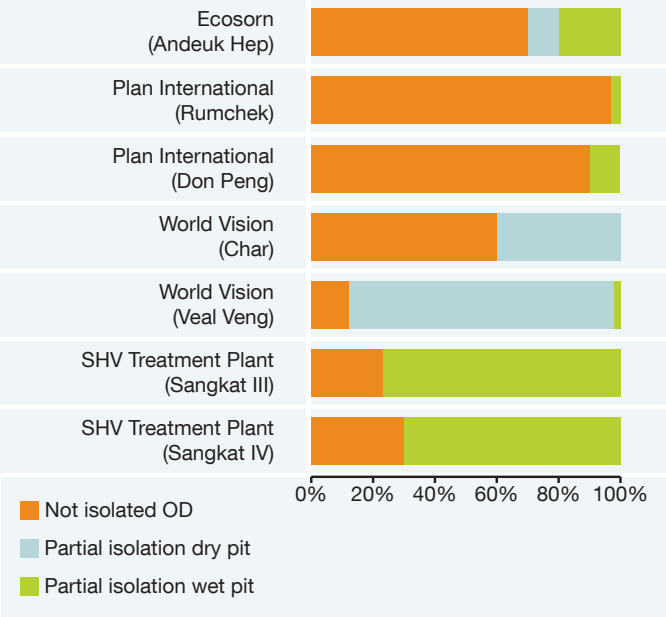


tion villages. For the World Vision project, E.coli readings in dug wells in control villages appear to be higher than intervention villages. E.coli in Ecosorn villages is relatively high if compared with other villages in other projects. Dug wells in both intervention and control villages tested in the Ecosorn project have high E.coli while those in other projects are lower. Figure 9 gives a general trend where the presence of pathogens in the water sources in intervention areas is less than that in the control areas. This may be due to the fact that fecal matter is better contained in areas with high sanitation coverage than in areas with lower coverage, and thus lowering the chance of contaminating water sources. However, the comparison between control and intervention villages is indicative, but does not scientifically prove that the sanitation intervention is effective. Despite the trend, a thorough sanitary survey is required to assess the cleanliness of the immediate environment, the source of pollution, and a pathway for contaminants to reach the water source, if a linkage between sanitation and a water source is to be explored. Such a comprehensive survey was not included in this study.

In Figure 10, the extent of human excreta isolation is illustrated at the commune level of some projects. Due to the limitation of data, only selected communes are presented here. It is observed that communes in the Plan International project area and one commune in the Ecosorn project area have higher rates of people practicing OD if compared with those of other projects. In contrast, the communes in the SHV treatment plant project have a high coverage of wet pit latrines.

The high level of OD practice means that excreta have a higher potential to be exposed to human beings and reflect the level of sanitation conditions in the commune. Also, the partial isolation indicates that sanitation could be further improved to achieve complete isolation.

FIGURE 10: EXTENT OF ISOLATION OF HUMAN EXCRETA AT COMMUNE LEVEL BY PROJECTS



4.2.3 HOUSEHOLD WATER ACCESS AND ACCESS COSTS

Table 18 presents the figures on access to water and associated access costs by households in rural and urban field sites. One of the major impacts of polluted water in wells, springs, rivers and lakes is that populations and water supply agencies will have to treat water, or if already treated – to treat water more intensively - for safe human use. Alternatively, populations and water supply agencies can access cleaner water from different and more distant sources, thus increasing access costs. Those who do not take precautionary measures are exposed to a higher risk of infectious disease, or poisoning due to chemical content.

Piped water can only be accessed by 30% of urban households interviewed in Sihanoukville's wastewater management project, so non-piped protected water is the primary source for both rural and urban areas, and serves 80% of the

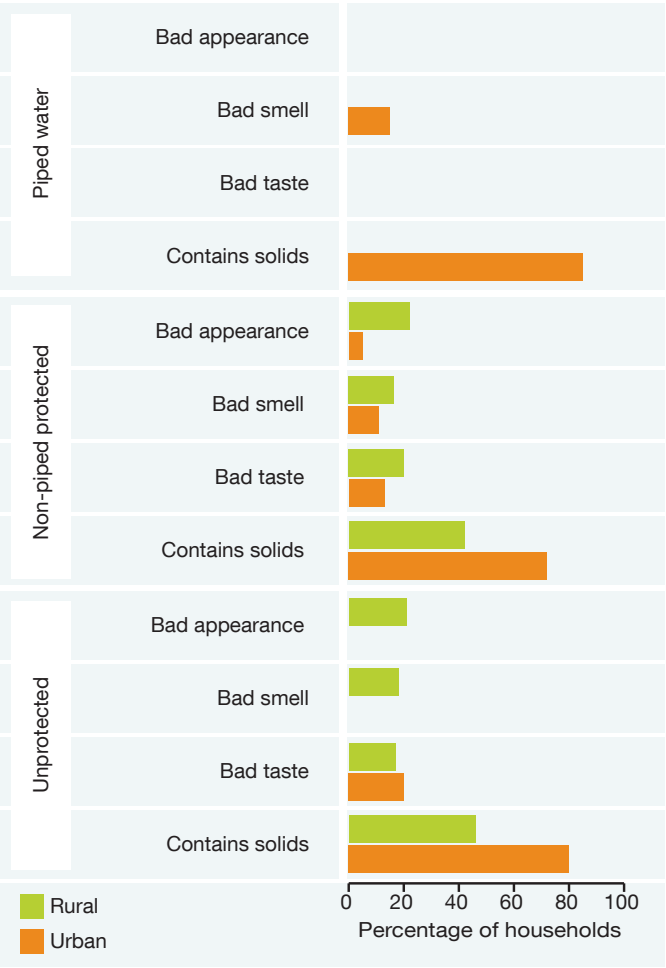
TABLE 18: WATER ACCESS AND RELATED COST PER HOUSEHOLD

Water source	Variable	Rural site	Urban site
Piped water	% access	0%	30%
	Average monthly cost	-	US$ 8.6
Non-piped water	% access	80%	56%
	Average monthly cost	US$ 7.7	US$ 3.7
Unprotected	% access	20%	14%
	Average monthly cost	US$ 3.0	US$ 1.6

rural population and 56% of the urban population. Similarly, unprotected water sources are still used by 20% of rural and 14% of urban populations, respectively. As rural populations largely depend on non-piped protected water sources, the access cost per month is US$7.7 (including the value of collection time) whilst the urban populations spend US$3.7. In particular, urban populations on average pay US$8.6 per month to access piped water. The cost estimated here includes both the financial cost and the access cost/time in collecting/obtaining water.

Figure 11 presents key characteristics of poor water quality cited by rural and urban households. Both rural and urban populations have similar perceptions about the characteristics of poor quality water. According to the survey, particle solids are usually cited as a major contaminant, especially for urban areas, where sediments are the main concern for users of piped water sources, non-piped protected water sources, and unprotected water sources. On the other hand, non-piped protected and unprotected water sources in both rural and urban areas are perceived to have other issues besides sediments. Sediments in non-piped protected water sources are cited as a pollutant by around 70% of urban households and 40% of rural households. In addition to sediments, the poor quality of non-piped protected water is also a cited concern in terms of bad appearance (22% of rural households), bad smell (16% of rural households) and bad taste (20% of rural households and 13% of urban households). For unprotected water sources, sediments are considered the main pollutant by about 80% of urban households, and 45% of rural ones. Besides this, the rural population cites bad appearance, smell and taste, and solids, while the urban population only mentions bad taste and solids.

FIGURE 11: RURAL AND URBAN HOUSEHOLDS CITING POOR WATER QUALITY FROM THEIR PRINCIPAL DRINKING WATER SOURCE



4.2.4 HOUSEHOLD RESPONSE TO CONTAMINATED WATER AND RELATED COSTS

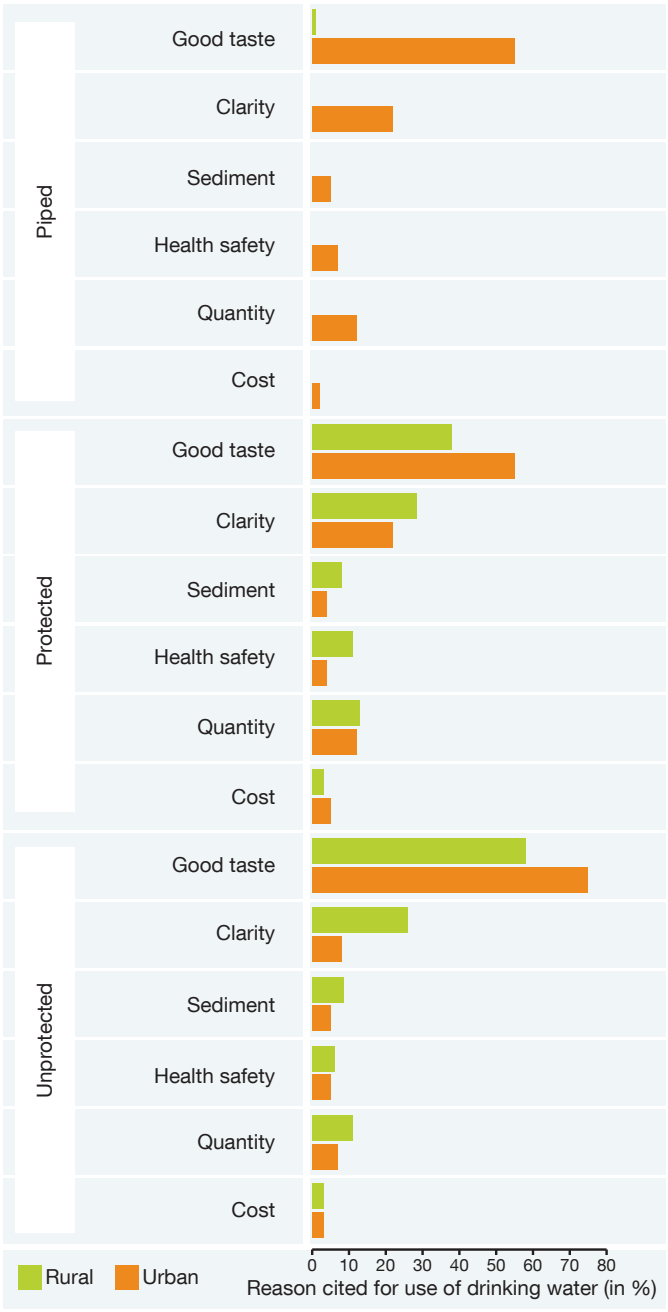
Figure 12 presents the rationale behind households' decision to use a particular water source. Households may respond to traditional water sources they know to be polluted in one or more of several ways: changing purchased source of water, walking further to haul free water, or water treatment. They may connect to a piped water source (if available and affordable), they may harvest rainwater, or they may purchase bottled water or bring in a tanker (more so in urban areas).

Data presented in Figure 12 show that people choose to use a water source by paying much attention to its taste. For a piped water source, which is available in only urban areas, 55% of households using a piped water source cite good taste as the main reason to use piped water as their water source, followed by clarity and quantity, which represent 21% and 12% respectively.

Similarly, a majority of households in both rural and urban areas cited good taste as their main reason to choose protected water sources followed by clarity, quantity, and others. Fifty-four percent of households in urban areas cite good taste as the main reason for using the current protected water sources, while it is only 37% for households in rural areas. Clarity is also mentioned as the second main reason for using the water sources. Twenty-eight percent of

households in rural areas and 21% in urban areas cite water clarity as one of the main reasons for using protected water sources. Clearly, urban households place higher importance on taste than rural households, and vice versa for the water clarity issue. More interestingly, 12% of rural households consider the health aspect as the main reason for choosing a protected water source while it is only 4% for urban households.

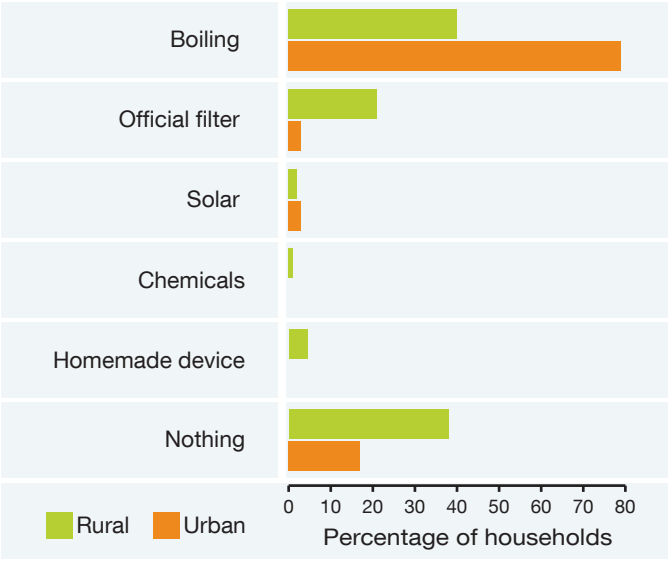
FIGURE 12: PRIMARY CITED REASONS FOR HOUSEHOLDS USING THREE CATEGORIES OF WATER SOURCES (PIPED, PROTECTED, UNPROTECTED)



For an unprotected water source, 47% of rural households and 75% of urban households cite good taste as their main factor for using unprotected water sources such as surface water, unprotected wells, etc. Clarity and quantity are cited by 25% and 11% of rural households, respectively, which are higher than those of urban households. In rural areas, unprotected water sources, such as lakes, ponds and rivers, are most commonly used by households as there is insufficient improved water supply. Even though there are some bore wells in their communities, they sometimes turn to unprotected water sources for drinking and using as they prefer the taste. In conclusion, both rural and urban households consider aspects such as taste, clarity and quantity of water source in choosing a particular water source

Figure 13 illustrates water treatment methods practiced by households in both rural and urban sites. It should be noted that boiling is a common practice for treatment of drinking water. The proportion of urban households boiling water for drinking is about double the proportion of rural households, which are 78% and 40% respectively. An official filter is used minimally by about 3% of urban households while 22% of rural households use it. The high rate of water filters in rural areas is attributed to the fact that many water supply projects in rural areas have introduced water filters to the people as a campaign to promote an alternative water treatment method. As a result, rural people are satisfied treating water by filtering but most of them do not continue using the filter or do not do maintenance after it breaks down. Besides this, solar, chemical, and homemade devices

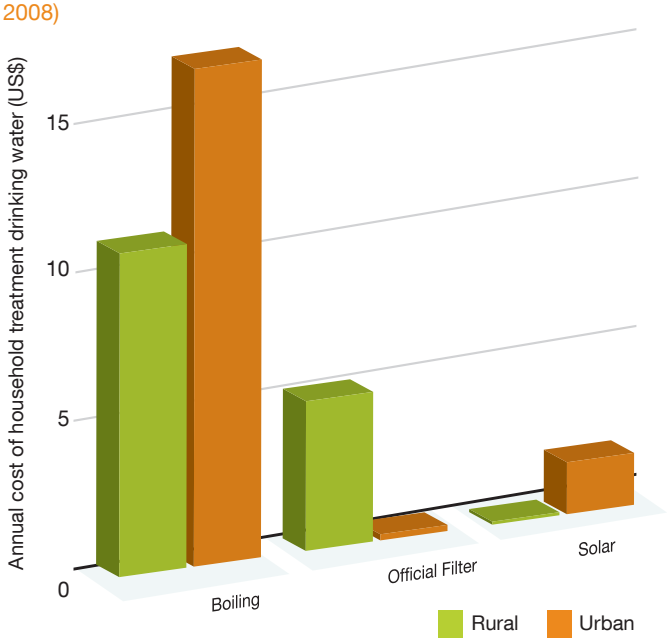
FIGURE 13: HOUSEHOLD WATER TREATMENT PRACTICES



are not commonly used. Thirty-seven of rural households and 16% of urban households do not practice any water treatment. Those who do not practice water treatment can be exposed to a high risk of diarrheal diseases, especially in the areas where feces are not properly contained and disposed of.

In terms of the treatment costs, the cost of water boiling is higher for urban than for rural households as they spend US$16.2 annually to boil water, while rural households spend US$10.4 as presented in Figure 14. This difference between urban and rural households is because urban households pay higher for fuel and wood to boil the water while the rural households get biomass fuel at lower cost by collecting it locally. The annual cost incurred for treating water by official filter is US$4.8 for rural households. Water treatment costs using solar, chemical and other means are negligible.

FIGURE 14: ANNUAL HOUSEHOLD WATER TREATMENT COSTS, BY METHOD AND RURAL/URBAN LOCATION (US$, 2008)



4.2.5 HOUSEHOLD WATER COSTS AVERTED FROM IMPROVED SANITATION

Table 19 presents the costs to householders for water access and treatment, and the averted cost due to improved sanitation. The access cost comprises time spent collecting water and the financial cost in obtaining the water, while treatment cost refers to the cost of making water safer to drink through different household treatment methods. Generally, a rural household spends on average US$128 per annum to access their current water sources, whilst an urban household spends US$167.5. Costs for accessing water do not differ much between rural and urban households because both mostly depend on non-piped protected water. Annually, a rural household spends on average US$5.2 on water treatment but an urban household spends US$12.7. This difference in water treatment cost is because rural households can find firewood to treat water or use low cost water treatment methods, such as an official filter, but urban households must spend considerably more to treat water by boiling.

In rural areas, there are not many easily accessible water sources so sometimes people have to travel to a distant source to fetch water. Also, if a nearby water source, e.g. a tube well, is available, they sometimes do not use it as they prefer the taste or quality of a distant source, e.g. a pond or lake, for drinking. People have to spend a lot in accessing and treating water, in this case. This high cost, however, can be averted by improving the sanitation situation in the communities. This means that 100% improved sanitation coverage in the village is believed to be able to contribute to better quality of water sources and encourage people to use local water sources instead of distant ones. As a result, households would reduce time accessing water sources and may use lower-cost methods to treat water, which could significantly reduce costs for water treatment. In a situation where sanitation is improved, a rural household and

TABLE 19: WATER ACCESS AND HOUSEHOLD TREATMENT COSTS INCURRED AND AVERTED (US$)

Variable	Annual average costs per household		Annual average costs saved per household following 100% sanitation coverage	
	Rural	Urban	Rural	Urban
Water source access	128.1	167.5	9.0	1.5
Water treatment	5.2	12.7	1.8	0.6
Total	**133.4**	**180.2**	**10.8**	**2.0**

an urban household can save an average cost of US$9.0 and US$1.5 per annum on accessing water sources, respectively. For treatment cost, a rural and urban household can save an average cost of US$1.8 and US$0.6 per annum, respectively. Although it is assumed that people will use nearby water sources and turn to lower-cost treatment methods, the study tries to make a very conservative assumption to be more realistic with the current situation, in which people would not be very willing to shift from their preferred sources and methods. So the annual average cost saved seems to be small if compared to the overall costs.

4.2.6 WATER USE COSTS IN NON-DOMESTIC ACTIVITIES

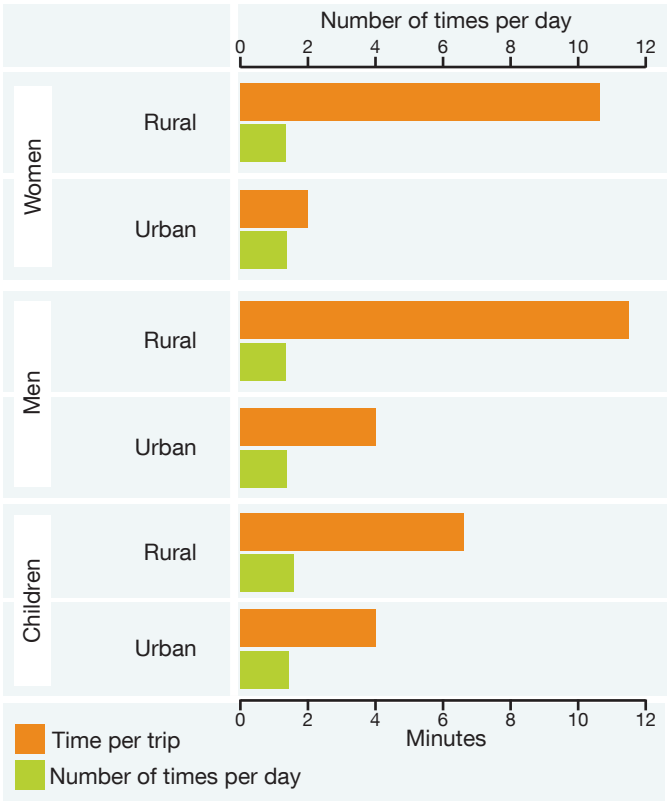
As well as household use for drinking, cleaning, bathing and cooking purposes, water is also crucial to the daily productive and other non-productive activities of the village/urban environment. In rural areas, these include irrigation for agriculture, livestock farming, fish production, and production such as cottage industries. In urban areas, these include offices, factories, etc. However, the study did not attempt to assess the cost of water use in non-domestic activities.

4.3 ACCESS TIME

4.3.1 ACCESS TIME AND TIME SAVED

Figure 15 illustrates daily time spent on accessing toilets for those householders without a toilet. Regardless of rural or urban areas, men or women, old or young, a person usually goes to the toilet for defecation at least once per day. Women and men in rural areas would go to the toilet 1.36 times a day, while those in urban areas would go 1.37 times a day. The children in rural areas go to the toilet 1.59 times a day and urban children 1.44 times a day. The number of times a person defecates and the traveling time to a place to defecate would bring about losses of opportunity costs of time. Time spent on traveling to a defecation place is more problematic for those who do not have a toilet in their households. A woman in a rural area without a toilet needs to spend about 10.6 minutes to access a place to defecate or urinate, while a woman in a town without a toilet spends 2.0 minutes to find a toilet or place to defecate. Similarly, a rural man uses 11.5 minutes and an urban man uses 4 minutes to find place of defecation. A child in rural areas also spends 6.6 minutes while a child in urban areas spends only 4.0 minutes to travel to defecate.

FIGURE 15: DAILY TIME SPENT ACCESSING TOILET FOR THOSE WITH NO TOILET (MINUTES)



The significant difference between rural and urban field sites indicates that there are more toilets available in urban areas than in rural areas so that the urban population can find a nearby toilet more quickly. More importantly, urban areas are more densely populated, hence shared and private toilets are more physically proximate for these populations. In contrast, rural populations are scattered and thus they have to spend more time to find a toilet in their neighbors' latrines or to defecate elsewhere in the bush away from home.

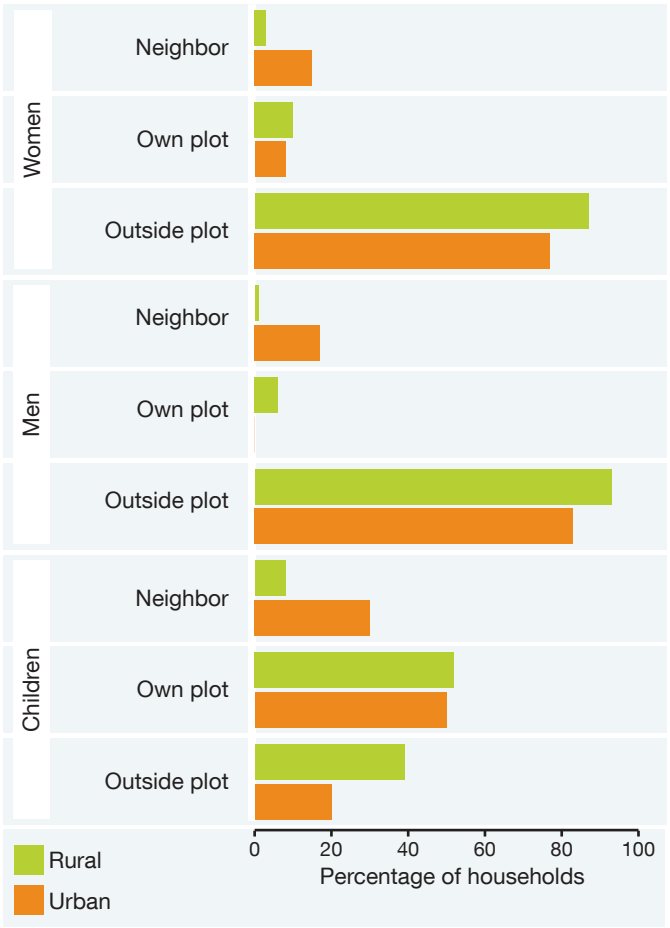
Those who do not have their own toilet use alternative places to defecate. As seen in Figure 16, a majority of women and men in both rural and urban areas use outside plots for defecation while a large proportion of children use their own plot.

Almost 87% of rural women without toilets use an outside plot for defecation, while 77% of urban women do the same. However, more women in urban areas use neighbors' toilets than those in rural areas. This is partly because of more spaces being available in rural areas than in urban

areas, and the common habit of open defecation in rural areas. This trend is also observed among men in both rural and urban areas, where more rural men use outside plots than urban men and more urban men use neighbors' latrines than do rural men.

For children, only 40% of children in rural areas use outside plots while around 20% of urban children use the outside plots for defecation. Thirty percent of children in urban areas use neighbors' yards or latrines for defecation while only 8% of children in rural areas do so. Moreover, the proportion of rural and urban children using their own plot for defecation is comparable, which are 52% and 50% respectively. This largely explains that households without a toilet often experience poor surroundings and environment in their house yards as children more often defecate in their own plot. This poor environment can put all household members at risk of sanitation related diseases, especially diarrheal diseases and helminthes.

FIGURE 16: PLACE OF DEFECATION OF HOUSEHOLDS WITH NO "OWN" TOILET

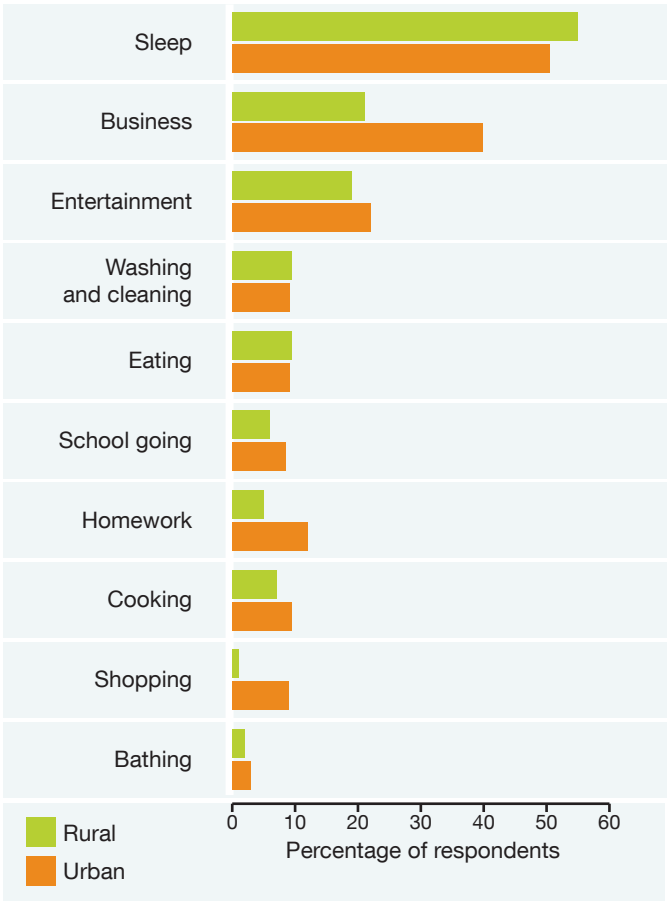


4.3.2 TIME SAVING PREFERENCES AND UNIT VALUES OF TIME

Regarding the householders' preference related to toilet convenience from the household questionnaire, a nearby toilet (proximity) is the main perceived subject of importance for all households, regardless of whether or not they have a toilet in their house or plot. Around 81% of rural households and 77% of urban households who own a toilet are more than satisfied if a toilet is in close proximity to them. Time saving is mentioned as a benefit of a latrine by 80% of rural and 77% of urban households who do not own a latrine. Also, the location of a latrine next to home would be preferred by 81% of rural households and 78% of urban households who do not have a toilet.

Figure 17 presents the opportunity cost of time for householders if they have the extra 30 minutes per day. The cost of accessing a latrine can be significantly saved if more latrines are available for both the urban and rural population.

FIGURE 17: OPPORTUNITY COST OF TIME – WHAT RESPONDENTS WOULD SPEND AN EXTRA 30 MINUTES A DAY DOING (%)



This opportunity cost of time is of great advantage for them. Out of the surveyed households, more than 50% of either rural or urban households would spend an extra 30 minutes of free time for sleeping while another 20% of both rural and urban households would spend it on entertainment.

In urban areas, 40% of respondents would spend time on a business if they had an extra 30 minutes a day while 20% of rural households would do the same. This activity would be beneficial to people in raising their households' incomes and thus improving living conditions. In addition, some respondents would use an extra 30 minutes free time per day on eating, school going, homework, shopping, cooking, washing and cleaning, and bathing. Therefore, it can be concluded that if the people in both rural and urban areas have their own toilets at their disposal, they would not be using their time in going to the bush or any distant toilet facility, resulting in having more time to do other recreation and productive activities.

4.3.3 TOTAL VALUE OF TIME SAVED

Having latrines does not only benefit health, it also can save time for households instead of going to the field for OD. Those without latrines have to bear the opportunity cost of wasting time to defecate as they need to travel longer. According to the study, people in rural areas take more time than those in urban areas to go to the bush for defecation.

FIGURE 18: AVERAGE TIME LOST PER YEAR PER HOUSEHOLD MEMBER PRACTICING OPEN DEFECATION (HOURS PER YEAR)

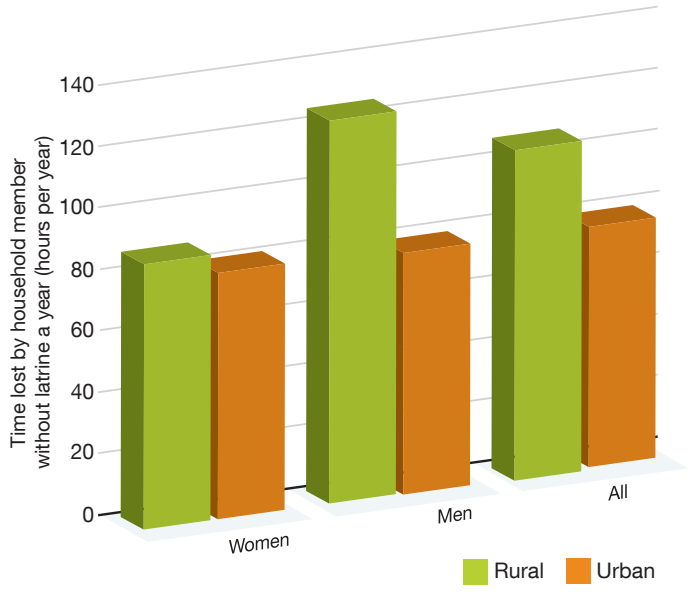


Figure 18 shows the average time lost for women who do not have a latrine at home in rural and urban areas is 87 hours and 79 hours per year respectively. Men in rural areas lost 123 hours while the urban men lost only 78 hours. Rural men and women have to go further distances than those in urban areas, so they need to have more time. The loss of time can be translated into the time saved if the latrine is in place in every household so that they can use their time to do other productive things.

As the time lost by household members is presented above, this loss can be translated into value of time saved in monetary terms if the sanitation is improved (Figure 19). As rural household members lose more time than urban people, their savings would be higher. Rural women can save US$8.8 per year while the urban ones save US$7.9. Also, rural men save US$12.4 a year and urban men save US$7.9. On average, a person in a rural area with a latrine can save US$10.6 annually from the time of not needing to go far for a toilet, and US$7.9 for a person in an urban area.

4.4 INTANGIBLE SANITATION PREFERENCES

Table 20 illustrates respondents' understanding of sanitation from the household survey. The findings indicate that people have knowledge about sanitation. They often define sanitation in terms of personal cleanliness and the level of cleanliness inside and outside of houses.

FIGURE 19: AVERAGE ANNUAL VALUE OF TIME SAVINGS, PER HOUSEHOLD MEMBER (US$, 2008)

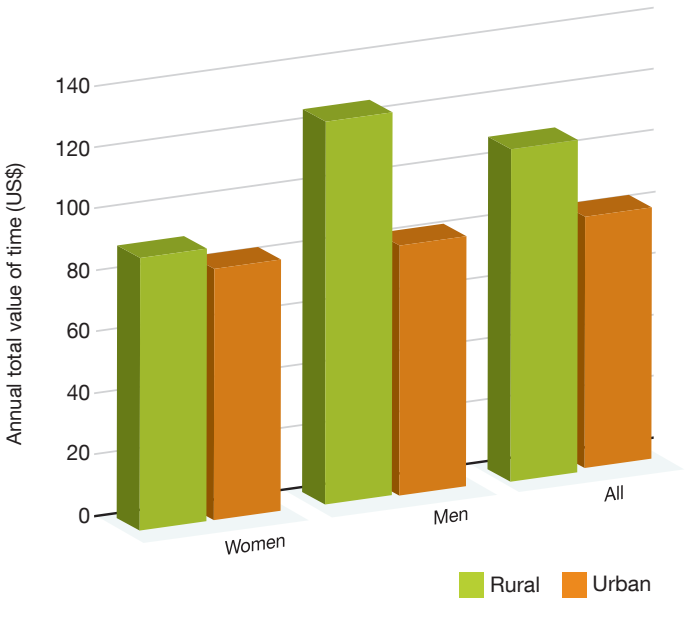


TABLE 20: RESPONDENTS' UNDERSTANDING OF SANITATION, RANKED FROM THE FOCUS GROUP DISCUSSION

Areas	With latrine		Without latrine	
	Men	Women	Men	Women
Rural	1. Drink boiled and clean water 2. Clean house and its surroundings 3. Washing hands before eating and after defecation 4. Clear garbage and animal excreta around house and community	1. Clean the house and surrounding areas 2. Washing hands with soap after defecation and before eating 3. Drink boiled water 4. Clean water tanks and toilets 5. Washing clothes and taking baths 6. Eat hygienic food	1. It is about eating with good hygiene 2. Clean the house and body with soap 3. Eat and drink with good hygiene 4. Clean around the house	1. Wash hands with soap after defecation and before eating 2. Wash clothes and dishes 3. Drink boiled water 4. Use toilet 5. Take shower and sleep under mosquito net
Urban	1. Good living environment 2. Eat and drink hygienically 3. Clear garbage around the house or community	1. Wash hands 2. Clean house and surroundings	1. Have a good living standard 2. Eat and drink with good hygiene 3. Clear garbage around the house	1. Clean hands and legs 2. Clean house

In rural areas, sanitation is perceived by households with latrines as drinking boiled and clean water, clearing the house and its surroundings, washing hands after defecation and before eating, washing clothes, taking baths, and cleaning water tanks and toilets. Similarly, those without latrines also have the same views on sanitation as those with toilets. They focus on cleaning the house, eating hygienically, drinking clean water, using toilets, washing hands, taking baths, and clearing garbage and surrounding areas.

Urban respondents, however, both with and without toilets, seem to limit sanitation to only a few aspects. Having said this, however, urban households with toilets and those without toilets share the same view of sanitation such as having a good living environment, drinking clean water, cleaning house, clearing the surroundings, and washing hands.

In terms of sanitation understanding by gender and by those with and without toilets in both rural and urban areas, there are not many differences as they share some views. However, women in rural areas, both with and without toilets, seem to have more understanding than men.

Regardless of rural or urban areas, and men or women, households with latrines and without latrines define sanitation in the same way. Personal and household cleanliness and sanitary drinking, eating, and living are perceived as key aspects of sanitation.

Table 21 summarizes householders' preference related to toilet convenience from focus group discussion (FGD)and the reason that households adopt the current sanitation practice. Both rural and urban households, men and women, have very similar perceptions on latrine convenience regardless of the ownership of a latrine. The most common perceived benefit among all the groups is time saving, while other associated preferences relate to safety, comfort, cleaner environment, and privacy. It is noted that comfort in toilet use is mentioned mainly by women in urban field sites, while it is less obvious among women in rural areas. Instead, women in rural areas emphasize the benefits in terms of privacy and dignity, reduced workload in bringing a child to the bush, and not being wet during the rainy season. Clearly, the different preferences among the two groups reflect the fact that women in rural areas who do not have a toilet at home are currently concerned with having privacy and the burden of taking a child to the bush for defecation. Aside from the rural urban divide, it is also interesting to observe the differences in perception across gender. While the perceptions of benefit among men and women are largely similar, women often mentioned comfort, privacy, dignity, and the reduced workload in taking a child to the bush. This perception is typical for women in rural areas.

TABLE 21: PREFERENCES RELATED TO TOILET CONVENIENCE AND REASONS FOR CURRENT SANITATION PRACTICE, FROM FOCUS GROUP DISCUSSIONS

Areas	With latrine		Without latrine	
	Men	Women	Men	Women
Rural	PREFERENCE RELATED TO TOILET CONVENIENCE			
	1. Time and money saving 2. Improved health 3. Environmental cleanliness 4. Safety for humans 5. Comfortable defecation 6. Safe disposal of exreta	1. Convenience 2. Safety for humans 3. Time and money saving 4. Environmental cleanliness 5. No smell affecting environment 6. Improved health 7. Privacy and dignity for humans 8. No insects that cause infectious diseases	1. Time and money saving 2. Easy to defecate or urinate 3. Safe disposal of excreta 4. Reduced infectious diseases 5. Reduced pollution of environment 6. Safety, privacy and dignity for humans 7. Good sanitation	1. Time saving 2. Improved health 3. No smell affecting environment 4. Reduced infectious diseases 5. No insects that cause infectious diseases 6. No need to accompany children to defecate 7. Environmental cleanliness 8. Safety, privacy and dignity 9. Defecate easily without getting wet in rainy season
	REASON FOR CURRENT SANITATION PRACTICE (UP TO FIVE RANKED RESPONSES)			
	1. Save time 2. Improved health 3. Good environment and sanitation 4. Be safe	1. Convenience 2. Safe from danger (especially women at night) 3. Save time 4. Not smelling 5. Improved health	1. High cost 2. Do not get support from NGOs	1. Not important 2. Not used to defecating in the toilet 3. No space available for building the latrine 4. Dry pit has bad smell 5. Do not have money
Urban	PREFERENCE RELATED TO TOILET CONVENIENCE			
	1. Time and money saving 2. Easy to defecate or urinate 3. No infectious diseases 4. Environmental cleanliness 5. Safety	1. Time and money saving 2. No infectious diseases 3. Easy to defecate or urinate 4. Feel comfortable	1. Time saving 2. Easy to defecate and urinate 3. No smell affecting 4. No sickness and infectious diseases	1. Time and money saving 2. Improved health 3. Easy to defecate and urinate 4. Environmental cleanliness and good sanitation 5. No smell affecting environment
	REASON FOR CURRENT SANITATION PRACTICE (UP TO FIVE RANKED RESPONSES)			
	1. Not smelly to the neighbor 2. Be safe	1. Convenience 2. Safety (especially women at night) 3. Improved health 4. Save time		

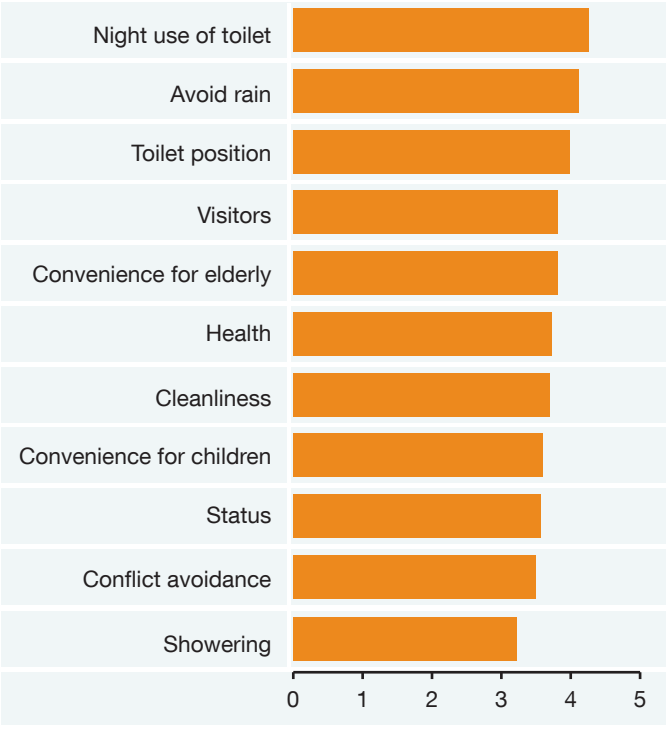
Besides preferences related to toilet convenience, Table 21 also shows the top five reasons that householders in both rural and urban areas give in adopting the current sanitation practice. The reasons stated by men and women in both rural and urban areas who own a latrine are very similar. Time saving, hygiene, convenience, safety (particularly at night), and cleaner environment are the typical reasons that latrine owners give to own a latrine at home. Interestingly, the non-latrine owners give very different reasons for not having a toilet at home. The high cost of a toilet and lack of external support are the major reasons for not having a toilet, while other reasons such as: low priority for owning a toilet, not used to defecating in an enclosed cubicle, and the problem of space in the house plot are also highlighted.

Figure 20 presents the satisfaction level of households with improved sanitation with their current latrine option. Households with improved sanitation are satisfied with their current latrine in every aspect such as latrine location, cleanliness, social status, guest visits, convenience for children, and ease of use at night. Comparatively, it indicates that households are most satisfied with their present latrine in terms of ease of use at night because they can defecate without any concerns. It is consistent with the result from

FGD which shows that having a latrine is safe and easy to use at night. In addition, ease of maintenance, good health, avoidance of conflict with neighbors, convenience for the elderly, rain avoidance, possibility of showering in the latrine, and avoidance of dangerous animals are the reasons raised by households in favor of improved sanitation. Therefore, it can be concluded that having a latrine at home would benefit households a lot as it would improve the sanitation in the households and community, safety at night, convenience, and health conditions among family members. These are good arguments to convince households without toilets to consider building one.

Figure 21 demonstrates the latrine characteristics wanted by those without a latrine, with corresponding important scores. Water-based latrines are the most preferred option of households without latrines as they are much easier to use than dry pit latrines. Also, there are many other obvious characteristics such as proximity to houses, cleanliness, privacy, comfort for defecation, and not sharing with other households, which generally share an importance score of 4, respectively. This high rating indicates that building a latrine is vitally significant for households. Similarly, a latrine which can lead to a clean environment is another important characteristic. To a certain extent, having a toilet disposal system that does not require emptying and does not cause pollution give rise to a score of 3 out of 5 for degree of importance.

FIGURE 20: LEVEL OF SATISFACTION WITH CURRENT TOILET OPTION, IMPROVED SANITATION (1 = NOT SATISFIED; 5 = VERY SATISFIED)



Regarding the concern of those practicing OD as shown in Table 22, a significant proportion of respondents, 39%, frequently feel in danger when defecating in the open, while 52% said they sometimes feel in danger. In terms of children's safety during open defecation, 42% often have major concerns while 48% sometimes feel worried. Moreover, even though 50% of the total respondents have never heard of someone being attacked by animals, 42% sometimes hear about it.

Based on the results, households without toilets and practicing OD have concerns about their own safety and their family members, and they also understand the importance of having a latrine at home. But the question here is why they have not built their own latrine and what can be done to encourage them to invest a small amount in a latrine. As commonly known in the sector in Cambodia, households in rural areas tend to assume that it is complicated to build a latrine, or building a latrine is a big expense, or they do not want a low cost dry pit latrine. This concern is, however, being addressed with the introduction of a more affordable Easy Latrine design in some parts of the country, incorporating the aspirational aspects and removing the high purchase cost barrier the rural households usually face.

FIGURE 21: DESIRABILITY OF TOILET CHARACTERISTICS FOR THOSE CURRENTLY WITHOUT A LATRINE (1 = NOT IMPORTANT; 5 = VERY IMPORTANT)

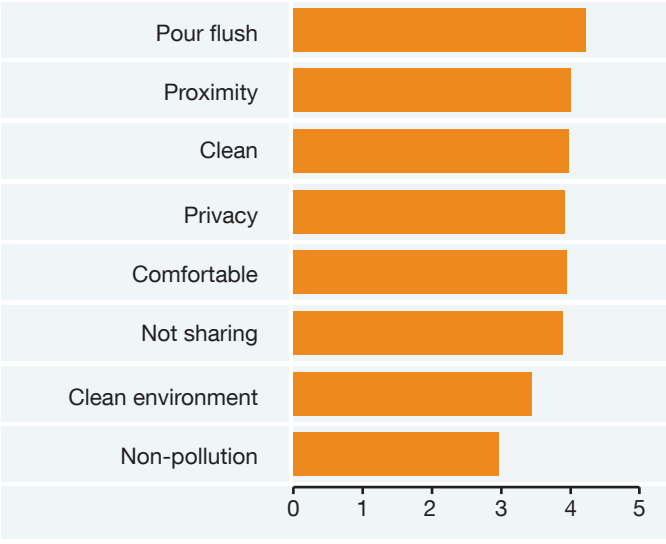


TABLE 22: CONCERNS OF THOSE PRACTICING OPEN DEFECATION

Concern	No. respondent	Responses (%)		
		Never	Sometimes	Often
Have you felt in danger when going for OD?	367	9	52	39
Are you worried about the safety of your children?	367	10	48	42
Have you heard about someone being attacked by animals?	367	50	42	8

FIGURE 22: PROPORTION OF HOUSEHOLDS WITH TOILET WHO CONTINUE TO PRACTICE OPEN DEFECATION (%)

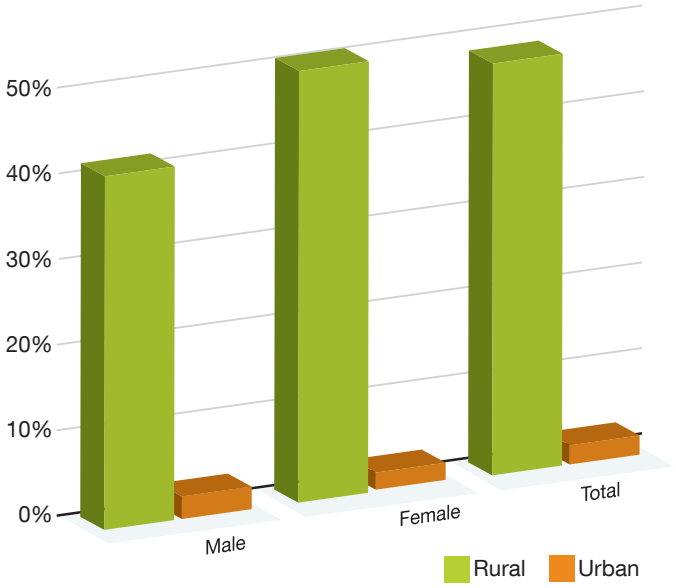
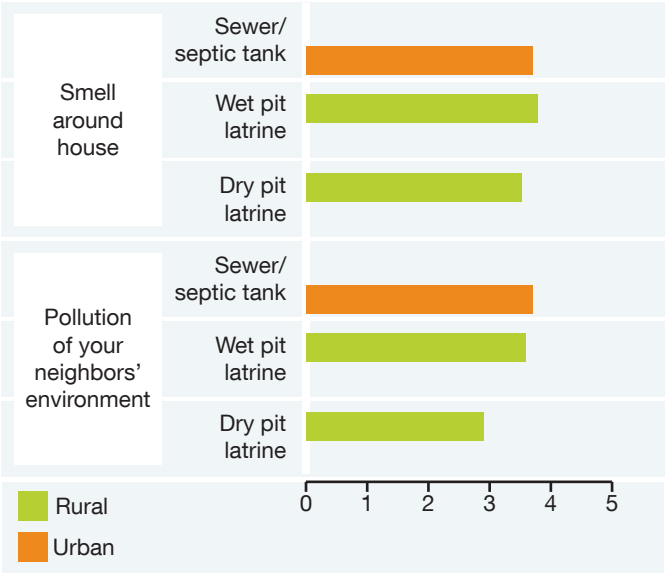


FIGURE 23: IMPLICATION OF CURRENT TOILET OPTION FOR EXTERNAL ENVIRONMENT (1 = NOT SATISFIED; 5 = VERY SATISFIED)



4.5 EXTERNAL ENVIRONMENT

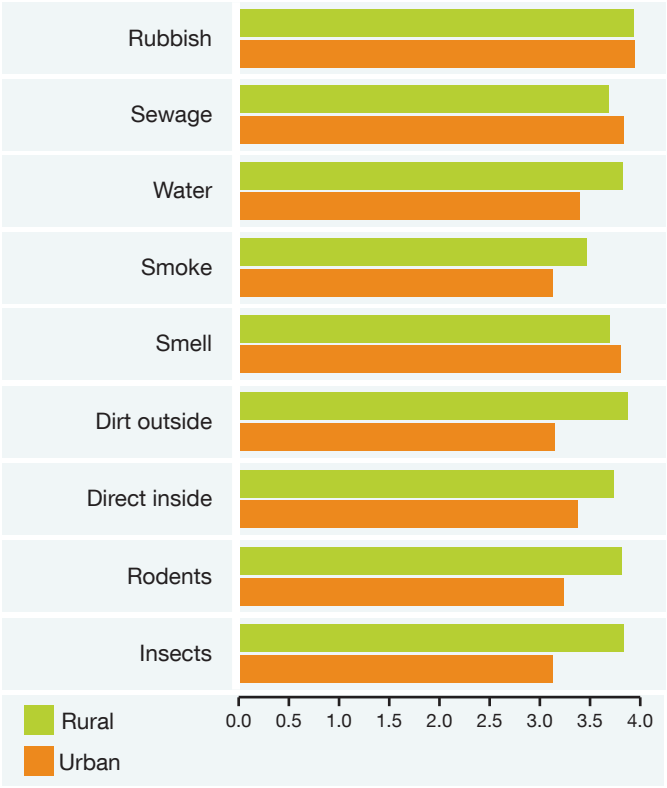
"External" environment refers to the area outside the toilet itself and not related to toilet-going, and can include living area, public areas, and private land, which can all be affected by open defecation practices and unimproved toilet options. The impacts on the quality of local water resources have already been covered in Section 4.2, and hence this section focuses on how poor sanitation affects other aspects of the environment. The sources of data are mainly the ESI field surveys: physical location survey, household interviews, and focus group discussions. Given that the external environment is also spoiled due to other sources of poor sanitation – i.e., mainly inadequate solid waste management practices – these have also been assessed to understand the contribution of each, and relative preferences regarding their improvement.

Figure 22 shows the households with latrines who practice unimproved sanitation. Rural households have a high rate of unimproved sanitation practices even though they have latrines at home. Generally, about 48% of rural households with latrines still practice OD at the bush while it is only 3% for urban households. This is mainly due to the difficulty in changing people's habits, and the availability of sites for open defecation in rural areas. According to the survey, female household members practice unimproved sanitation more often than male members in rural areas, while in urban areas the rates are similar.

According to Figure 23, wet pit latrines connected to sewerage/septic tanks are more favorable than dry pit latrines in terms of smell and environmental impact reduction. The wet pit latrines provided in ECOSORN and TSRWSSP are of a high-end type and can reduce impacts as do latrines connected to septic tank and sewerage. The figure presents the satisfaction level of households in terms of reducing bad

smells and environmental pollution. Sewers or septic tanks, which are generally available in urban projects, have a satisfaction rating of 3.7 in terms of reducing bad smells around houses and environmental contamination of individual households and neighbors (five being very satisfied, and one being not satisfied). This shows how much people in urban areas are satisfied with the fact that the latrines connected to septic tanks and a sewerage system do not affect their immediate surrounding environment. In rural areas, where wet and dry latrines are the only option, wet latrines have been given a higher satisfaction score than dry latrines in terms of pollution in the surrounding environment. This implies that the perception of people in Cambodia toward dry latrines is not as positive as wet latrines. This, however, can be partially overcome by introducing proper operation and maintenance methods of dry pit latrines to the community so that smell can be reduced to the minimum.

FIGURE 24: DEGREE OF PERCEIVED ENVIRONMENTAL DEGRADATION IN THEIR NEIGHBORHOODS - HIGHER SCORE DENOTES GREATER CONCERN (MAXIMUM SCORE 5)



Householders' perception of the importance of environmental sanitation management is illustrated in Figure 24. Most households give the importance of all aspects of environmental sanitation management at a fairly similar level. Improving solid waste management, sewage management, and smell control are the key aspects that are perceived as very important in both rural and urban areas for improving household surroundings, and thus should deserve attention. It is also interesting to note that while the three aforementioned aspects were perceived as less important among rural households than urban households, other aspects such as accumulation of storm water, dirt, rodents and insect control are more important among rural households than urban households. This may be explained by the higher prevalence of those aspects in rural areas compared to urban areas.

4.6 SUMMARY OF LOCAL BENEFITS

Table 23 provides a summary of the local level impacts, as presented in Chapter 4.

TABLE 23: SUMMARY OF LOCAL IMPACTS OF SANITATION IMPROVEMENT

Benefit	Benefits of improved sanitation and hygiene		
	Quantitative benefit (US$ household/ year)		Qualitative benefit
	Urban	Rural	
HEALTH			
Health burden/quality of life			• Avoid lost productivity • Reduce patient/carer time loss • Improve hygiene in household • Reduce diseases of poor sanitation
Health care cost averted			
OD to basic sanitation – wet and dry pit latrine (rural)		6.1	
OD to basic improved sanitation with septic tank (urban)	5.3		
Basic sanitation to sewerage (urban)	1.9		
Productivity cost averted			
OD to basic sanitation – wet and dry pit latrine (rural)		4.6	
OD to basic improved sanitation with septic tank (urban)	5.9		
Basic sanitation to sewerage (urban)	2.1		
Mortality cost averted			
OD to basic sanitation – wet and dry pit latrine (rural)		13.2	
OD to basic improved sanitation with septic tank (urban)	11.2		
Basic sanitation to sewerage (urban)	4.0		
WATER			
Overall quality			• Better quality water sources • Clarity, and good taste • Less pollutants in the water source
Savings from access costs	1.5	9.0	
Savings from water treatment cost	0.6	1.8	
ACCESS TIME	7.9	10.6	• Save more time to do other productive work
INTANGIBLES			• Convenience and comfort • Clean household environment • Safety • Privacy and dignity
EXTERNAL ENVIRONMENT			• Reduce smell around the house • Reduce pollution to neighbors • Good living environment in the community

V. National Benefits of Improved Sanitation and Hygiene

This chapter presents the potential impacts of improved sanitation on:

- Tourism (Section 5.1)
- Businesses and foreign investment (Section 5.2)

5.1 TOURISM

Tourism has been one of the fastest growing sectors of the economy, and has made a significant contribution to Cambodia's economic growth. Tourist arrivals reached 2.1 million in 2009. For the tourism sector, good sanitation is important to help tourists have an enjoyable stay, and reduce the risk of getting sick.

Table 24 shows the background information on 298 holiday tourists and 36 businessmen who responded to the survey. The respondents were 64% male and 36% female, and the largest geographical grouping was Europeans, followed by North Americans and Southeast Asians. The majority of visitors were staying in the lowest (34%) and second lowest (23%) hotel brackets. Australians and New Zealanders had the longest average stay at 10 days.

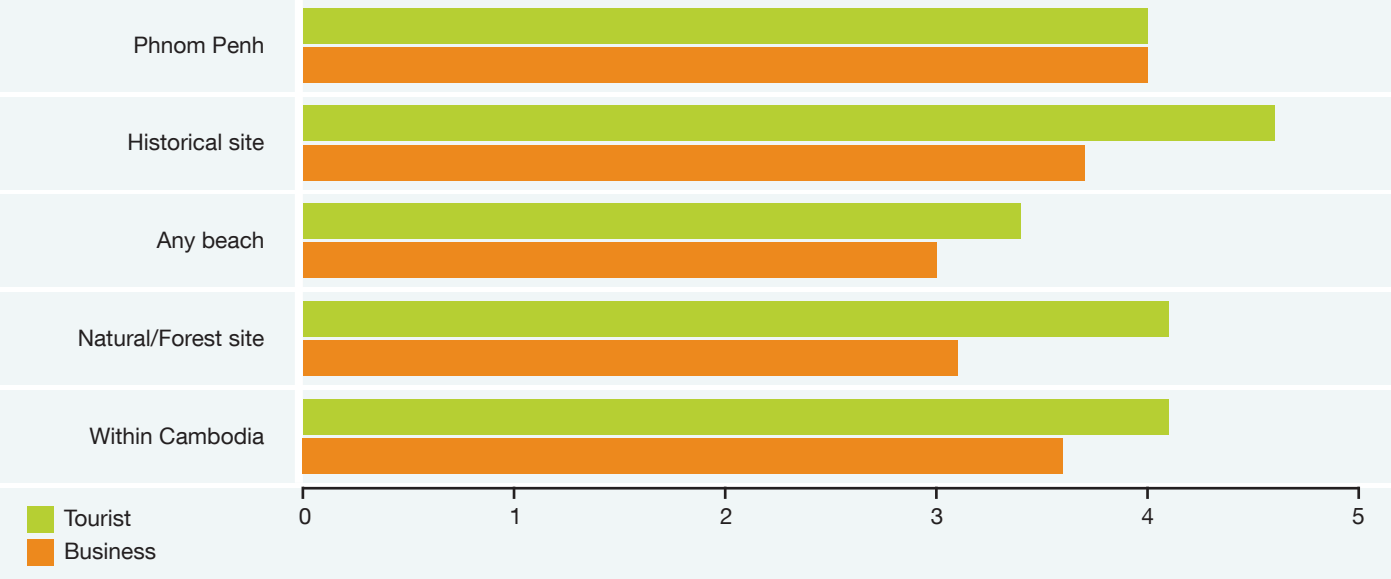
Figure 25 illustrates the enjoyment level of foreign visitors during their stay in Cambodia. By rating from 1 to 5 to indicate their level of enjoyment (5 = highest enjoyment), foreigners rate their enjoyment 4.6 for staying in Historical Sites, 4.1 for Natural or Forest Sites, 4.1 for other visited places within Cambodia, 4.0 for Phnom Penh, and 3.3 for beaches. The rating score is higher among foreigners who come as tourists than those who come for business purposes. Beaches get the lowest rating by foreign visitors, given the sanitation conditions of the beaches in Cambodia at the time of survey, which do not have good waste management and on which solid waste is commonly scattered. Generally, foreign visitors expressed their enjoyment during their stay in Cambodia.

TABLE 24: BACKGROUND CHARACTERISTICS OF FOREIGN VISITOR RESPONDENTS BY REGIONAL GROUPINGS (INTERVIEWED IN AIRPORTS)

Variable		Australia & New Zealand	South & East Asia	Europe	USA & Canada	Southeast Asia	Other	Total
No. of visitors interviewed		44	28	149	70	37	6	**334**
Gender (%)	Male	65	81	60	68	61	50	**64**
	Female	35	19	40	32	39	50	**36**
Average no. of previous trips to Cambodia		0.78	1.25	0.68	0.86	3.96	2.5	**1.67**
Average length of stay of this trip		10	7.3	8.1	8.1	4.8	8.0	**7.7**
Purpose of visit (%)	Tourist	93	57	95	99	68	83	**89**
	Business	7	43	5	1	32	17	**11**
Hotel bracket (%) (nightly tariff in US$)	US$1-US$29	39	30	41	30	16	50	**34**
	US$30-US$59	27	23	23	15	33	17	**23**
	US$60-US$89	24	10	14	4	16	17	**14**
	US$90-US$119	6	13	5	6	24	-	**9**
	US$120-US$149	3	17	4	9	6	-	**6**
	US$150+	-	7	14	36	6	17	**13**

South and East Asia includes India, Bangladesh, Mongolia; Europe includes UK, Belgium, Scotland, Sweden, Portugal, Spain, Switzerland, Norway, Denmark, Hungary, Ireland; North America includes US, Canada, Mexico; Southeast Asia includes Vietnam, Malaysia, Singapore, Thailand, Indonesia, and Laos.

FIGURE 25: PLACES VISITED BY FOREIGN VISITORS AND ENJOYMENT OF STAY (SCORE: 5 = VERY MUCH; 1 = NOT AT ALL)



The interviewed foreign visitors gave a score of only 2.7 for general sanitary conditions as shown in Figure 26, which is much lower than sanitary conditions in other specific places. This average score means that the general sanitary conditions of Cambodia are not good enough while sanitary conditions at hotels or guesthouses, swimming pools, and restaurants are better, rated at 4.1, 4.3, and 3.8, respectively. However, the sanitary rating for general water sources (sea, rivers and lakes), for the capital city, and for other cities within Cambodia are relatively lower, rated at 2.8, 3.0, and 3.2, respectively. Phnom Penh scored lower than other cities because of some problems such as its drainage and sewer systems, and waste on the streets. For tourists in Sihanoukville (SHV), they rate the general condition in Sihanoukville as being about the average at 2.5. However, specific ratings for other locations are good. The sanitation in hotels in SHV is rated at 3.6, swimming pool 3.8, open water 3.1, and restaurant at 3.7. In general, while sanitation conditions in those locations are fairly good for tourists in Sihanoukville, the sanitary condition of the sea is still perceived the lowest by tourists. Interestingly, the beach which is the main attraction for tourists to SHV has its sanitary condition rated at 3.1, the lowest among other places. It is observed that in general, tourists perceive that a better sanitary condition exists at privately owned places, while poorer sanitation is perceived in public places. Business visitors tend to have a worse sanitary experience than ordinary tourists.

Foreign visitors experienced good toilet facilities at private places such as hotels, restaurants, and airports during their stay in Cambodia, rating their experience as being good. Generally, the sanitation in hotels is good. Tourists at airports rated the sanitation in hotels at 4.2, business visitors at 3.8, and tourists in Sihanoukville at 3.9. Sanitation in restaurants and airports is rated good for all tourists and business visitors as shown in Figure 27. They, however, have had poor sanitary experience with toilets at public places such as in bus stations and in city centers. Bus stations and locations in the city achieved the same score of 2.4, lower than the average, suggesting toilets in bus stations and around cities are not well prepared and/or maintained to serve tourists' needs. The sanitary experience with toilets among business visitors and SHV tourists is even worse compared to ordinary tourists.

Similarly, foreign visitors perceived hand washing facilities as poor. In particular, as illustrated by Figure 28, hand washing facilities in restaurants scored 3.9 by tourists interviewed at the airports, 3.2 by business visitors, and 2.9 by tourists in Sihanoukville. However, the facilities in bus stations and city locations were rated 2.6 and 2.7 by tourists at the airport and below average by business visitors and tourists at Sihanoukville. It can be implied that hand washing facilities are more available in restaurants than other public places. However, the business visitors and tourists in Sihanoukville seem to experience worse hand washing situations in bus stations and in the city.

FIGURE 26: GENERAL SANITARY EXPERIENCE OF FOREIGN VISITORS (SCORE: 5 = VERY GOOD; 1 = VERY POOR)

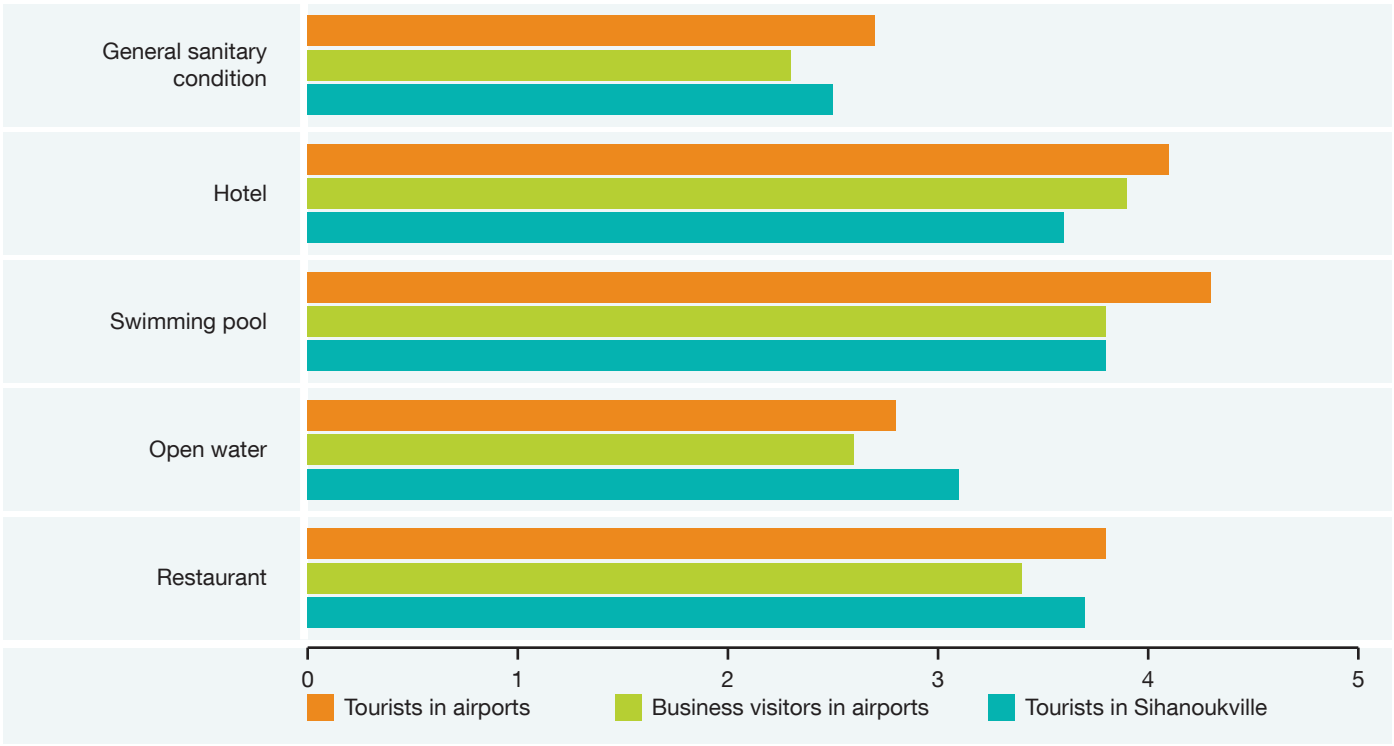


FIGURE 27: SANITARY EXPERIENCE OF FOREIGN VISITORS IN RELATION TO TOILETS AND HAND WASHING (SCORE: 5 = VERY GOOD; 1 = VERY POOR)

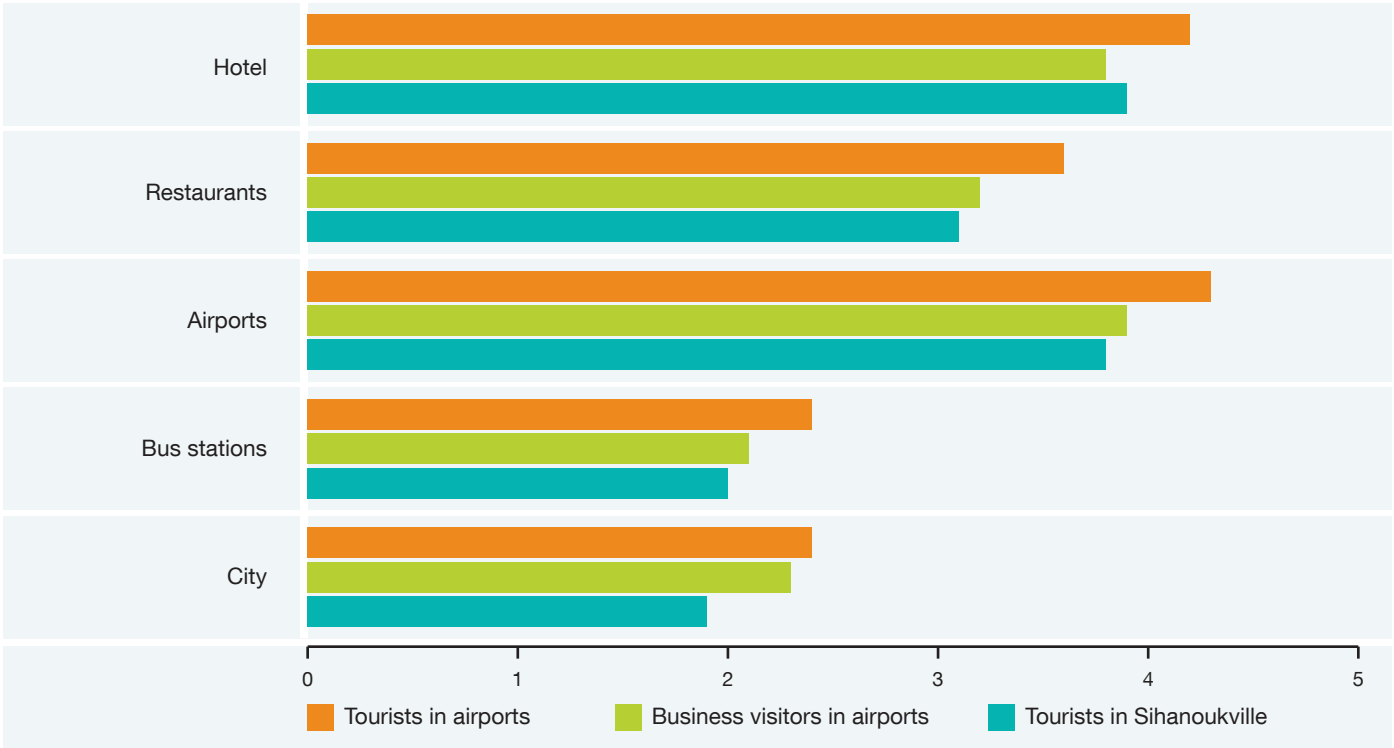


FIGURE 28: SANITARY EXPERIENCE OF FOREIGN VISITORS WITH HAND WASHING (SCORE: 5 = VERY GOOD; 1 = VERY POOR)

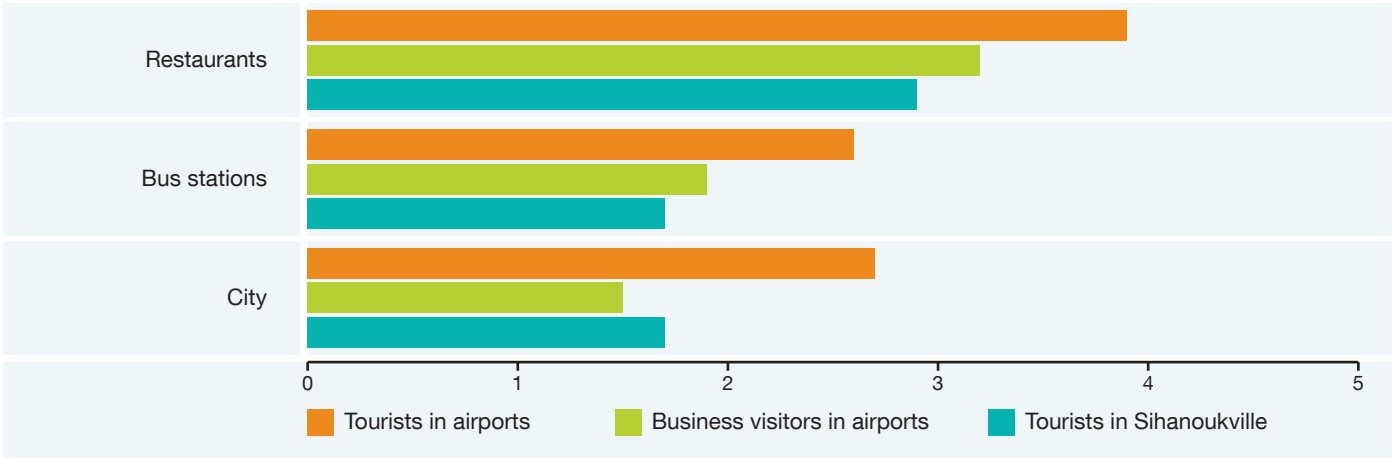
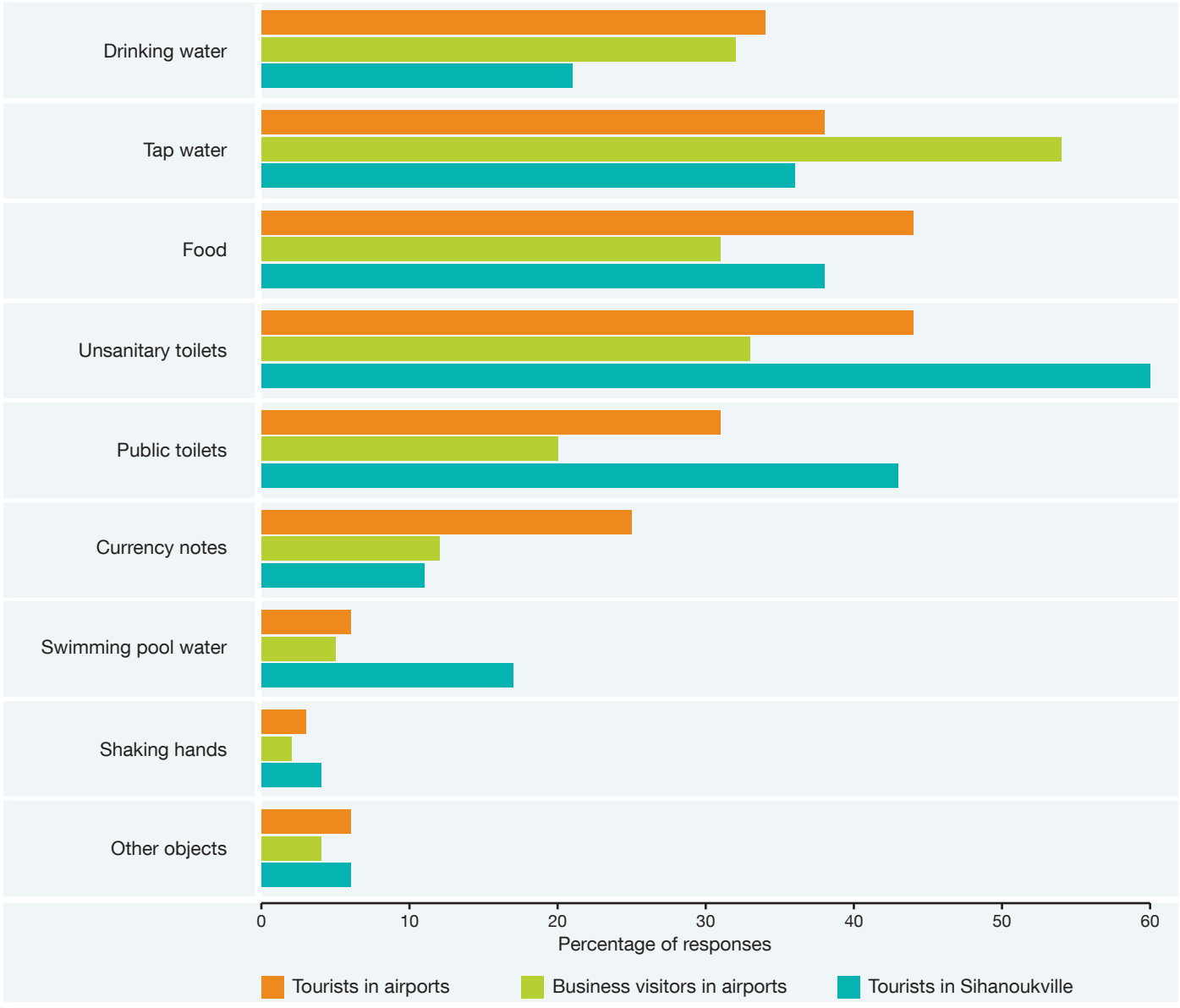


FIGURE 29: SANITARY FACTORS OF MOST CONCERN TO FOREIGN VISITORS (% CITING, 3 RESPONSES PER RESPONDENT)



Out of the total number of interviewed tourists, food and unsanitary toilets are a major concern, followed by quality of tap water and bottled drinking water. As shown in Figure 29 below, 44% of the interviewed tourists at the airport are concerned by unsanitary toilets and food, 38% by tap water, and 34% by drinking water. For business visitors, tap water is a major concern as 52% of them cite this as the main factor of their concern, followed by unsanitary toilets (33%), drinking water (32%) and food (31%). Also, tourists in Sihanoukville are most concerned with unsanitary toilets (60%), followed by public toilets (43%) and food (38%). Tap water and bottled drinking water are also main concerns for them.

With regard to illness related to sanitation, 22% of tourists reported gastro-intestinal illness while 17% of the total business visitors reported being sick. Figure 30 illustrates the probable causes or sources of illness or infection of foreign visitors during their stay in Cambodia. Sixty-six percent of the total interviewed tourists and 75% of interviewed business visitors blame food as the most probable cause of illness. Drinking water comes as a second major source of illness or infection as indicated by 26% of tourists and 25% of business visitors. It should be noted that food and drinking water are the main causes of health troubles for both tourists and business visitors, so there should be more attention on improving the hygiene in preparation of food and drinking water in restaurants. In this way, adopting sanitation and hygiene practices such as stopping the spread of contaminating water sources through building and using toilets and practicing hand washing with soap would largely reduce the risk of those diseases.

The majority of tourists and business visitors expressed their intention to return to Cambodia, as illustrated in Figure 31. Around 89% of the interviewed business visitors and 82% of the interviewed tourists are intending to come back. Only 11% of tourists and 13% of business visitors are not sure whether they will come to Cambodia again. For tourists in Sihanoukville, only 67% of them said they will return while only 3% of them will not return to Cambodia and 27% are not sure whether or not they will come again.

FIGURE 30: PROBABLE CAUSES OF HEALTH TROUBLES (SELF-REPORTED) OF FOREIGN VISITORS (PERCENTAGE OF RESPONSES, MORE THAN ONE RESPONSE POSSIBLE PER RESPONDENT)

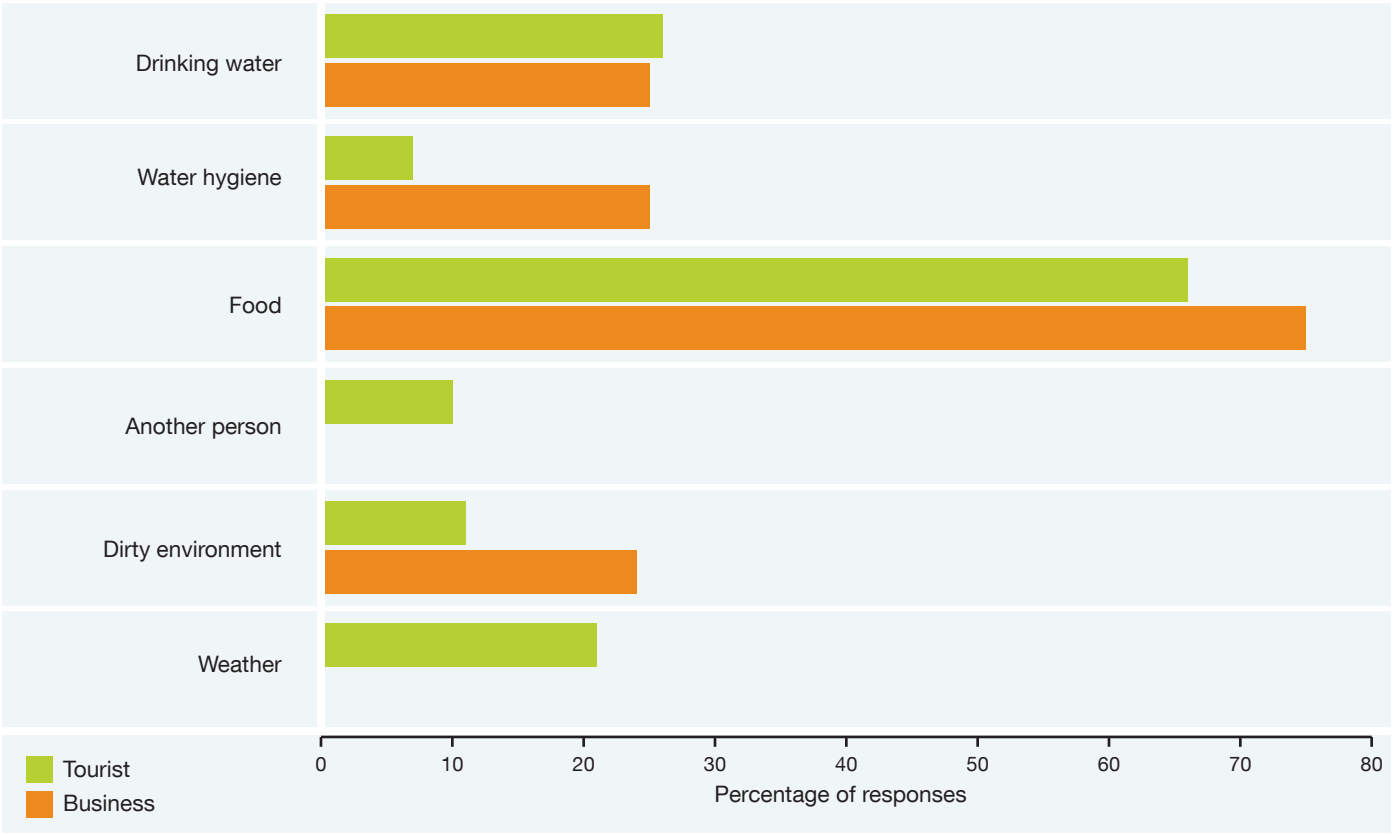


FIGURE 31: INTENTION OF FOREIGN VISITORS TO RETURN TO CAMBODIA (PERCENTAGE OF RESPONSES)

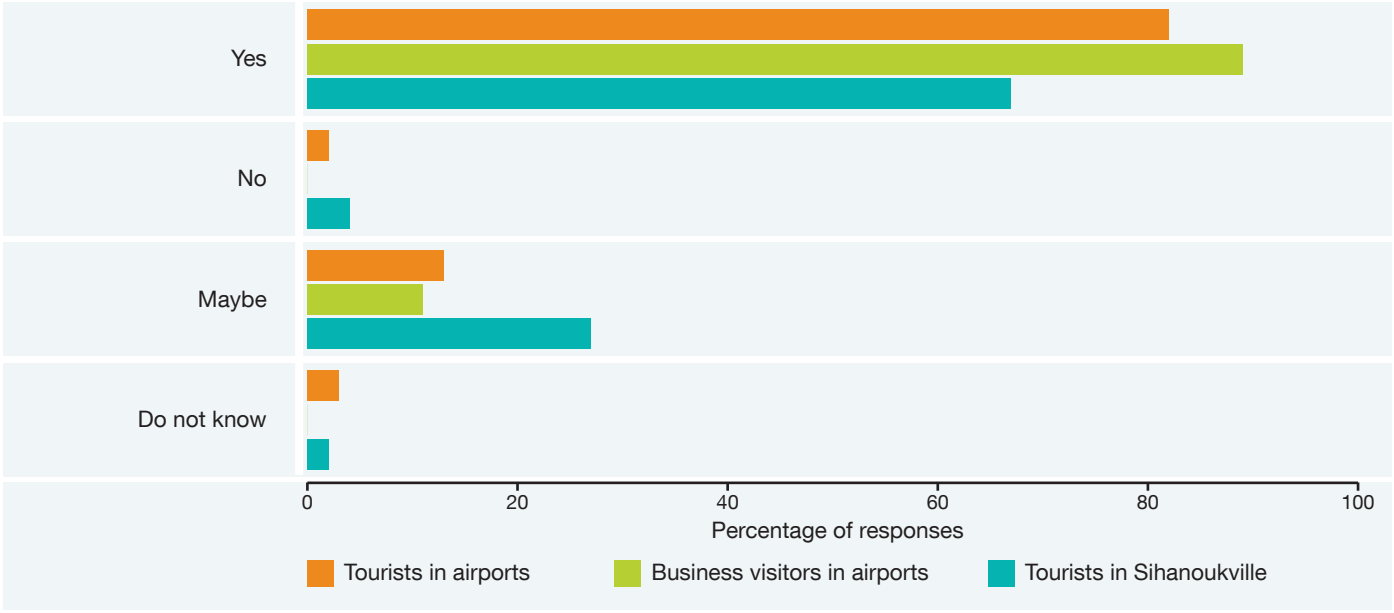
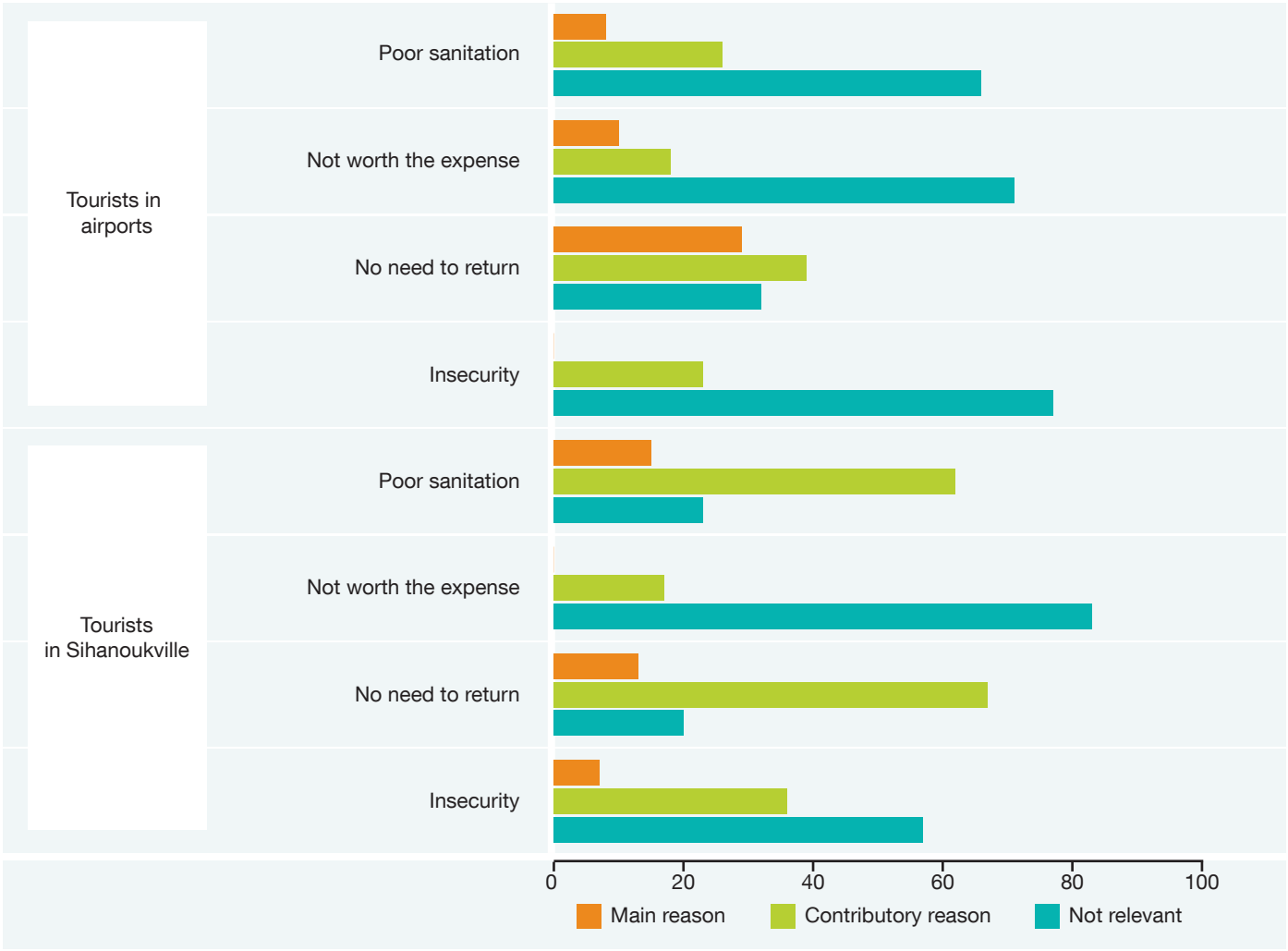


FIGURE 32: REASON FOR HESITANCY OF FOREIGN VISITORS TO RETURN TO CAMBODIA (PERCENTAGE OF RESPONDENTS)



Although there are some problems with sanitation conditions in Cambodia, there is still a high rate of visitors intending to return to Cambodia again on the part of both tourists and business visitors. However, if sanitation conditions are improved, more tourists would be attracted to Cambodia.

Figure 32 illustrates reasons why some tourists at the airport and tourists in Sihanoukville do not want to return to Cambodia. Among tourists at the airport who are not sure and willing to return to Cambodia, 29% of them mention that they have already experienced Cambodia so that it is not necessary for them to come back. Also, 39% cite this as only a contributory reason. For another 10% of respondents, the main reason for not returning is that they did not feel like they got value-for-money from their stay in Cambodia. Nine percent of respondents blame poor sanitation as the main reason not encouraging them to return, while 25% cite poor sanitation as a contributory reason for their decision not to return.

In particular, 15% of SHV tourists cite poor sanitation as the main reason for not returning to Cambodia while another 13% think that they do not need to come again. Insecurity is a contributory reason as expressed by 36% of them while poor sanitation was stated by 62% as a contributory reason for not returning. Since poor sanitation can be a main or contributory factor discouraging tourists to visit Cambodia again, improving sanitation in the country is also crucial if the Cambodian government is to promote Cambodia as an attractive tourist destination.

5.2 BUSINESS AND FDI

The study also polled businesses in Cambodia over sanitation and its implications for their business. The study interviewed 19 business firms around Phnom Penh, of which six are foreign firms and the other 13 are local. The firms were chosen from various sectors—five travel agencies, two hotels, three restaurants, four drinking water factories, three food producers, and two trading firms.

Although sanitation does not have much influence on investment decision making, business people admitted that they also take into account the sanitation conditions in the locations of their investment, as this would have some impacts on business, especially for food producers and restaurants.

Figure 33 illustrates the current situation of environmental sanitation in various business locations in Phnom Penh. In general, sanitation conditions for all interviewed businesses are perceived acceptable as they report that sanitation in their locations is not problematic for their business operations. Only water quality in rivers and toilets in public places receive poor ratings by some businesses, including travel agencies, restaurants, food producers and other businesses. In particular, the conditions of household/office solid waste management for travel agencies, hotels, restaurants, and pure drinking water businesses received the highest rating while ratings for food producers and other businesses were good.

Availability of cheap and good land, a pleasant environment for staff, unpolluted natural water and a healthy workforce are very important for hotels, food producers, and other businesses as shown in Figure 34 below. In particular, workforce health and a pleasant environment for staff are very important for travel agencies, while the availability of cheap and good land is not very significant. Overall, environmental conditions are of vital significance to businesses.

Table 25 illustrates the impact of sanitation on production locations of business. As regards the health of workers and its importance to business productivity, all the surveyed businesses admitted that poor workforce health would have negative impacts on their operations. Similarly, poor water quality is perceived by all firms as being detrimental to the production process. This leads them to spend much more on water treatment, especially pure drinking water, which costs on average US$4,183 per month.

Many businesses admitted that a poor local environment has a negative impact on their customers, workers, suppliers and others, especially travel agencies, restaurants, and pure drinking water factories. In contrast, other commercial firms and food producers gave less importance to the local environment.

FIGURE 33: RATING OF ENVIRONMENTAL SANITATION CONDITIONS IN THE LOCATION OF THE BUSINESS SURVEY INTERVIEW (1 = BEST; 5 = WORST)

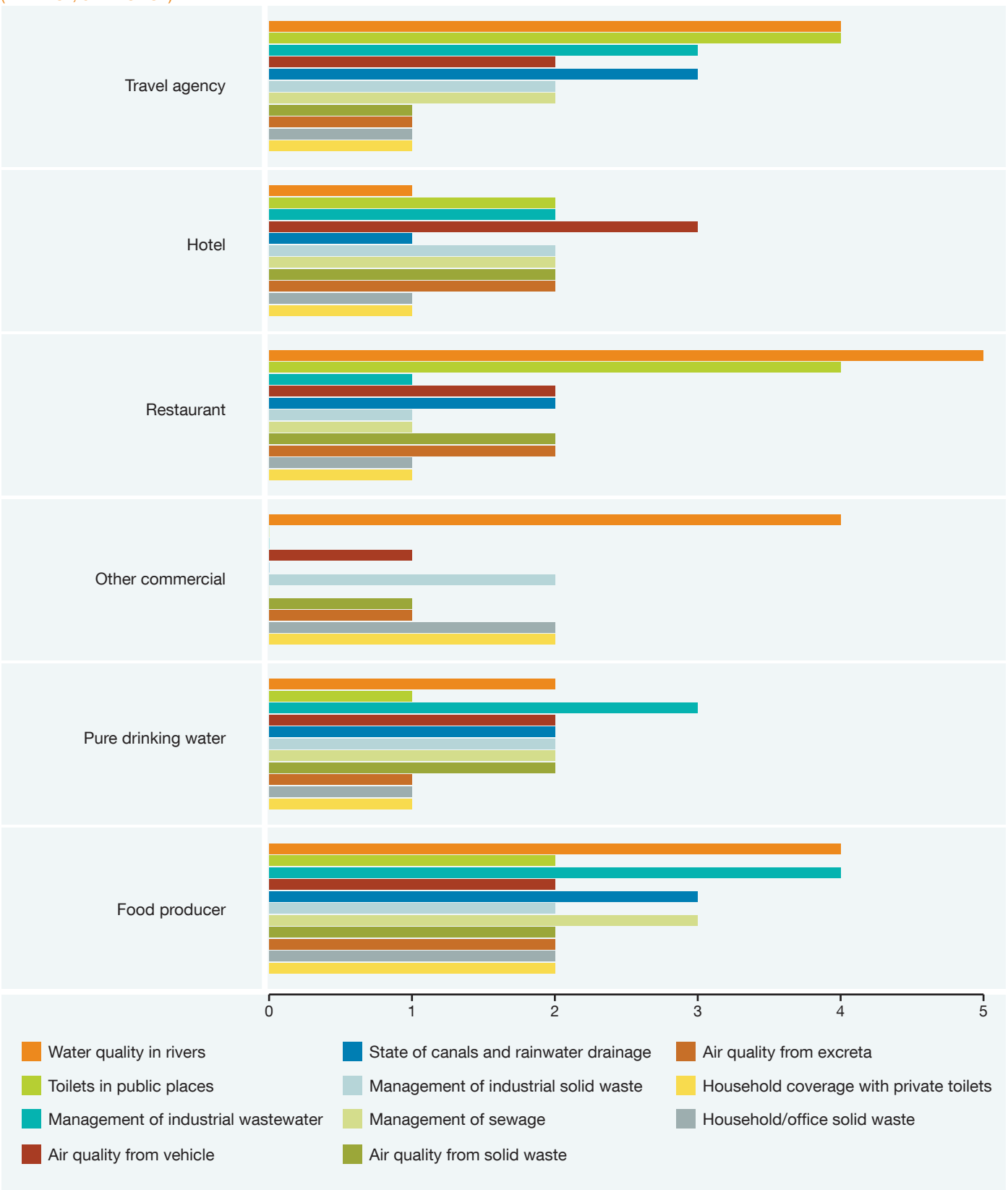


FIGURE 34: IMPORTANCE OF ENVIRONMENTAL SANITATION CONDITIONS FOR LOCATING THE COMPANY (1 = UNIMPORTANT; 5 = IMPORTANT)

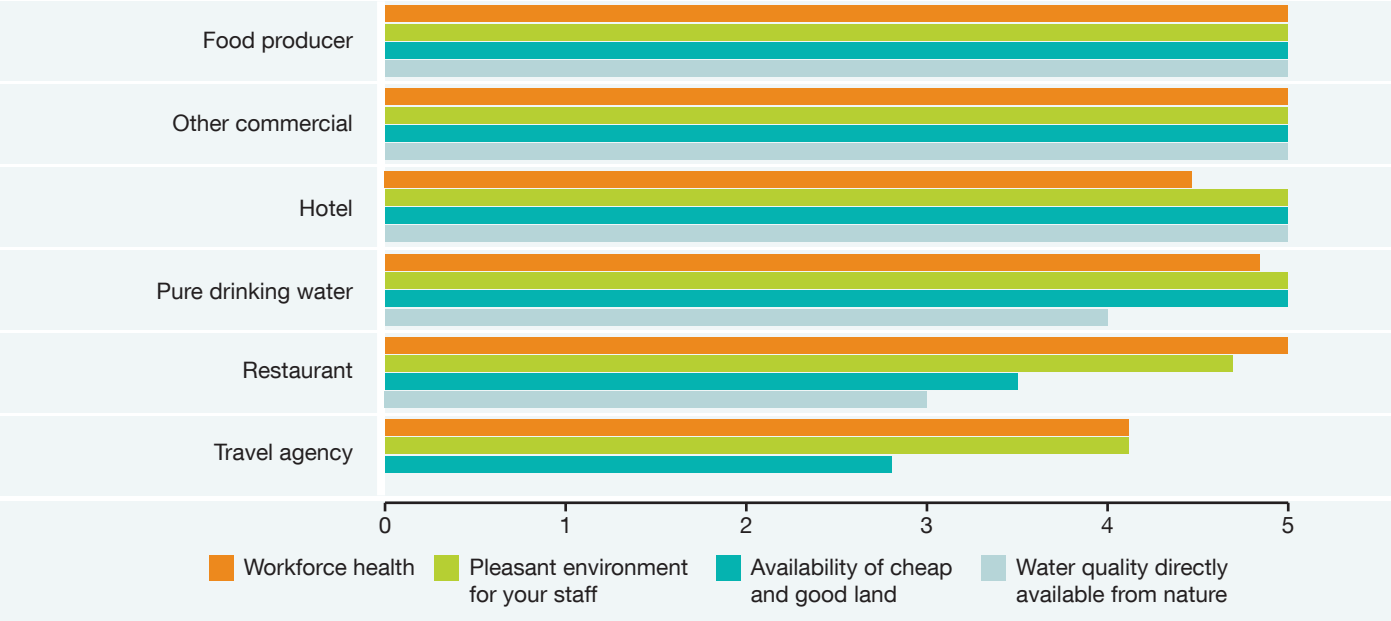


TABLE 25: COSTS OF DOING BUSINESS: PRODUCTION (IN COLUMNS: MAIN SECTORS REPRESENTED)

Variable: Firms who say that ...	No. with response	Sectors					
		Travel agency	Hotel	Restaurant	Other commercial	Pure drinking water	Food producer
HEALTH							
Poor workforce health affects their business (% respondents)	100	100	100	100	100	100	100
WATER							
Water quality is not adequate (% respondents)	0	0	33.33	0	0	0	0
Poor water quality affects their business (1 = unimportant; 5 = important)	3.7	5.0	5.0	5.0	4.6	5.0	
They treat their own water (% respondents)	0%	50%	35%	100%	100%	100%	
Average monthly cost of water treatment	n/a	$1,900	$70	$600	$4,183	$1,867	
POOR LOCAL ENVIRONMENT (1 = UNIMPORTANT; 5 = IMPORTANT)	4.7	3.5	5	5	5	4.7	
Affects customers	5.0	3.0	5.0	1.0	3.6	3.0	
Affects current workers	5.0	3.0	4.7	1.0	3.2	2.7	
Affects staff recruitment	2.5	3.0	3.0	1.0	4.2	2.7	
Affects suppliers	n/a	2.0	4.3	1.0	3.4	2.7	
Affects other company stakeholders	5.0	2.5	5.0	1.0	3.8	2.3	
Average monthly cost of environment cleanup	US$165	US$450	US$537	US$50	US$100	US$127	
OTHER ASPECTS							
Loss of business days due to local environmental factors (% respondents)	0%	0%	35%	0%	0%	35%	
Fines paid for poor environment	0%	50%	0%	0%	0%	0%	
Considered moving production facilities to industrial parks	0%	0%	0%	100%	20%	0%	

Table 26 shows the actual impacts of poor sanitation on the sales of firms. All firms in each sector said polluted environment around sales offices would have a negative influence on their business operations, both for customers and employees. This suggests that sanitation is very important for business operations and receives much attention from firms. When asked whether they plan to move to another location, 50% of hotels, 100% of commercial firms, 40% of pure drinking water firms, and 35% of food producers, wish to move to new and cleaner locations. Some of them cite insufficient finances and lack of alternative locations as the main reasons that prevent them from moving.

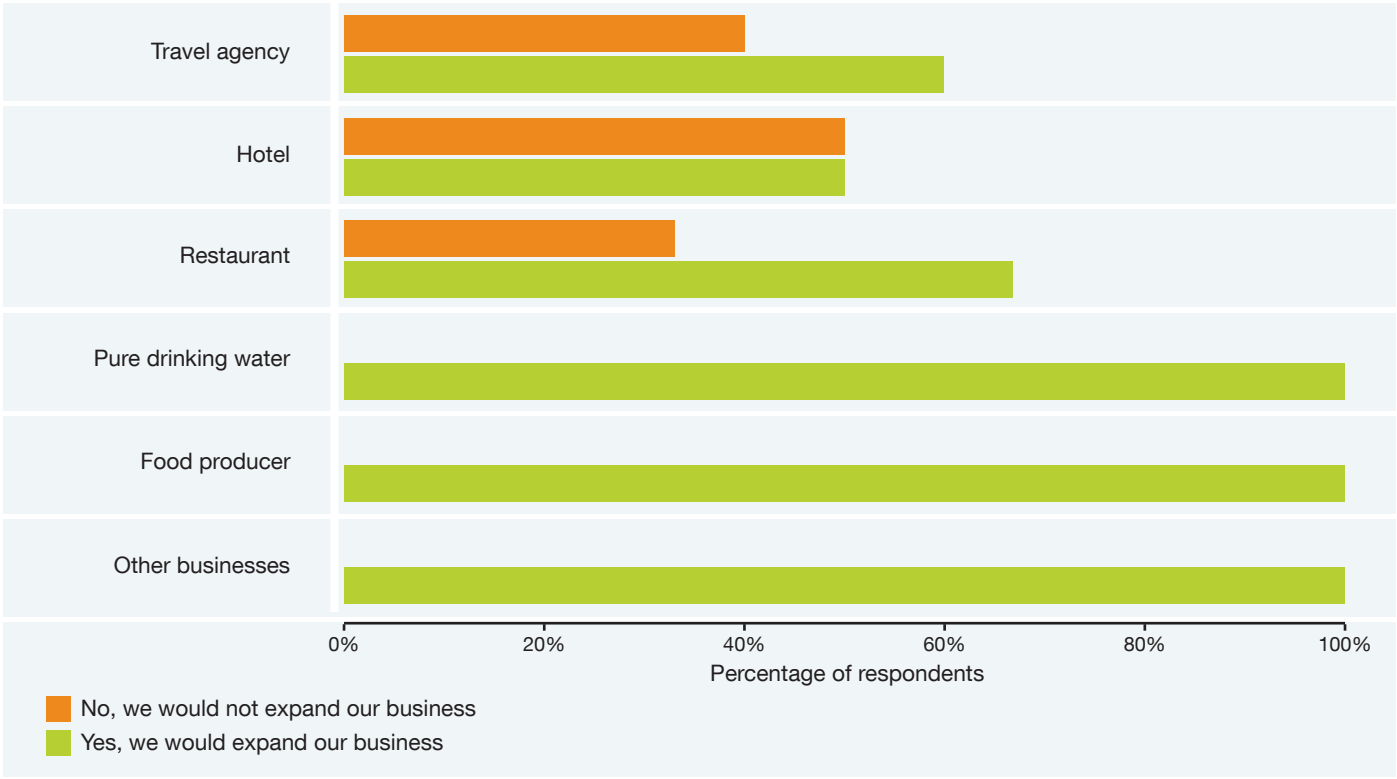
Figure 35 illustrates a relationship between improved sanitation and business expansion. If sanitation is improved, 67% of restaurants and 60% of interviewed travel agencies will expand their business operations, and 50% of hotels will do so. This is because they will see more locations with clean environments for their business. Interestingly, if sanitation in Cambodia is considerably enhanced, pure drinking water companies, food producers, and other businesses will expand their businesses. In fact, businesses believe that they will gain by improved sanitation through increased productivity of staff, reduced sanitation costs, improved quality of products and services, more tourist arrivals and new markets.

TABLE 26: COSTS OF DOING BUSINESS: COMPANIES WORKING IN SALES

What the firms say	Sectors					
	Travel agency	Hotel	Restaurant	Other commercial	Pure drinking water	Food producer
"The location of our sales office affects business" (% respondents)	100%	100%	100%	100%	100%	100%
"We have taken the following measures to deal with the poor environment"	Use spray everyday and clean by ourselves	The goal of hotel is to make it clean all time	Hire cleaners and managers to oversee the cleaners	We always want clean air and increase the air quality around us	Use vacuum cleaner and dryer machine	Prepare and clean this place
"We have considered moving sales outlets to other parts of town" (% respondents)	0%	50%	0%	100%	40%	35%
"Factors preventing moving are…"	n/a	n/a	n/a	n/a	We need more land but are afraid of not having enough electricity	We do not have much money to support business development
"Other factors keeping us here are…"	No plan, we are comfortable here	n/a	Workplace is already clean	n/a	n/a	Economic reasons

n/a = not applicable

FIGURE 35: IMPLICATIONS OF IMPROVED SANITATION FOR BUSINESSES EXPANDING THEIR ACTIVITIES (%)



VI. Costs of Improved Sanitation and Hygiene

This chapter presents a summary of costs of different sanitation technologies and projects, in various formats for decision makers. Annex I presents more detailed financing data on each project.

6.1 COST SUMMARIES

Table 27 summarizes the composition of average cost per household for different hygiene and sanitation options in rural and urban areas. Capital cost is the initial start-up cost of putting hardware in place while program cost reflects software components of the intervention such as promotion, education, training, monitoring and management. It should be noted that the hygiene costs presented are in addition to sanitation costs. The hygiene cost generally includes the cost of personal care and preventive measures to reduce incidence and spreading of diseases and in this study the hygiene cost includes the cost of soap purchase, which is estimated at US$0.39 per household per year.

The two common sanitation options for rural householders are a wet (pour-flush) pit latrine and dry pit latrine.

An unlined simple dry pit latrine, constructed in the context of a CLTS program, costs US$74 for initial investment costs (US$20 hardware and US$54 program costs) and US$2.4 per annum for recurrent cost. As this latrine

TABLE 27: SUMMARY OF AVERAGE COST PER HOUSEHOLD FOR DIFFERENT TYPES OF SANITATION, USING FULL (ECONOMIC) COST (US$, 2008)

Cost Items	CLTS dry pit	Concrete ring dry pit	Rural wet pit	Urban wet pit latrine	Urban sewerage (Ideal)	Urban sewerage (Actual)
INVESTMENT COSTS: INITIAL ONE-OFF SPENDING (US$)						
1. Capital	20	86	116	211	5,040	16,794
2. Program	54	65	52	-	223	743
SUB-TOTAL	74	151	168	211	5,263	17,537
RECURRENT COSTS: AVERAGE ANNUAL SPENDING (US$)						
3. Operation	-	1.1	-	-	8	26.7
4. Maintenance	2.4	1.7	1.9	12.9	8	26.8
5. Program	-	1.9	-	-	-	
SUB-TOTAL	2.4	4.7	1.9	12.9	16.1	53.5
AVERAGE ANNUAL COST CALCULATIONS						
Duration[1] (year)	1	3	8	20	20	20
Cost/household (US$)	76.4	63.2	31.1	34.4	552.1	1,839
Cost/capita	15.5	12.5	6.6	6.7	107.6	358.5
OF WHICH:						
% capital	26%	53%	65%	62%	93%	95%
% program	71%	40%	29%	0%	4%	4%
% recurrent	3%	7%	6%	38%	3%	0%
Observations[2]	165	120	285	114	-	152

[1] Refers to length of life of hardware before full replacement.
[2] Number of households surveyed.

is expected to last for only one year on average (based on field observations and MRD's CLTS evaluation report), the life cycle annualized average cost is US$74.6 per household. Start-up program costs account for 71% of the annualized cost in this CLTS program. However, this finding reflects the specificities of this CLTS program and such high program costs per household are unlikely to be found in other CLTS projects. Furthermore, in subsequent years, the program costs per household are likely to be reduced as the same initial groundwork of CLTS does not need to be repeated.

In the World Vision project, the dry pit latrine with concrete rings is conservatively expected to last for three years. With an investment cost of US$151 (US$86 hardware and US$65 program costs) and a recurrent cost of US$4.7, the life cycle annualized cost per household is US$63.2.

The investment cost of a pour-flush latrine averages US$168, with an average operational (recurrent) cost of US$1.9 per year. Based on an expected life of eight years, the life cycle annualized average cost is US$31.1 per household, or US$6.6 per capita. Due to the longer expected length of life of a pour-flush latrine compared with an unlined dry pit latrine, the annualized costs are significantly lower for the pour-flush latrine than the dry pit latrines with a shorter lifespan.

Interestingly, adopting a low cost latrine option which lasts for shorter periods of time actually incurs a higher annualized cost per household than a longer lasting and more expensive option (see Figure 36). This high annual cost mainly accrues to the program cost which becomes 2-6 times higher than others. However, this result needs careful interpretation. First, the program costs in subsequent years for rebuilding collapsed simple pit latrines is likely to decrease drastically from the first year costs of US$54 per household, hence making latrines delivered through CLTS considerably cheaper in terms of annual cost. Second, more expensive options are less financially unaffordable to the average rural household due to the high up-front capital costs. Therefore, improving the quality of the intervention by making a more affordable and long lasting toilet available to the community would reduce both the up-front cost and the annualized cost.

In urban areas, septic tanks and sewerage are the two main improved sanitation options for urban householders in Sihanoukville. The investment cost of wet pit latrines with a tank is US$211 while the average operation cost is US$12.9 per annum. Hence, the life cycle annual average cost per household is US$34.4, with an assumed length of life of 20 years. While the sewerage also has a lifetime of 20 years, it needs an investment cost of US$17,537 and an annual recurrent cost of US$53.5. Thus, the life cycle annualized average cost for households with a sewerage connection and wastewater treatment is US$1,839. The annual average cost of hygiene practice for urban households is US$0.71.

Figure 36 shows the annualized cost breakdown of each latrine in rural areas in the study areas.

FIGURE 36: LIFE CYCLE ANNUAL ECONOMIC COSTS PER RURAL HOUSEHOLD FOR MAJOR ITEMS (US$, 2008)

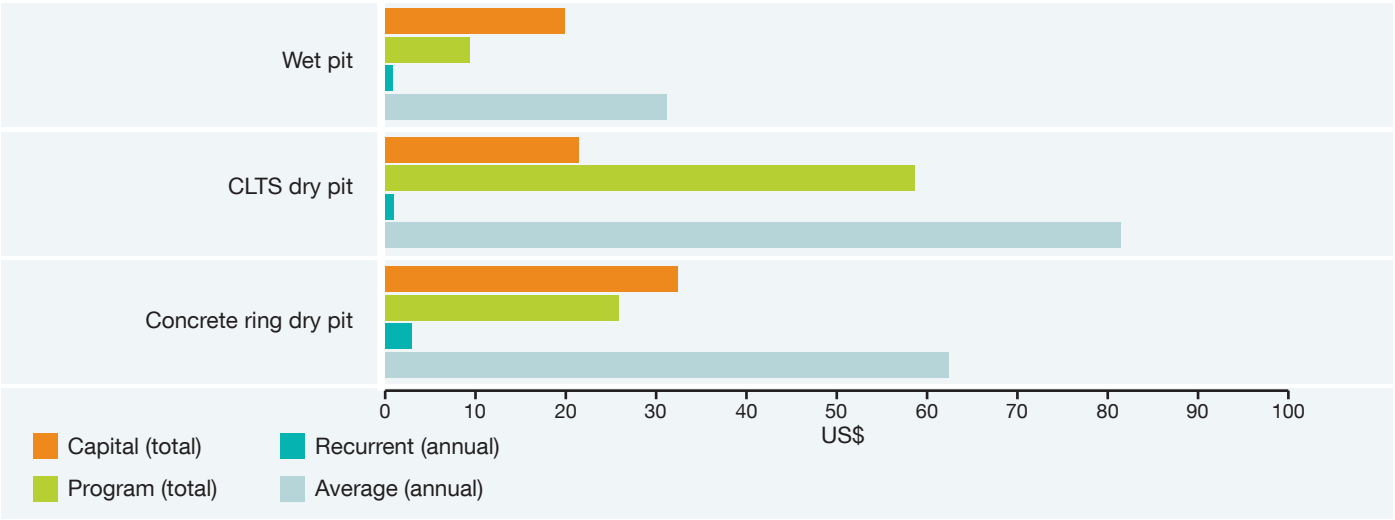


FIGURE 37: ECONOMIC COSTS PER URBAN HOUSEHOLD FOR MAJOR ITEMS – AVERAGE ANNUALIZED COSTS (US$, 2008)

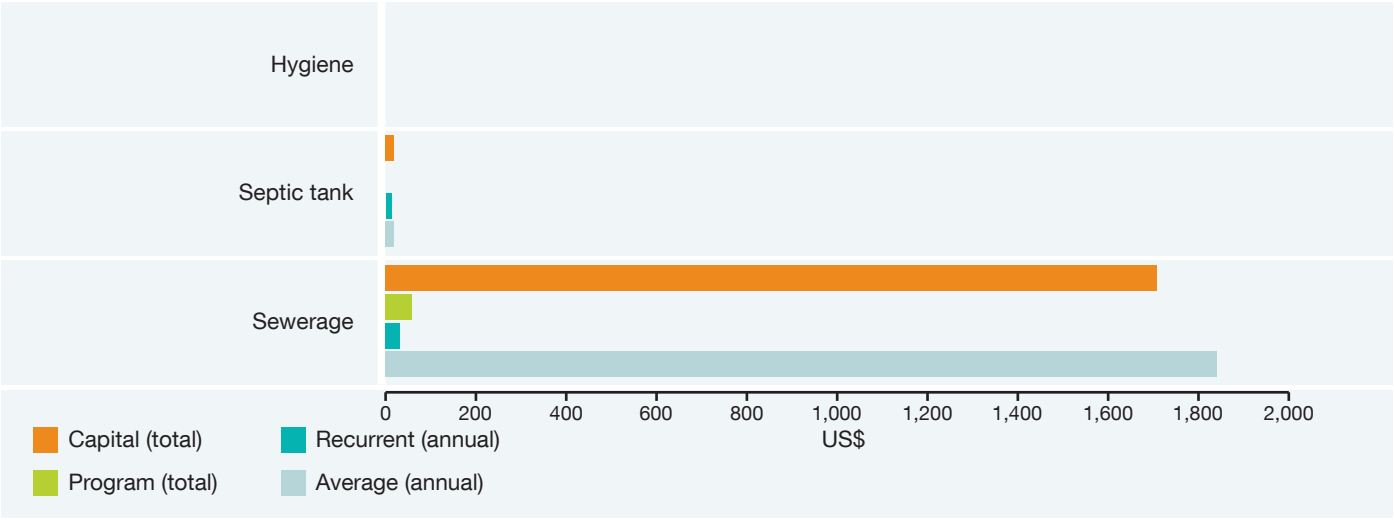
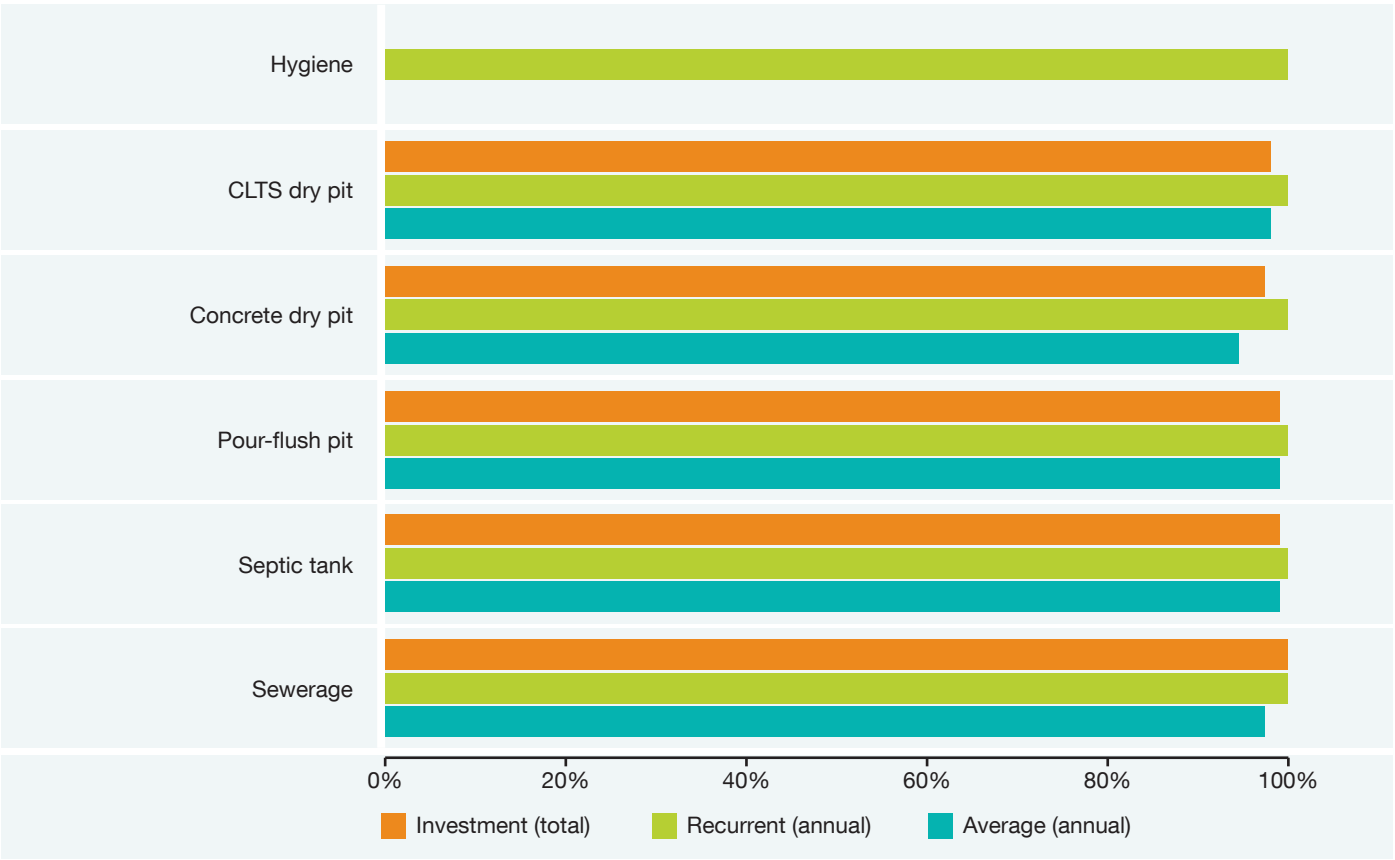


FIGURE 38: PROPORTION OF TOTAL (ECONOMIC) COSTS WHICH ARE FINANCIAL, ACROSS ALL FIELD SITES (%)



The composition of economic costs for sanitation and hygiene options in urban areas including hygiene practice, pit latrine with tank and sewerage connection is shown in Figure 37. The life cycle annualized capital cost of a sewerage connection is US$1,839, which is much higher than the annualized cost of a wet pit latrine, which is US$34.4. Similarly, the annual recurrent cost of a toilet connected to sewerage is US$53.5 while that of the wet pit latrine is US$12.9. Since the toilet with a sewerage connection has a large amount of investment cost for the sewerage system and wastewater treatment plant, the annualized cost per household is much higher than the cost of a wet pit latrine.

Figure 38 presents the proportion of total economic cost for hygiene and sanitation interventions, which are financial. The recurrent cost of all hygiene and sanitation options is totally financial. For rural areas, financial investments come to 97% for CLTS dry pits, 97% of total investment for concrete ring dry pits, and 98% for wet pit latrines, respectively. Consequently, 97% of the average life cycle annual cost per household for concrete ring dry pit latrines are financial and 3% non-financial, which is in the form of around 15 hours of labor to dig a pit and construct the latrine. For a wet pit latrine, labor input averages 17 hours, which represents 2% of total investment cost as non-financial. For urban areas, the wet pit latrine with a tank and to sewerage option costs are made up of 99% and 100% of financial costs, respectively. These findings indicate that the majority of the costs of hygiene and sanitation interventions are financial in nature, which are focused on initial investment and ongoing operation and maintenance of hardware.

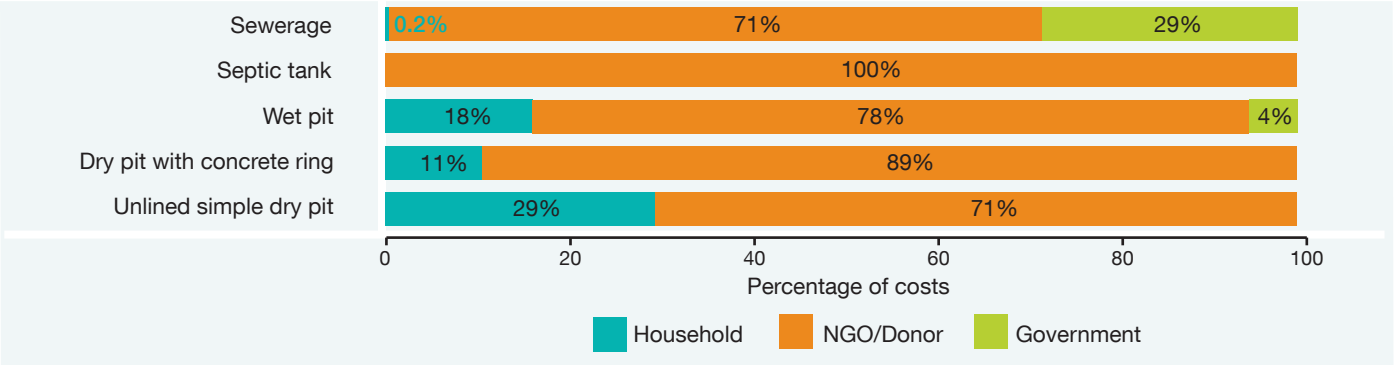
6.2 FINANCING SANITATION AND HYGIENE

The financing sources for sanitation interventions in both rural and urban study projects are shown in Figure 39. For concrete dry pit latrines, 89% of total costs are financed by NGOs while another 11% are from households. However, for the simple pit latrine under the CLTS project, the households' financing contributes 29% of latrine construction, while NGOs contribute 71% of total costs, the latter consisting of program costs. For wet pit latrines, 78% of total costs are from NGOs, 18% are from households, and the other 4% are financed by the government. Overall, for rural projects, around 80% of total latrine investment costs are contributed by NGOs or governments in the form of hardware contribution or program cost, while the households contribute from 10% to 30%, depending on the project.

For the urban wastewater management project in Sihanoukville, 70.8% of the initial costs were financed by an external donor, the Asian Development Bank. As part of the grant agreement, the Government of Cambodia contributed 29%, and 0.2% of investment costs were funded by households. The ADB contribution mainly covered the construction of the sewerage network and wastewater treatment plant, while the government contributed to the construction costs, and is responsible for financing the recurrent costs. To partially repay the investment cost, households are charged a connection fee, and also a monthly service fee to cover recurrent costs.

If the total investment cost of each type of sanitation intervention is compared with the annual consumption per household, it can be seen that the cost is rather high for the poorest quintile and very low for the richest quintile. Figure 40 shows that for rural areas, the cost of a wet pit latrine has the highest cost as a proportion of annual household consumption for every quintile, while the cost of an unlined dry pit latrine is the lowest. For Cambodia as a whole, the cost of a wet pit latrine is around 6.9% of annual household consumption, 3.0% for a CLTS dry pit latrine, and 6.2% for a concrete ring dry pit latrine. For the poorest quintile, the cost of an unlined dry pit latrine is about 8.2% of annual household consumption, while it is 16.8% for a concrete ring dry pit latrine and 18.7% for a wet pit latrine. These findings demonstrate that the cost of intervention of each type of latrine is a significant burden for poor households. However, the cost would be lower if the program cost is

FIGURE 39: PROPORTION OF UPFRONT SANITATION COSTS FINANCED FROM DIFFERENT SOURCES (%)



excluded and other low cost technologies are used to build the latrine. The decision to improve sanitation is influenced partly by the initial investment cost, and also the recurrent costs. Households with a lower cash income will be more sensitive to hygiene and sanitation costs. Therefore, the analysis here focuses on the financial costs to the household.

To be more specific, the annual intervention cost per household is compared with the average annual household consumption for each quintile. The cost includes all costs, irrespective of payer. Figure 41 shows the annual costs of an unlined dry pit latrine and concrete ring dry pit latrine are of the highest proportion in all quintiles. The high proportion of both types of latrines is because the lifetimes are shorter hence giving rise to higher annualized costs than wet pit latrines. For Cambodia as a whole, the annual cost of an unlined dry pit latrine is 3.4% of annual consumption per household, and it is around 2.6% for a concrete ring dry pit, and 1.3% for wet pits. For the poorest 20% quintile, the annual cost of a CLTS dry pit is around 9.2% of annual consumption per household, 7.0% for a concrete ring dry pit latrine, 3.5% for a rural wet pit latrine, and 3.8% for a latrine connected to a septic tank.

FIGURE 40: INVESTMENT COSTS AS PERCENTAGE OF ANNUAL HOUSEHOLD CONSUMPTION BY QUINTILE (%)

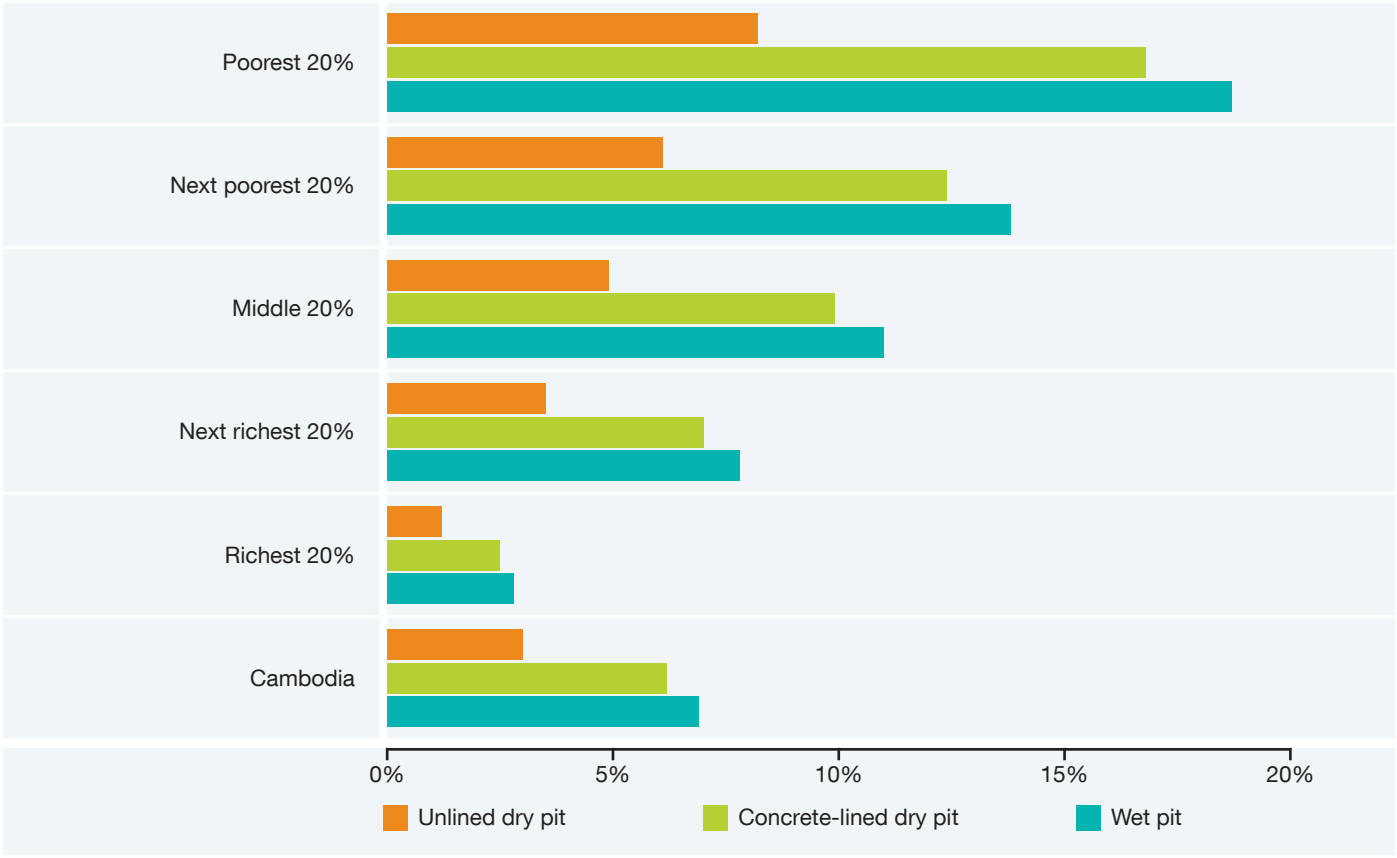
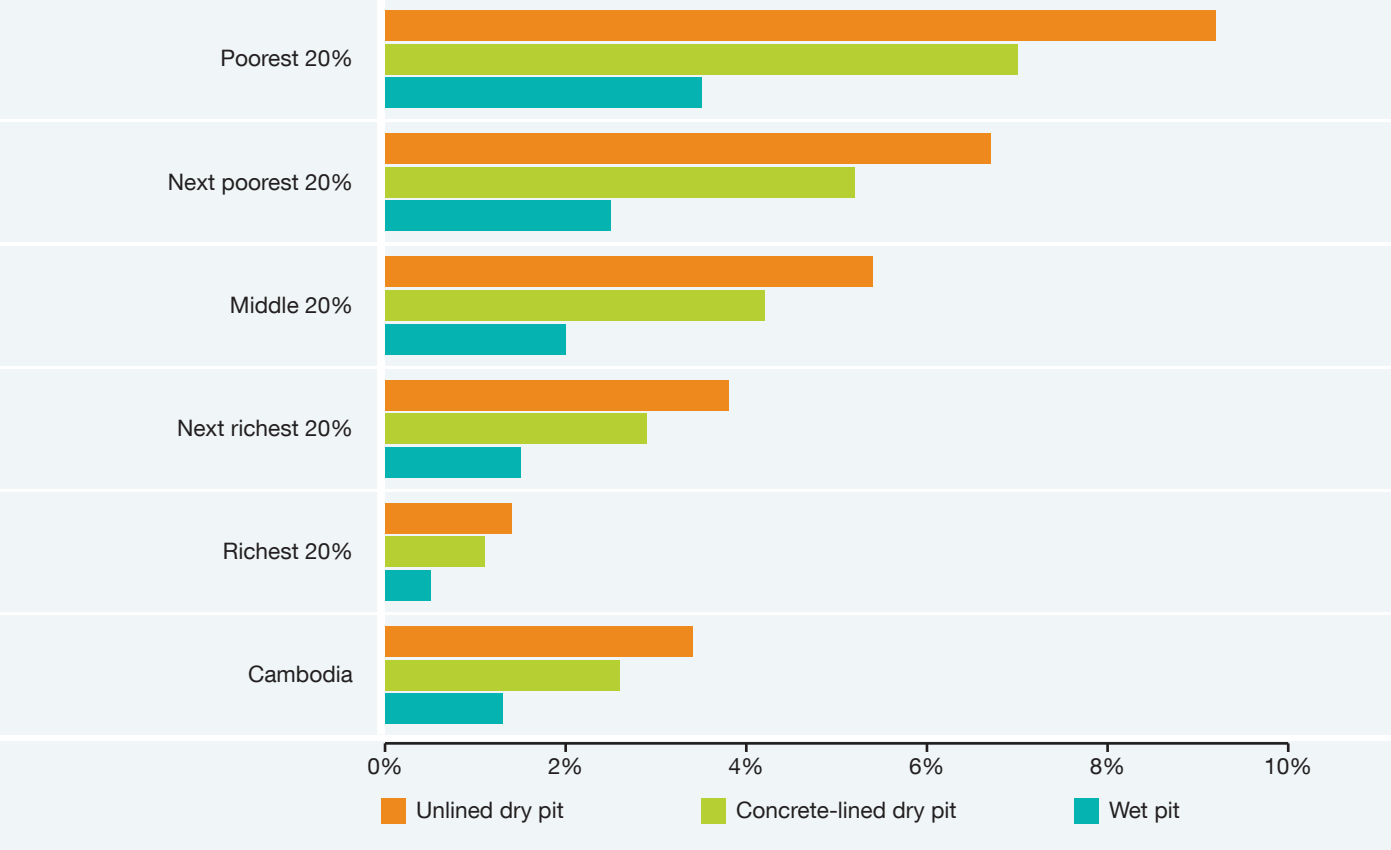


FIGURE 41: ANNUAL INTERVENTION COST AS PERCENTAGE OF ANNUAL HOUSEHOLD CONSUMPTION, BY QUINTILE (%)



VII. Sanitation Program Design and Scaling Up

7.1 PROGRAM APPROACH ANALYSIS FROM FIELD SITES

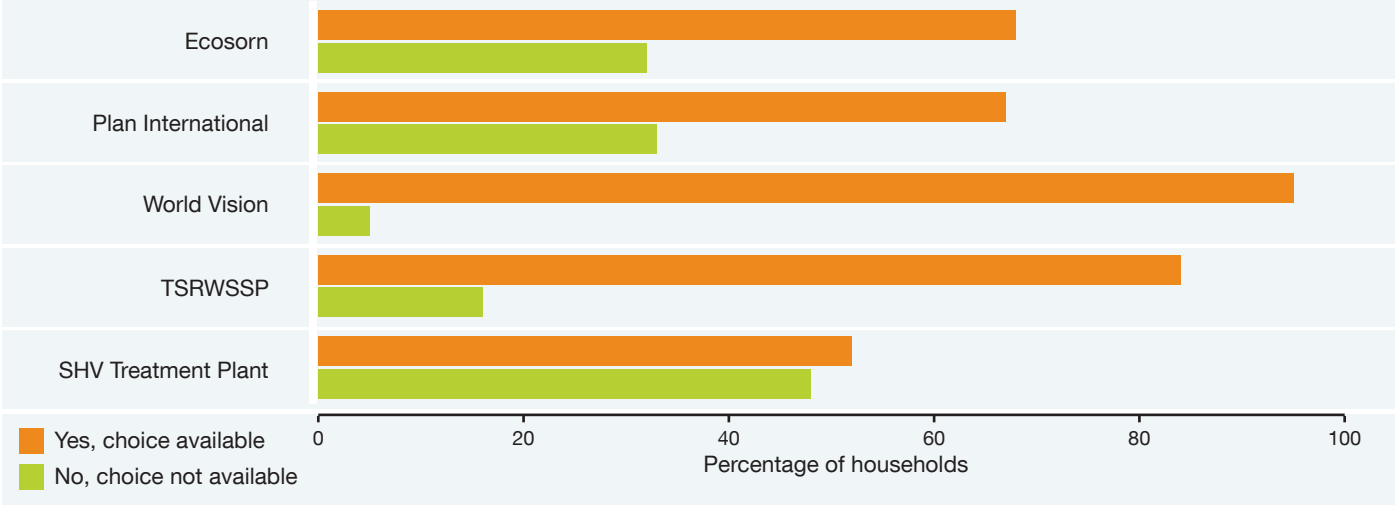
Table 28 shows program information in terms of starting and finishing coverage for each project. The initial sanitation coverage for all projects is below 5%. This means that most households in rural areas were practicing open defecation before the projects started, and in urban areas the open drainage system was discharging untreated wastewater to the receiving water body. After the project interventions, there is much improvement in the targeted areas. In ECOSORN project sites, the coverage has increased to 30% of the population in the targeted areas, who have a latrine at home, and it is 80% for Plan International project areas. But the dry pit latrines in Plan International sites do not last long, less than one year, so the rate fluctuates. For World Vision sites, the project provides 100% coverage in the selected study sites and it is 66% for TSRWSSP sites. For urban sites, the connection rate increased to 30% after the wastewater treatment plant and sewerage network were built.

Respondents were asked if they were provided options for their latrines, 68% of respondents in ECOSORN sites report that other options were available for them while 84% of respondents in TSRWSSP sites reported this. World Vision sites report the highest response of being given many choices (see Figure 42).

TABLE 28: SANITATION COVERAGE INFORMATION PER FIELD SITE

Site	Rural/ urban	Total households reached by program	Project start		Project end	
			Year	Coverage (%)	Year	Coverage (%)
ECOSORN	Rural	6,223	2006	<5%	2010	30
Plan International	Rural	3,942	2006	<5%	2010	80
World Vision	Rural	748	2006	<5%	2008	100
TSRWSSP	Rural	34,888	2006	<5%	2010	66
Sihanoukville Wastewater Treatment Plant	Urban	1,010	2003	0%	2006	30

FIGURE 42: MORE THAN ONE OPTION GIVEN TO HOUSEHOLDS (%)



A total of 822 households with toilet facilities were interviewed under the ESI field research to understand: (1) the financial value of the household's contribution versus project funding – i.e. in terms of the proportion of households making a contribution, and the value of these household inputs – and (2) the proportion of households with the appropriate technology for water and sanitation services.

The respondents from the wastewater management project in Sihanoukville – the only urban project site in the study – recorded the highest household expense of US$274. This was also true for the value, and composition, of household inputs; respondents here only contributed cash, whereas the households in rural project sites contributed both cash and materials.

In all rural projects, households contribute to the projects in terms of both financial and non-financial resources to the projects. While financial resources refer to the monetary contribution or the money required to purchase certain materials for latrine construction, non-financial resources refer to labor and materials that are sourced locally. According to the survey, households who live in Plan International project sites contribute an equivalent of US$20 while those in World Vision sites contribute US$17 for a toilet. As the Plan International project implements the CLTS approach, households are responsible for the cost of dry pit latrine construction while the project pays the program (software) cost. For wet pit latrines, households in ECOSORN project sites contributed an equivalent of US$30 while those in TSRWSSP sites contributed US$26. Households' contribution varies from one household to another as some households have invested substantially to upgrade their latrines from a simple latrine to a larger latrine with showering/bathing facility. The project requires households to contribute only a certain amount of the total cost in the form of labor and materials based on the construction structure the household wishes to have. For toilets connected to sewerage, the households would spend around US$19 on average for the connection fee as they have latrines already. Figure 43 shows the contribution by household in financial and non-financial terms in order to obtain a latrine in comparison to the project contribution, which is borne by an NGO and the government. It is noted that in all cases, the project contribution is very much higher than household contribution. The project contribution in TSRWSSP per latrine is the highest among others while that of Plan International is the lowest. The lowest project contribution per latrine of the latter can be explained by the fact that Plan International does not pay any hardware subsidy, while the other projects do.

Table 29 presents the data pertaining to those households with the appropriate technology for water and sanitation services. This was measured with respect to the proportion of households: (1) with insufficient water for flushing; (2) with pit flooding; and (3) with pit overflow. All three were measured in terms of their frequency, recorded as either "Sometimes" or "Often."

FIGURE 43: FINANCIAL VALUE OF HOUSEHOLD VERSUS PROJECT CONTRIBUTION (US$, 2008)

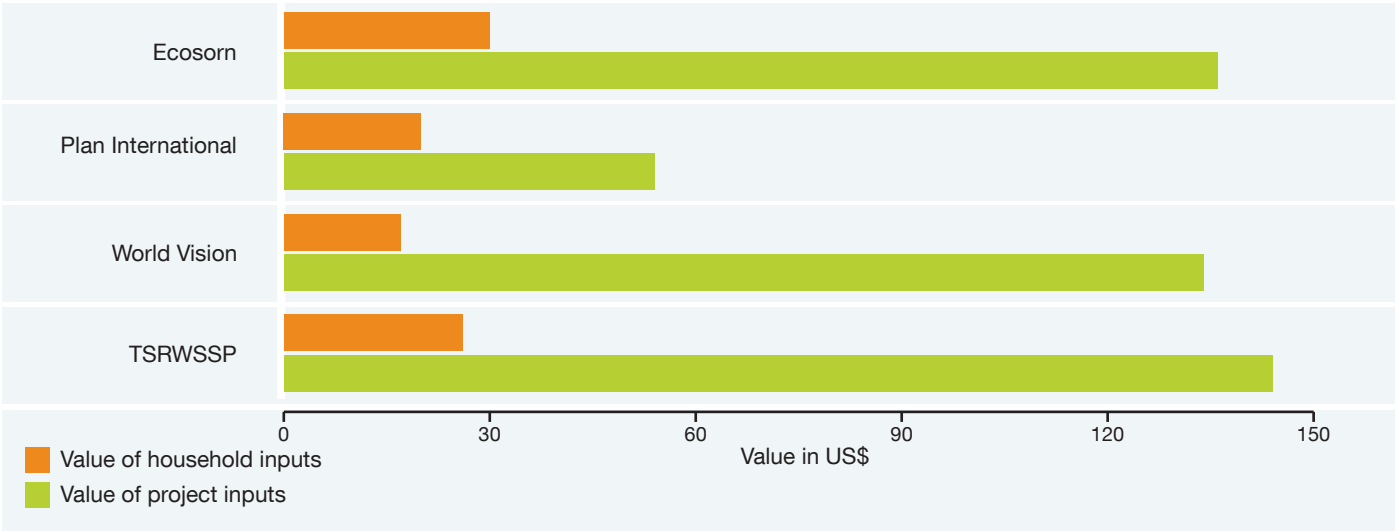


TABLE 29: INDICATORS OF APPROPRIATENESS OF SELECTED TECHNOLOGIES

Site	Rural/ urban	Number of households interviewed	% households with insufficient water for flushing		% households with pit flooding		% households with pit overflow	
			Sometimes	Often	Sometimes	Often	Sometimes	Often
ECOSORN	Rural	120	4.2%	0.0%	n/a	n/a	n/a	n/a
Plan International	Rural	165	n/a	n/a	21.8%	18.8%	4.8%	22.9%
World Vision	Rural	120	n/a	n/a	10.9%	3.0%	1.9%	3.8%
TSRWSSP	Rural	159	4.0%	0.0%	n/a	n/a	n/a	n/a
Sihanoukville Treatment Plant	Urban	266	0.0%	0.0%	n/a	n/a	n/a	n/a

The respondents at the Plan International project site were reported as having the highest proportion of households with pit flooding, with 21.8% stating this occurs "Sometimes" and 18.8% stating this occurs "Often." The project site also had the highest proportion of households reporting pit overflow, with 4.8% responding "Sometimes" and 22.9% responding "Often." The interviewed households at the World Vision site also reported pit flooding and pit overflow, although at a lower frequency. For pit flooding, 10.9% reported that this occurs "Sometimes" and 3.0% responded that it occurs "Often," whereas pit overflow was reported at 1.9% for "Sometimes" and 3.8% for "Often."

On the other hand, households at the ECOSORN and the TSRWSSP project sites reported an insufficient amount of water for flushing. Neither of the project sites' respondents stated that this occurred "Often," although 4.2% of households in ECOSORN project sites and 4.0% of households in TSRWSSP project sites reported that the lack of water for flushing occurs "Sometimes."

None of the respondents from the urban project site and the urban wastewater management project in Sihanoukville, reported an insufficient amount of water for flushing.

Figure 44 presents selected indicators of overall effectiveness of sanitation projects in both rural sites and the urban site, regarding the improved sanitation indicators of the households. A fuller set of indicators is provided in Table 30. In general, the urban site performs better than rural sites in almost all aspects of sanitation, which is common for the situation in Cambodia where rural sanitation and hygiene are still relatively undeveloped.

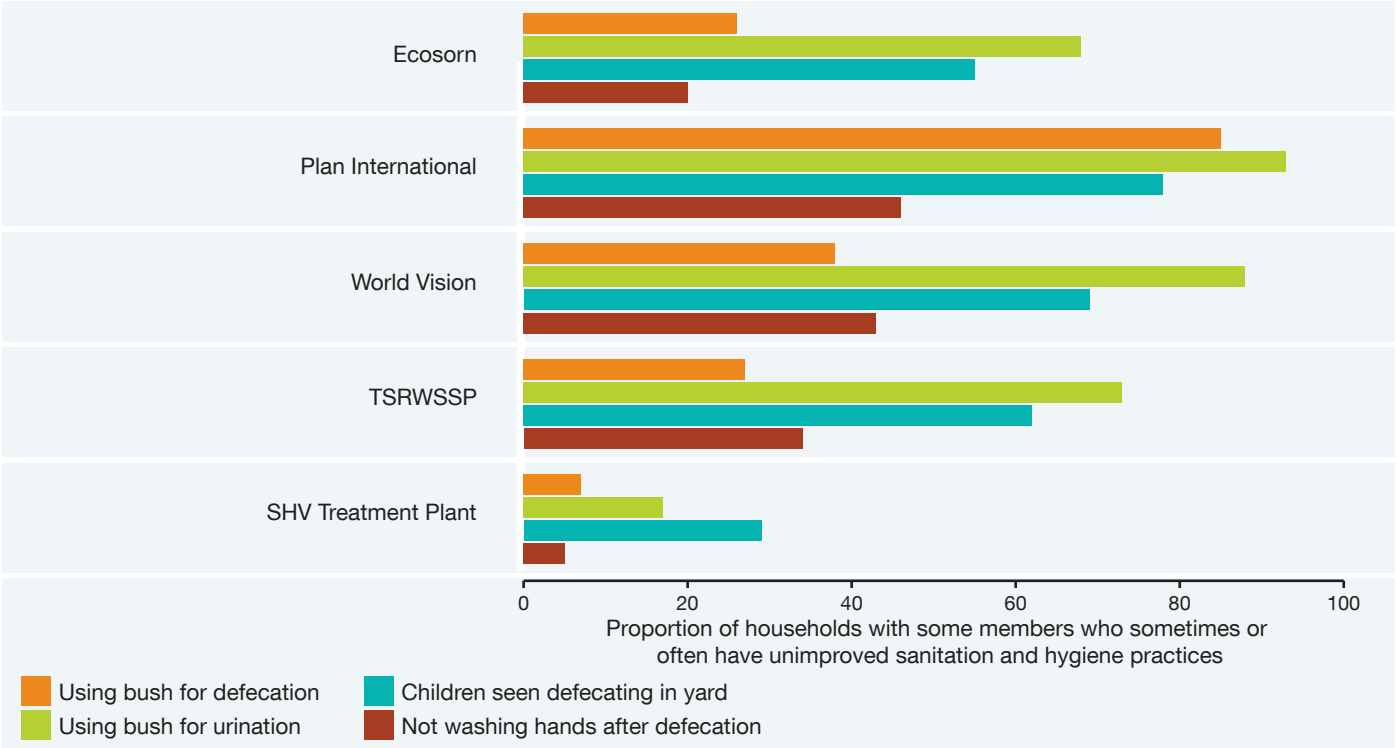
Even though many households have received sanitation interventions, some of them still go to the bush for defecation. Seven percent of total respondents with latrines in urban sites in Sihanoukville still go to open spaces for defecation. For households with latrines in ECOSORN sites and TSRWSSP sites, only 26% and 28% of them go to the bush respectively while it is 38% for World Vision sites. Eighty-five percent of households with latrines in Plan International sites still go to the bush. This tends to show that many people in rural areas cannot adapt easily to latrine use and in many cases their latrines collapsed recently (before the survey)[12] and hence they currently have no household latrine to use. Also, regarding the urination in the bush, 93% of households with sanitation coverage in Plan International sites still do not always urinate in the toilet in the toilet, followed by 88% in World Vision sites, 73% in selected areas of TSRWSSP sites, and 68% in selected areas of ECOSORN sites. In contrast, there are only 17% of households in Sihanoukville sites practicing urination outside their toilets.

The proportion of children using toilets is still low in rural areas while it is higher in urban areas, as shown in Figure 44 and Table 30. According to Table 30, households claim high rates of hand washing with soap the day before the interview, but soap was observed as being available in a significantly lower proportion of households.

Twenty to forty-six percent of households interviewed in rural sites do not practice hand washing after defecation, while the rate is 5% in Sihanoukville. Soap availability in the toilet for hand washing is very high in the urban project site, at 94% of the latrines visited. In rural project sites,

[12] CLTS program of the Plan International project is to raise sanitation awareness among people and convince them to build their own pit latrine at low cost. However, that kind of latrine does not last long and collapses when the rainy season comes. As a result, many households fail to reconstruct their latrines. The details can be found at MRD's formative evaluation report on CLTS in Cambodia.

FIGURE 44: PROPORTION OF HOUSEHOLDS WITH IMPROVED SANITATION WHO CONTINUE WITH UNIMPROVED SANITATION AND HYGIENE BEHAVIOR (%)



however, only one-third of toilets visited in World Vision and TSRWSSP have soap. The rate of availability of soap is higher in ECOSORN site, at 43%. No households whose pit latrine was visited in the CLTS sites had soap for washing hands, although 54% of householders reported hand washing after defecation.

7.2 DISCUSSION

Given that the five projects evaluated in this study are implementing different approaches, it is instructive to have a closer look at the effectiveness, efficiency, and impacts of each approach, as well as its potential to be put into practice or for implementation. It should also be noted that the analysis is only on the areas the study team visited and does not represent all areas covered by each project. However, the study tries to analyze the approach itself, not the project.

With the current approach of each project, the impacts differ from each other and to different extents, and therefore it is not easy to compare them. For the ECOSORN project site, the sanitation coverage has increased in the targeted areas during the period of the project intervention. The project adopts the subsidy approach to the target households. However, the project is not intended to cover 100% of the target villages and only a few households have built their own latrines without support from the project.

TSRWSSP is a project funded by ADB and RGC and implemented by the Ministry of Rural Development. The project is intended to provide 100% sanitation coverage to targeted villages. However, this is not achieved in all villages as there are many challenges on the ground. Its approach is to subsidize households to build their own latrines with their contribution based on the selected type of latrine. Interestingly, while the project provides many options for households to select from, most people tend to opt for a pour-flush latrine, rather than a more affordable dry pit latrine. In this regard, the poor often cannot afford the required financial contribution to the high-cost preferred latrine option, and thus cannot benefit from the project. Instead the non-poor have tended to benefits from the subsidy[13].

[13] Robinson A. 2010. Sanitation finance in rural Cambodia: Review and recommendations. WSP and ADB.

TABLE 30: INDICATORS OF OVERALL PROGRAM EFFECTIVENESS

Variable	Rural sites				Urban sites	All
	ECOSORN	Plan International	World Vision	TSRWSSP	SHV Treatment Plant	
Households interviewed	230	245	170	250	285	1180
Years of program	5	5	3	5	4	
Toilets received	6223	3942	748	34888	1010	
Toilets/year	1245	788	249	6978	253	
Approx. cost/HH (US$)[1]	167	76	156	173	17,590	
Pit/toilet type	Wet pit	Unlined dry pit	Concrete ring dry pit	Wet pit	Flush to WWTP	
% HH contribution to cost	19	29	11	16	2	
% IMPROVED SANITATION HOUSEHOLDS, WITH MEMBERS SOMETIMES OR OFTEN:						
Using bush for defecation	26	85	38	27	7	37
Using bush for urination	68	94	88	73	17	68
Children using latrine	44	40	32	33	54	41
Children seen defecating in yard	55	78	69	62	29	59
Washed hands with soap yesterday	80	68	58	79	98	76
Washing hands after defecation	80	54	57	66	95	70
% IMPROVED SANITATION HOUSEHOLDS, OBSERVED:						
Using well which is not covered	74	43	59	14	29	44
Using bucket to withdraw water from well	87	84	83	44	32	66
Signs of feces/waste around toilet	2	nd	nd	7	3	2
Signs of insects in toilet	63	100	nd	79	71	62
Running water in or near toilet	8	nd	nd	12	57	15
Soap available for washing hands	43	0	33	35	94	41

[1] This cost only takes into account the basic latrine components without additional accessories added by households such as water trough, tiles, toilet room expansion, etc.
nd - no data recorded

Plan International has adopted the CLTS approach and it is seen that this approach works well in creating demand for a latrine, yet the latrine structure resulting from the process is still questionable. During the survey, it was observed that the dry pit latrines built by the households after the demand triggering do not last long due to a weak structure and an unlined pit. The sanitation coverage seems to increase rapidly at first but drops sharply as the households are reluctant to rebuild after the latrine collapses.

Under World Vision's approach of subsidizing the dry pit latrine for households, the cost of a latrine is relatively high compared to other dry pit latrines due to the provision of concrete rings and a slab. The coverage has increased from 3% at the beginning of the project to 100% coverage after the project since the project aims at subsidizing every family in the project villages to obtain a latrine. The dry pit latrine of World Vision is expected to last much longer than that constructed in Plan International sites. A conservative estimate of a 3-year lifespan is used in the cost-benefit analysis.

Also, the Sihanoukville wastewater treatment plant and sewerage network required huge investment for a limited number of beneficiary households in the area. This leads to a very high cost per household covered, given that around 30% of the target households are actually connected to the sewerage system leading to the WWTP. Many households opt not to pay the connection fee as they do not attach

much importance to the treatment of their wastewater or, apparently, the resulting impacts on coastal (beach) water quality.

The differences observed in subsidy policies and practices of financing and implementing agents can be said to have caused some confusion in Cambodia, as in other countries. While most people in rural areas still do not have their own latrines and practice open defecation, the latent demand or potential unexploited market for latrines is still very high. However, as many households still get their latrines delivered by donor projects, i.e., latrines with a significant hardware subsidy, the incentive for households to make their own independent decision to finance their own latrine is consequently very low. The approach adopted by the ECOSORN and TSRWSSP projects in providing wet pit latrines with a hardware subsidy is very costly to the project, and it generates a culture of "subsidy expectation" among households. The approach of World Vision is similar to those of ECOSORN and TSRWSSP as it is a partial subsidy - the concrete rings and slab provided to households is comparable to the subsidy provided for wet pit latrines. The CLTS approach adopted by Plan International is effective in generating demand for sanitation, but the short lifetime of latrine structure prompts the return to open defecation among households. This requires both improving the quality of CLTS facilitation and monitoring and combining other interventions with CLTS to enable households to improve latrine structure over time.

VIII. Efficiency of Improved Sanitation and Hygiene

This Chapter synthesizes the information presented in Chapters 4 to 7 to estimate the overall efficiency of the sanitation interventions, both ideal and actual program conditions. As a major determinant of sanitation option selection, non-quantified impacts are also presented alongside the quantitative cost-benefit and cost-effectiveness ratios. The chapter consists of three sections:

- Efficiency of sanitation interventions, compared with no option (Section 8.1)
- Efficiency of moving from improved sanitation options to other options "higher" up the sanitation ladder (Section 8.2)
- Contextualization of the results in a national context (Section 8.3)

8.1 EFFICIENCY OF SANITATION AND HYGIENE IMPROVEMENTS COMPARED TO NO FACILITY

8.1.1 QUANTITATIVE ANALYSIS

Economic analysis combines evidence on the cost and benefits of sanitation improvements already presented in earlier chapters, giving a number of alternative measurements of efficiency. Efficiency measures are presented for rural interventions in Table 31 and for urban interventions in Table 32, for a time horizon of an analysis of 20 years. The cost-benefit analysis is conducted under two scenarios: ideal and actual. The ideal scenario is a situation where the latrine is used effectively by every household who receives a latrine. The actual scenario is a downward adjustment on the ideal scenario, taking into account the actual proportion of households using their latrine effectively at the time of the household survey. It is also important to note that, although being quantitative, the study only takes a snapshot of the program at one particular point in time which may not necessarily reflect the overall program evolution and improvement over time. The program may also experience different efficiencies over different locations, which have not been captured in this study due to the limitations in sampling. The different measures of efficiency are discussed in turn:

Benefit-cost ratio (BCR) reflects the average value of the benefit gained from an investment of US$1 of sanitation expenditure. In the actual situation for dry pit latrines, World Vision's ratio is 1.3 while that of Plan International is 0.84. The low rate of Plan International is due to the fact that the dry pit latrines built by households under the CLTS approach mostly collapsed after operating for less than one year which requires reconstruction each time it collapses, and also the significant program costs of the NGO per household toilet constructed. World Vision's dry pit latrine is built with a strong structure (i.e. concrete ring) and lasts longer, and thus reinvestment is not needed until after the (conservatively assumed) three-year life span. However, its cost is marginally higher. The benefit-cost ratios of latrine intervention in ECOSORN and TSRWSSP sites are similar as they provide wet pit latrines to households in rural areas with a similar location. The ratios are 1.9 and 1.7 for sanitation intervention in ECOSORN and TSRWSSP sites respectively. As shown in Table 31, benefit-cost ratios are higher under the ideal scenario. However, to achieve this ideal scenario (of 100% latrine use), more costs would need to be spent on sensitization, quality assurance etc, and hence the investment and recurrent costs would be higher than those observed.

Internal rate of return (IRR) is the interest rate that reflects the benefits from cost of investment. In the actual situation, IRR of World Vision is 60% and that of Plan International projects cannot be calculated as the benefit is lower than the cost. For the ECOSORN sites, the IRR is 45%, higher than that of TSRWSSP sites of 35% even though the two projects offer a similar intervention. The difference is due to the program effectiveness measured in the study where actual use of latrines varies between the

projects. In an ideal scenario, the IRR would be 40% in the Plan International project, 110% in the ECOSORN project, 70% in the TSRWSSP project and 250% for the World Vision project.

Payback period (PBP) is the period required to recover the investment and ongoing recurrent costs. For concrete-lined dry pit latrines, the cost is recovered after two years under the ideal scenario, while for wet pit latrines it takes two to three years, depending on the project. Investment in unlined dry pit latrines is paid back in under one year under the ideal scenario, but under the actual scenario it is never paid back, with a lifespan assumption of one year. If only the household contributions were taken into account in the calculations, the payback period would be reduced significantly to under one year for all pit latrine options.

Net present value (NPV) is the value of a latrine in current prices after the future costs and benefits are discounted at a discount rate of 8%. The NPV difference between the actual and ideal scenarios is quite large for all projects. Under the actual scenario, the NPV of a latrine in World Vision sites is US$204 while that of Plan International sites is negative reflecting the benefit-cost ratio of below one. The NPV for a latrine in the ECOSORN and TSRWSSP sites are US$290 and US$222 respectively. Under the ideal scenario, the NPVs for all projects are higher. It is US$337 for the Plan International site, US$622 for World Vision sites, US$612 for ECOSORN sites, and US$444 for TSRWSSP.

Cost per disease case averted is the average cost that must be invested in sanitation interventions to avoid one case of illness. Under the actual scenario, US$62 has to be spent per household in the Plan International sites to save one disease case, while for wet pit latrines it is as little as US$15 to US$18. Under the ideal scenario, the cost per case averted could be lower for all projects, especially Plan International where the cost could be reduced to US$37 to avert one disease case.

Cost per death averted is the average cost that must be invested in sanitation interventions to save one life. The

TABLE 31: RURAL AREA EFFICIENCY MEASURES FOR MAIN GROUPINGS OF SANITATION INTERVENTIONS, COMPARED TO "NO TOILET"

Efficiency measure	Scenario	Private dry pit		Private wet pit	
Field sites included per option[1]		Plan International	World Vision	Ecosorn	TSRWSSP
Option sub-types included		Unlined Dry Pit (CLTS)	Concrete-lined Dry Pit	Wet Pit (offset)	Wet Pit (offset)
COST-BENEFIT MEASURES					
Benefits per US$1 input ($)	Ideal	1.4	2.0	2.9	2.3
	Actual	0.84	1.3	1.9	1.7
Internal rate of return (%)	Ideal	40%	250	110	70
	Actual	-	60	45	35
Payback period (years)	Ideal	1	2	2	3
	Actual	-	3	4	4
Net present value ($)	Ideal	337	622	612	444
	Actual	(613)	204	290	222
COST-EFFECTIVENESS MEASURES					
Cost per DALY averted ($)	Ideal	1,543	1,101	320	534
	Actual	2,572	1,786	432	735
Cost per case averted ($)	Ideal	37	26	11	13
	Actual	62	43	15	18
Cost per death averted ($)	Ideal	48,094	29,347	14,040	18,217
	Actual	80,157	47,587	18,972	25,099

"-" could not be calculated due to one year assumed length of life and a BCR which is 1 or below 1.

highest cost is US$80,000 in Plan International under the actual scenario, followed by World Vision of US$47,587. For wet pit latrines, the cost to avoid a death is US$25,000 or less. Under an ideal scenario, the cost per death averted is less than US$50,000 for all sites.

Cost per DALY averted is the average cost that must be invested in sanitation interventions to save one disability-adjusted life-year, which is an index of disease burden which combines both deaths and disease cases. Under the actual scenario, the cost per DALY averted for Plan International sites is US$2,572, while for World Vision sites it is US$1,786. Wet pit latrines have a significantly lower cost per DALY averted at less than US$750 under the actual scenario, and US$550 under the ideal scenario.

Table 32 shows the results for the urban project in Sihanoukville relating to wet pit latrines alone, and toilets with a sewerage connection and wastewater treatment.

Benefit-cost ratio: The benefit cost ratio for wet pit latrines in urban sites is 1.4 under the actual scenario while the ratio of latrines connected to sewerage is only 0.03. This is very low due to the very high cost of investment. For the ideal scenario, the BCR is 1.8 for a latrine with a septic tank and 0.1 for a latrine connected to sewerage.

Internal rate of return: The IRR for wet pit latrines is 18.4% for the actual scenario and 27% for the ideal scenario. However, the rate is negative for latrines connected to sewerage as the cost far exceeds the benefits gained.

Payback period: For wet pit latrines, the household would recover the cost within 5.3 years under the actual scenario and 2.2 years under the ideal scenario. For latrines connected to sewerage, the recovery period is over 20 years.

Net present value: The net present value for wet pit latrines is US$143 for the actual scenario and US$275 for the ideal scenario. The NPV for toilets connected to sewerage is negative for ideal and actual scenarios.

Cost per disease case averted: Under the actual scenario, the cost per case averted is US$63 for wet pit latrines and US$1,192 for latrines connected to a sewerage connection. Under the ideal scenario the cost per case averted would be reduced to US$36 for wet pit latrines and US$204 for latrines connected to sewerage.

Cost per death averted: Under the actual scenario, cost per death averted is US$130,453 for households with wet pit latrines and over US$2 million for households with latrines connected to sewerage. For the ideal scenario, the cost per death averted for wet pit latrines is US$74,357 and US$414,483 for latrines connected to sewerage.

Cost per DALY averted: Under the actual scenario, the cost per DALY averted for households with wet pit latrines is US$2,695 while it is US$50,297 for households with latrines connected to sewerage. For the ideal scenario, the cost for households with wet pit latrines is US$1,536 and US$8,604 for households with latrines connected to sewerage.

FIGURE 45: ACTUAL VERSUS IDEAL BENEFIT-COST RATIOS OF SANITATION OPTIONS IN RURAL AREAS, COMPARED TO "NO TOILET"

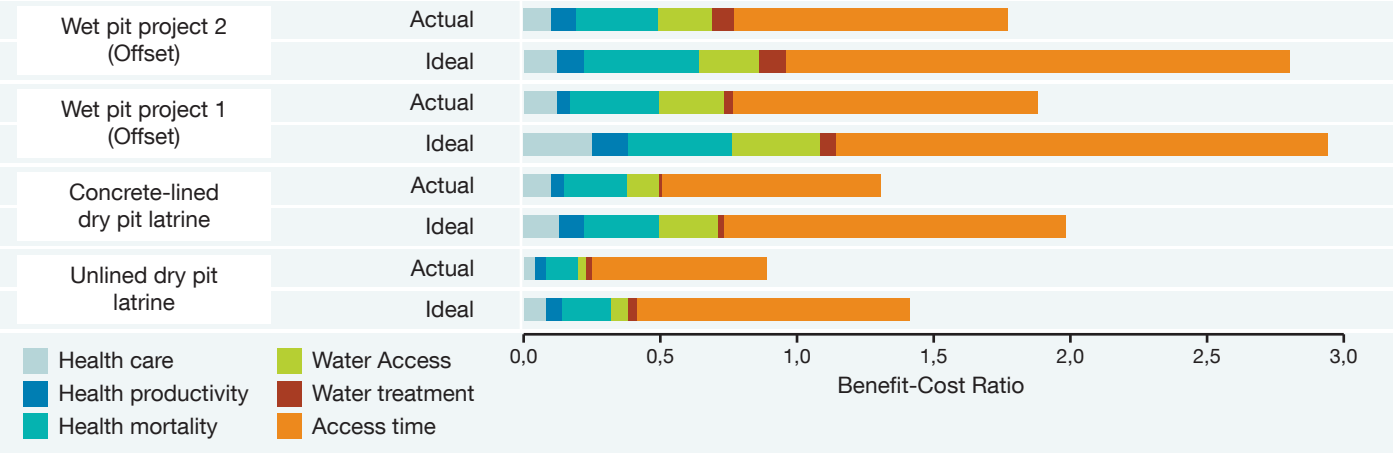
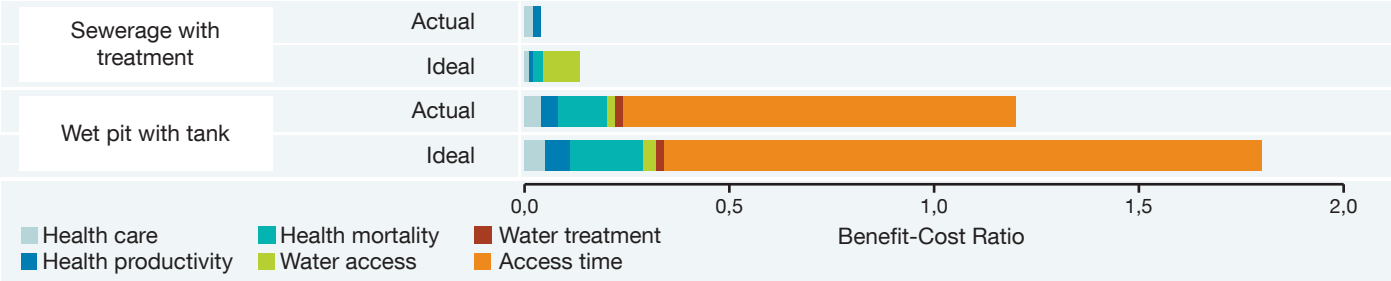


TABLE 32: URBAN AREA EFFICIENCY MEASURES FOR MAIN GROUPINGS OF SANITATION INTERVENTIONS, COMPARED TO "NO TOILET" FOR TOILETS WITH A SEPTIC TANK AND COMPARED TO "WITHOUT CONNECTION" FOR TOILETS WITH A SEWERAGE CONNECTION

Efficiency measure	Scenario	Private wet pit	
Option evaluated		Wet pit latrines	Sewerage connection
COST-BENEFIT MEASURES			
Benefits per US$1 input ($)	Ideal	1.8	0.14
	Actual	1.4	0.03
Internal rate of return (%)	Ideal	27.0	-
	Actual	18.4	-
Payback period (years)	Ideal	2.2	-
	Actual	5.3	-
Net present value ($)	Ideal	275	(4,642)
	Actual	143	(17,560)
COST-EFFECTIVENESS MEASURES			
Cost per DALY averted ($)	Ideal	1,536	8,604
	Actual	2,695	50,297
Cost per case averted ($)	Ideal	36	204
	Actual	63	1,192
Cost per death averted ($)	Ideal	74,357	414,483
	Actual	130,453	2,422,857

FIGURE 46: ACTUAL VERSUS IDEAL BENEFIT-COST RATIOS OF SANITATION OPTIONS IN URBAN AREAS, COMPARED TO "NO TOILET"



8.1.2 QUALITATIVE ANALYSIS

Besides the quantitative efficiency, qualitative impacts also need to be considered in the study for each intervention. Sections 4.4 and 4.5 give detailed results, summarized briefly below.

Although households with dry pit latrines seem to prefer wet pit latrines, both rural and urban households share similar views on the benefits and satisfaction of having a latrine at home. Also, households with both dry pit and wet pit latrines cite similar benefits from having a latrine. The most common perceived benefits of owning a latrine are safety at night, convenience, saving time, privacy, status, good health, and good environment. These benefits clearly illustrate the positive impacts of the intervention of each project on sanitation situations in rural and urban areas as people have perceived the benefits of having a latrine at home. It is worth noting that households do perceive the benefits of sanitation even though some of their latrines do not last long. Moreover, people gain better understanding of sanitation through awareness raising campaigns promoted in each project area, which is key to sanitation behavior change. However, continuing expectations of external assistance in latrine financing is still a major constraint for translating latent demand into a real demand for a latrine.

For the level of satisfaction with their current latrines, households are generally highly satisfied with their current latrines, whether they are dry pit or wet pit latrines. They include convenience at night, avoiding danger from animals, having dignity and status, and being healthy and clean. However, most households prefer having wet pit latrines to dry pit latrines as they think that wet pit latrines are cleaner and smell less, and will last longer - meaning that they do not need to rebuild latrines within a short period of time. In summary, each sanitation intervention has positive impacts on the sanitation situations in the community and households even though some approaches and interventions are not so efficient and effective. These stated benefits from the surveys can serve as examples to convince and promote households' understanding of the importance of having a toilet first, before the actual latrine selection and subsequent construction.

For the urban site, even though the connection rate is still low, the wastewater treatment plant in Sihanoukville is, to some extent, contributing to the improvement of the environment in the city as well as reducing the pollution to the sea, where the collected wastewater used to be discharged without treatment. However, the wastewater from unconnected households, which still forms a majority of households in Sihanoukville, still drains untreated to the sea. The potential importance of this intervention to the tourism sector development in the city cannot be understated: tourists will be put off by polluted sea water at the bathing area of the beach in Sihanoukville, and thus the poor environment will constrain future tourism development.

8.2 SCALING UP RESULTS FOR NATIONAL POLICY MAKING

The ultimate use of this study is not only for the improvement of sanitation decisions in the field sites of the study, but in assessing national policies in the of the field level results. The field sites selected for the study broadly contain common characteristics that represent large parts of the country. All rural field sites, ECOSORN, TSRWSSP, World Vision, and Plan International, are located in the Tonlé Sap zone, which is home to one third of the population of Cambodia, and which has the second highest prevalence of poverty in Cambodia. The urban field site – namely the Wastewater Treatment Plant and Sewerage System in Sihanoukville – however, represents the urban coastal zone which has the lowest population compared to other zones. Table 33 shows the population size, poverty level and sanitation coverage of the typical zones in Cambodia and the field sites selected in the study.

Although rural field sites do not geographically represent the other zones, the rural characteristics of the sites are not significantly different from other rural areas in Cambodia. All parts of the country have the same climatic conditions which affect sanitation solutions and disease burden in a

TABLE 33: TYPICAL NATIONWIDE SANITATION SUBGROUPS VERSUS FIELD SITE CHARACTERISTICS

Sites	Population size represented	Climate	Poverty rate[1]	Starting sanitation coverage
Typical locations				
Coastal zone	7.2%	Tropical	27%	32.7%
Plateau and mountain zone	11.4%	Tropical	52%	19.9%
Tonle Sap zone	32.5%	Tropical	43%	30.6%
Plains zone	39%	Tropical	32%	27.6%
Phnom Penh	9.9%	Tropical	5%	90.7%
Field sites*				
1. ECOSORN	Tonle Sap zone	Tropical	-	<5%
2. Plan International	Tonle Sap zone	Tropical	-	<5%
3. World Vision	Tonle Sap zone	Tropical	-	<5%
4. TSRWSSP	Tonle Sap zone	Tropical	-	<5%
5. Wastewater management project	Coastal zone	Tropical	-	0% (WWTP)

[1] Source: Cambodia Halving Poverty by 2015? Poverty Assessment 2006, World Bank, February 2006.
* Data based on the project fact sheets provided by each project.

similar way. Moreover, rural sites selected are within the mid-level poverty range, which reflects the average in the country. Therefore, the results of the analysis can be generalized or replicated to other parts of rural Cambodia, except the ones living in challenging environments such as floating communities where the required sanitation solution is different from the sanitation options assessed in this study. In this regard, the results from the study can be the basis for supporting the decision in any national policy making which aims at improving sanitation in rural areas.

For urban field sites, however, the results mainly represent the typical coastal city and not the rest of the urban areas in Cambodia. The topography of the coastal areas differs from urban areas in other zones, and also the climatic conditions are different. Therefore, the specific results from the analysis can be used mainly for other coastal areas in Cambodia, and should be used with caution in other parts of Cambodia. However, the findings and conclusions from this urban site are also instructive for other urban centers of Cambodia looking to develop their wastewater management capacity in the coming years.

In light of limited resources for the sector, the results will be insightful for decision makers on the cost-benefit and cost-effectiveness of each sanitation intervention. The study looks at both subsidy and non-subsidy approaches to sanitation interventions. The subsidy approach tends to reduce the cost of latrine uptake by households, while often requiring additional upfront investment costs due to the more advanced sanitation technologies selected. Also, the heavily subsidized latrines which benefit a smaller proportion of households per target village are usually more durable than the non-subsidized self-built latrine. It is argued that the health benefit of a latrine can only be achieved when the majority of community members have access to toilets. Therefore, targeting a few households in the community to gain access via more expensive latrines through a significant subsidy may not contribute much to community health as the presence of feces produced by the unserviced households still pollutes the environment. However, the international health evidence is weak on the relative importance of individual versus community adoption of improved sanitation. In this case, using public funds to increase sanitation uptake among the masses through low-cost or affordable options, and later encouraging households to upgrade with proper technical support from government as well as the local private sector, is key to scaling up sanitation in the country. Once the majority of population adopts improved sanitation practices, the scarce resource can be used to target the remaining minority in the communities, especially the poorest families. This will be efficient in reducing the disease burden and at the same will not distort the local market, which is able to provide services to communities in the longer run.

8.3 OVERALL COST-BENEFIT ASSESSMENT

The benefits of improved sanitation at the national level can be the tourism sector, business, health budget, environment, economic benefits, and other intangible benefits. For the tourism sector, the improvement of sanitation in Cambodia is very important to move the tourism sector to another level with higher satisfaction of tourists. The improvement of the situation of toilets and hand washing facilities in urban centers, restaurants, and bus stations can be a convincing factor to increase the satisfaction of tourists to Cambodia. Some parts of the business sector are sensitive to poor environments and polluted water sources, especially with those in the food and beverage sector, and tourist-related businesses. One hotel has to spend over US$1,000 per month to treat their water for internal use, while it is around US$70 for a restaurant for the same purpose. Nationally, this expense would be huge when many hotels and restaurants need to privately treat water.

Based on the above analysis and results, some approaches result in high returns from a US$1 investment. Based on the CBA results under actual program conditions, the benefits from a one dollar investment in the CLTS dry pit is not economically viable with a BCR of only 0.84 compared to a concrete ring dry pit latrine with a BCR of 1.3. Although these CLTS interventions are cheaper than others in improving sanitation conditions in Cambodia, there should be some adjustments to reduce the cost of program delivery and improve the technologies to the appropriate standard with clear follow-up support and monitoring. It is expected that with an ongoing CLTS scale-up in Cambodia, the lessons learned from the pilot or initial CLTS programs can be used to define programs that have lower unit costs and improved effectiveness.

Also, sanitation improvements have other intangible benefits to the community as well as households. Improved sanitation would improve the environment in the community leading to improved health and quality of life. Moreover, improved sanitation in households is important from several angles such as improved health, convenience, more privacy, improved status, safety, and more cleanliness/hygiene in the surrounding areas.

IX. Discussion

9.1 MAIN MESSAGES

This study has shown that sanitation interventions in rural and urban areas yield both quantitative and qualitative benefits to households as well as the communities in which they live. In rural areas, the benefit-cost ratio of moving up from open defecation to dry pit latrines varied between 0.84 and 1.3, under actual program conditions. Wet pit latrines were shown to have a higher benefit-cost ratio under actual program conditions, of between 1.7 and 1.9. The ratios could be considerably higher in all sites if it had been found that 100% of those households receiving a latrine were actually using it. For urban sites, the benefit-cost ratio was 1.4 for households obtaining a wet pit latrine with a tank and only 0.03 for households obtaining a toilet connected to sewerage, with wastewater treatment. The economic benefits monetized were health, access time and saved costs from less polluted drinking-water sources. On average, sanitation improvement could save a household US$23.9 per year of health-related costs in rural areas, and an additional US$8.0 per year in urban areas from receiving a sewerage connection.

Qualitative benefits from these same interventions were found such as dignity, privacy, convenience, safety, freedom from disease, more comfort, better social status and an improved environment. In terms of convenience, households with a latrine at home would find it easy to defecate and use at their disposal without disruption from others. Moreover, this is very important for women and elderly people who need to use it at night and in the rain. For safety, the latrine is very useful especially at night when household members would not have to travel some distance to defecate and in the case of women running the risk of being attacked or harmed by other people, as well as avoiding some dangerous animals and insects. Also, privacy is another concern that households should consider, especially for female household members. Without a latrine, they have to go to the bush for defecation or urination. This would cause some inconvenience for them as they need to find a place to hide from others' eyes. So having a latrine would give female household members comfort and peace of mind during defecation and urination.

Besides the benefits directly going to households, improving household sanitation would benefit the entire community. This would include a better environment, cleaner water sources for drinking, less polluted water for aquatic life, reduced time and effort required for cleaning the environment and for health prevention measures in the community. Improved sanitation of each household would improve the environment in the community as there would be more feces-free land, good surroundings, and better quality air which all contribute to good health and quality of life for people living in the communities. In addition, improved sanitation in communities would reduce the disease pathogens which cause disease outbreaks, thus reducing public expenditures on reactive measures against disease outbreaks, and thus the savings could be used for other development purposes.

Therefore, having sanitation interventions in the communities is necessary and more attention and funding should be earmarked for the sanitation sector as a large number of rural households still lack access to improved sanitation in Cambodia. As discussed above, improving sanitation will not only benefit the households' health, but also public health in the community. Therefore, sanitation should not only be considered as a private matter which should be addressed at the household level, but should also be tackled at the community level, which requires public funding. The proper use of public funds in changing and sustaining the behavior of the community in adopting improved sanitation would yield higher benefits than providing a one-off intervention. The study shows that if the community's behavior is sustained, a US$1 investment in sanitation improvement would yield a return of US$1.5-3.0, which is

higher than the current actual return of only US$0.8-2.0, where a number of household members still practice OD despite owning a latrine. This economic return can be increased if the cost of intervention is reduced and the intervention can reach even more households in the community.

Sanitation improvement has very strong linkage with poverty reduction and at the same time contributes to a number of other MDG targets. Economically, it helps reduce household health expenditures, it helps provide access to cleaner water sources, and it saves time. In addition to economic benefits, improving sanitation also contributes to gender equality through better privacy and convenience for women, reduced child mortality through improving children's health, and improved maternal health through better nutrition among household members.

Although the study chose several sites from around the country in order to be representative of the national level, the results have some limitations in influencing national sanitation policies. The rural sites selected were all from the Tonle Sap zone, hence the results reflect well these provinces. However, in generalizing the results to other regions of the country, differences in sanitation coverage, climate, geography, economic status, health indicators and demographics would all need to be taken into account. The results for the urban sites in this study represent coastal areas – in particular, the costs are likely to be different in towns and cities with different topography, land prices and population densities.

9.2 UTILIZATION OF RESULTS IN DECISION MAKING

9.2.1 POTENTIAL USES OF RESULTS

Most households understand the importance of having a latrine at home, but this knowledge rarely translates into action, with cost being the main barrier stated by households for not obtaining their own latrines. Therefore, economic evidence of the benefits of improving sanitation – in the form of advocacy materials targeted at ordinary households – would help households change their perceptions and recognize the potential paybacks of investing in sanitation. Action is more likely to be taken by households if they see the impacts at the household level, especially financial impacts and increasing time availability. This economic argument can be combined with other key messages used in the current sanitation projects to help translate the need for a toilet to effective demand and an investment decision. The results can also be used for convincing the government for more national budget allocation in the sector using the impacts at the national level combining impacts at the household, community, and national levels, which includes tourism and business benefits. The results of the study also form a basis for the selection of sanitation interventions in Cambodia by weighing the balance between the cost and the benefit of each intervention option, as well as taking into account other factors that play a role in sustaining sanitation improvements. For example, the simple dry pit latrine built under CLTS intervention yields a relatively low benefit-cost ratio compared to heavily subsidized latrines delivered under other projects. However, the CLTS has its merits in that the average hardware cost of a household in such a community is a fraction of the cost of the subsidized latrines. Once the CLTS programs reach a larger scale, the software costs – which were comparatively high in the project evaluated – will become significantly cheaper, thus leading to much more favorable benefit-cost ratios. Moreover, through mobilizing collective action, the CLTS approach can reach a wider population with sustained behavior change than the subsidy approach which often only benefits a few households per community, and creates further reliance on subsidy. This least costly option is very relevant to the Cambodian context under the very limited resource for sanitation investment and with a huge proportion of people still living without access to improved sanitation. To be more successful, CLTS needs more technical support and the offer of low-cost affordable and quality latrine options, which give the households a good experience of their first latrine, and encourages upgrades over time.

For urban areas, there is room for improvement of intervention in terms of reducing the cost of investment. The results of the analysis can be used to review where the cost of investment can be reduced and what alternative technology options can be examined.

The results from the study can also be the input for the national strategy on rural water supply, sanitation, and hygiene. It contributes to target setting for sanitation intervention among the poorest households who cannot afford to have a latrine. The cost of a latrine represents a high share of household cash income amongst the poorest groups.

Therefore, the cost and efficiency results will help policy makers know whom to target, what type of latrine to offer and how much to subsidize. The study presents the cost analysis of each intervention with details, including capital cost, program cost, and recurrent cost. Such information will provide important inputs in the sanitation financing strategy of both the government and agencies working in the sector.

9.2.2 TRANSLATING EVIDENCE TO ACTIONS

For the water and sanitation sector, the cost-benefit analysis result of this study will help them in their strategic planning and annual budget planning. Costs of each intervention approach per household have been presented in the cost section and with the analysis of the benefit-cost ratio. The study will help government and agencies to maximize the benefit of sanitation programs as it allows them to understand the determinants of intervention efficiency. By reducing the costs of sanitation improvement, it will reduce the cost of achieving health outcomes, such as the cost per child death averted. The study also explores the determinants of program performance which will ultimately help make the interventions more sustainable.

The beneficial health impacts and their associated economic values have been shown to be of key importance in this study. Avertable premature mortality, productivity time losses and health care costs from improved sanitation are the main components evaluated. Therefore, health and sanitation agencies need to better coordinate to ensure maximum impact on WASH-related diseases. For example, results of an under US$1,500 cost per DALY averted are below the threshold defined by the WHO as cost-effective health interventions of three times a country's GDP. A case of diarrhea can be averted for as little as US$10 with sanitation interventions. Hence, sanitation interventions can be justified from the perspective of the health sector. Furthermore, sanitation project implementers can draw on the cost-benefit analysis to help them select the most effective and efficient approaches to preventing disease.

In fact, the cost and benefit information can be used by the Ministry of Economy and Finance and the Ministry of Planning to include the sanitation sector into their planning cycles, and to earmark more funds to improve sanitation in Cambodia. Given the high economic returns from sanitation interventions, financial as well as non-financial, the results of the study would serve as a tool to justify the allocation of increased budgets for sanitation in Cambodia. The results of the analysis could also enable the government to estimate the costs and benefits of reaching CMDG (2015) and sector vision (2025) whereby appropriate evidence-based planning and budgeting can follow. The effectiveness of different intervention options will help them make informed decisions on appropriate interventions given under limited resources.

With the results of the study, the sub-national governments could have clearer views on the importance of the sanitation sector in development at the local level, helping them to integrate the sanitation sector into their development planning. At lower levels, they could use the cost and benefit results to support their sanitation campaign to encourage people to invest in a latrine at home and to pay more attention to sanitation in the community.

To households, it is important to convince them to invest in building and maintaining a latrine. The cost and benefits at the household level from having a latrine would be useful to present to them. This is a helpful tool for promotion campaigns as they will have a clearer view of the amount they would gain from the improved sanitation and lose due to unimproved sanitation. Furthermore, other non-financial benefits, such as convenience and privacy, should serve as a tool to convince households to understand the importance of family sanitation and its contribution to environmental sanitation beyond the household.

For donors and NGOs working on and interested in the sanitation sector, the results of the study would be helpful for them to have insight into the sanitation interventions and the quantitative and qualitative cost and benefits. It can be used to adjust their program design to be more effective and successful in order to maximize the economic returns on investment. This can serve as concrete evidence for them to advocate and convince local authorities and households to promote sanitation in their communities.

Disseminating the results comprehensively through mass media would be helpful to advocate the necessity of sanitation interventions from politicians. This would also highlight the sanitation situation in Cambodia to the public

to convince them that more attention needs to be paid to sanitation in Cambodia than before as it continues to inflict major economic costs on households, communities, business development and government. The media would play an important role here to convey the results and the main messages of this study to the public and especially to the government. They should quote the important messages and results that give more weight to the importance of the sanitation sector in Cambodia, such as the health, environmental, gender and economic benefits, as well as the efficiency ratios such as the benefit-cost ratio.

X. Recommendations

This study aimed to assess the economic performance of sanitation interventions in Cambodia, with a focus on different latrine types and program delivery approaches in rural areas. Based on the study findings summarized below, six recommendations aim to improve the selection and implementation of sanitation interventions in the future.

Finding 1: Sanitation interventions have very favorable socio-economic returns to households and society, contributing to improved health, a clean environment, dignity and quality of life, among many other benefits. Economic returns are potentially high – in excess of two dollars return per dollar invested – especially in rural areas where low-cost on-site solutions are feasible. However, the selection of appropriate technology and implementation delivery mechanisms (e.g. demand raising) is key for economic gains to be enjoyed at affordable cost and sustained over time.

Recommendation 1: The Royal Government of Cambodia and development partners should scale up sanitation coverage throughout rural Cambodia, using low-cost and proven effective and sustainable approaches to household sanitation improvement. Community-led approaches should be combined with sanitation marketing and development of the private sector to supply sanitation hardware and support latrine construction in rural areas.

Finding 2: New suitable latrine technologies and designs with lower cost are very important to the success of sanitation projects in rural areas. According to the study findings, rural people prefer wet pit latrines to dry pit latrines because they perceive the wet pit one will last longer and is more hygienic, comfortable and convenient. However, the cost of wet pit latrines is higher and many rural households cannot afford the full hardware cost in one installment. People are reluctant to invest in a dry pit latrine as they believe that it will not last long and take more time to rebuild in the near future. For instance, some projects have offered a wide range of latrine options to households, ranging from simple dry pit to wet pit latrine, but mostly wet pit latrines are selected by households, as they are heavily subsidized and they are willing to pay for the difference in hardware cost. However, with the right messages, other projects have shown that households can become convinced that they can start off with a low-cost dry pit latrine. Either way, it is critical that sanitation projects deliver solutions that are affordable and do not rely on high subsidies which may make it harder for the household to sustain coverage levels after project withdrawal.

Recommendation 2: To improve people's first experience of their own latrine and ensure sustained behavior change, the technology and design of latrines offered to them should be carefully selected to make it last long enough and respond to people's expectations of sanitation. A better but affordable latrine structure and design, particularly the slab and underground components, is key to the success of rural sanitation improvement in Cambodia. For scaling up throughout Cambodia, this requires development of the private sector to produce the latrine components and make them available for purchase in a location that can be accessed in all rural areas of the country, as well as supporting households to construct their latrines.

Finding 3: Community-led sanitation approaches need proper technical support and follow up on latrine construction for poor rural households. Community-led approaches without proper technical support on the construction of latrines and that lack continued follow-up have resulted in low effectiveness and efficiency of the programs, as the self-made latrines usually collapse within a short period of time, people are reluctant to rebuild a new one, and hence most people return to open defecation. As found in

the sites adopting community-led approaches – and corroborated by other evidence – the rate of people having their own latrine climbed to close to full coverage at first but then dropped sharply shortly thereafter when the latrine they built collapsed.

Recommendation 3: Technical guidance for latrine construction in the community should be incorporated in the community-led approaches so that latrines last longer. Also, there should be training held locally on latrine construction, and local resource people should be utilized so that people can go to them when their latrine collapses. Regular follow-up of activities in the communities is also crucial to sustaining the latrine uptake.

Finding 4: Project "software" costs to deliver interventions are relatively high for the Cambodian context (at least US$50 per household), and furthermore, the optimal impact and efficiency were not achieved due to people returning to open defecation. This was true for all rural projects evaluated. If limited subsidies from external partners are channeled to a small number of households to obtain a more superior latrine type than the average rural Cambodian household can afford, then it will still be a long time before universal sanitation coverage will be achieved in Cambodia.

Recommendation 4: To be more effective and efficient, future sanitation projects should carefully plan and implement activities cost-effectively, and closely monitor project costs and impacts, to ensure that the project resources are being appropriately utilized to contribute to universal sanitation coverage in Cambodia. Projects should ensure that the benefits of every aspect be maximized so that local communities would get greater benefits from the projects in the long run. In many cases, this means delivering integrated water, sanitation and hygiene interventions to reduce development transaction costs to efficiently deliver improved health and quality of life. Sanitation projects should focus more on hygiene behavior change, carrying out campaigns more frequently and throughout the project cycle to increase the rate of sustained behavior change. Furthermore, to obtain the full health benefits and improve equity in the distribution of project resources and enjoyment of the benefits, the project should also aim to improve sanitation in the entire community, and not just a selected number of households who can afford to pay the household contribution. Donor efforts and subsidies would therefore need to be more thinly spread over the country, channeled through a proven low cost but effective means to deliver improved sanitation at scale.

Finding 5: Large-scale urban infrastructure projects have a very high cost per household covered, especially when targeted households do not connect to the sewerage network. The quantified economic benefits are insufficient to give a positive net present value or a benefit-cost ratio above unity. However, non-quantified benefits such as an improved urban environment and reduced water pollution can be significant enough to warrant investments in networked urban sanitation solutions, especially when a city's revenues are closely linked to environmental quality, such as the tourism industry.

Recommendation 5: Decision makers in urban areas, including not only government but also donors and development partners, should consider a range of urban technologies including low cost options, and select options that are appropriate given the finances and implementation capacity available. Civil society and the community must be involved in the decision making process on sanitation option selection, given that the finances will need to be raised from tariffs as well as tax. In circumstances where high cost per household networked solutions are the most feasible solution, then financing, regulatory (legal) and institutional measures must be taken that ensure a high connection rate to deliver the full economic benefits of the intervention.

Finding 6: Improved hygiene and sanitation conditions in institutions, public places and tourist sites are important to attract more businesses and tourists to Cambodia. The sanitation conditions in places frequented by tourists in Cambodia have been reported to be poor, especially water resources and toilets/hand washing facilities in public places and restaurants. Moreover, foreign tourists in Cambodia have major concerns related to food preparation and drinking water. Also, the small sample of businesses interviewed felt that poor environmental sanitation affects their profitability in several ways. Hence, to make Cambodia a

more attractive place for tourists and businesses, broader definitions of improved sanitation than just household sanitation need to be utilized and implemented by Cambodia's public agencies.

Recommendation 6: As well as at household level, more measures should be taken to improve the sanitation and hygienic conditions in public places, transport routes and business areas. These measures are most important in tourist sites and thriving business districts (e.g. downtowns, markets). This recommendation is key to promoting Cambodia as an international tourist destination and in attracting more foreign business investment to the country, which will both strongly support the alleviation of poverty.

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ANNEX A: STUDY METHODS

TABLE A1: SUB-NATIONAL SANITATION COVERAGE RATES (%), LATEST YEAR 2008

Province	No toilet	Connected to sewerage	Septic tank	Pit latrine	Other
Banteay Mean Chey	65.00	14.51	17.07	3.05	0.38
Battambang	56.05	14.33	21.37	7.11	1.15
Kampong Cham	74.44	4.92	14.16	5.78	0.71
Kampong Chhnang	81.24	5.86	9.19	2.74	0.96
Kampong Speuu	82.51	6.36	8.43	2.39	0.30
Kampong Thom	72.19	4.27	8.98	13.27	1.29
Kampot	73.82	6.49	9.85	8.29	0.55
Kandal	54.25	13.47	25.70	5.97	0.62
Koh Kong	61.38	13.10	18.46	2.95	4.11
Kratie	73.93	3.23	14.25	6.50	2.09
Mondul Kiri	83.44	3.55	7.87	4.78	0.36
Phnom Penh	9.31	66.39	22.99	0.90	0.42
Preah Vihear	89.18	2.65	4.70	2.73	0.75
Prey Veng	83.20	4.97	5.67	4.98	1.18
Pursat	81.64	5.04	8.61	2.99	1.72
Ratanak Kiri	78.92	4.50	8.06	5.40	3.11
Siem Reap	72.90	12.09	11.85	2.59	0.57
Preah Sihanouk	50.39	17.19	28.26	3.12	1.04
Stung Treng	66.97	11.08	16.67	3.83	1.45
Svay Rieng	78.73	6.05	8.34	6.03	0.85
Takeo	76.28	7.82	12.10	2.99	0.80
Otdar Meanchey	78.62	6.58	9.36	4.51	0.93
Kep	73.95	9.87	11.90	2.18	2.10
Pailin	60.67	10.45	17.79	9.59	1.50
Total	**66.29**	**13.50**	**14.41**	**4.91**	**0.88**

Source: CENSUS 2008

TABLE A2: ASSESSMENT OF ADVANTAGES AND LIMITATIONS OF DIFFERENT DESIGN OPTIONS

No	Design	Advantages	Limitations
DESIGNS INVOLVING FIELD DATA COLLECTION			
1	Economic study designed entirely for research purposes, including matching and randomization of comparison groups	• Addresses the specific questions of the research • Highly scientific design	• Expensive and lengthy period • May not capture health impact • Limited transferability
2	Economic research attached to other research studies (e.g. randomized clinical trials)	• Captures health impact with degree of precision • Can conduct additional research on other impacts • Add-on research cost is small • Statistical analysis possible	• Expensive and lengthy period • Few ongoing clinic trials • Requires collaboration from start • Trials may not reflect real conditions • Limited comparison options
3	Economic research attached to pilot study, with or without randomization	• Add-on research cost is small • Options are policy relevant • Matched case-control possible • Can start research in mid-pilot	• Few pilot programs available • Pilots often not designed with scientific evaluation in mind (e.g. before vs. after surveys) • Pilot conditions not real life • Limited comparison options
4	Economic research attached to routine government or NGO/donor programs, without randomization	• Reflects real life conditions (e.g. uptake and practices) • Research addresses key policy questions • Matched case-control possible	• No research infrastructure • No scientific design • Limited comparison options
DESIGNS INVOLVING SECONDARY DATA COLLECTION			
5	Collection of data from a variety of local sources to conduct a modeling study	• Relatively low cost • Short time frame feasible • Can compare several options and settings in research model • Can mix locally available and non-local data	• Results imprecise and uncertain • Actual real-life implementation issues not addressed
6	Extraction of results from previous economic studies	• Low cost • Results available rapidly • Gives overview from various interventions and settings	• Limited relevance and results not trusted by policy makers • Published results themselves may not be precise

TABLE A3: 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 (especially 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: WHO http://www.who.int/water_sanitation_health/en/

[1] There are several other protozoa-based causes of gastrointestinal tract disorders, including:
- Balantidium coli – dysentery, intestinal ulcers
- Cryptosporidium parvum - gastrointestinal infections
- Cyclospora cayetanensis - gastrointestinal infections
- Dientamoeba fragilis – mild diarrhea
- 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)
- Intestinal Capillariasis (raw freshwater fish)

TABLE A4: WATER QUALITY MEASUREMENT PARAMETERS PER LOCATION, AND TEST METHOD

Parameter	Test	Test conducted for			
		Surface water	Well water	Piped tap water	Waste water
E.coli (cfu/100 ml)	Coliscan	Yes	Yes	No	Yes
Biological Oxygen Demand (BOD5) (mg/L)	5-day incubation	No	No	No	No
Chemical Oxygen Demand (COD) (mg/L)	5-day incubation	Yes	No	No	Yes
Dissolved Oxygen (DO) (mg/L)	Hach DO Probe	No	No	No	No
Nitrate (NO3-) (mg/L)	Hach Photometer	Yes	No	No	Yes
Ammonia (NH4)	Hach Photometer	Yes	Yes	No	Yes
Conductivity (µS/cm)	YSI Conductivity Meter	Yes	Yes	No	Yes
Turbidity (NTU)	TurbidiMeter	Yes	Yes	No	Yes
pH	pH Probe	Yes	No	No	Yes
Water temperature (°C)	Hach ThermoProbe	Yes	No	No	Yes
Residual chlorine (Cl) (in places provided with centralized chlorinated water supply) (mg/L)	Field Kit	No	No	Yes	No

TABLE A5: HOUSEHOLDS SAMPLED VERSUS TOTAL HOUSEHOLDS PER VILLAGE/COMMUNITY

Site	Sampling of households	Sewerage/STF		Septic tank	Wet pit latrine	Dry pit latrine	OD	Total
		With treatment	Without treatment					
ECOSORN	Sample	0	0	0	120	0	110	230
	Total	0	0	0	260	0	588	848
	% sampled	-	-	-	46%	0%	19%	27%
Plan International	Sample	0	0	0	0	165	80	245
	Total	0	0	0	0	464	114	578
	% sampled	-	-	-	-	36%	70%	42%
World Vision	Sample	0	0	0	0	120	50	170
	Total	0	0	0	0	738	200	938
	% sampled	-	-	-	-	16%	25%	18%
TSRWSSP	Sample	0	0	0	154	0	96	250
	Total	0	0	0	340	0	483	823
	% sampled	-	-	-	45%	-	20%	30%
Wastewater management project	Sample	87	62	109	0	0	19	285
	Total	1,010	n/a	n/a	0	0	n/a	n/a
	% sampled	8.6%	n/a	n/a	-	-	n/a	n/a
Total	**Sample**	**87**	**62**	**109**	**274**	**276**	**331**	**1172**
	Total	**1,010**	**n/a**	**n/a**	**600**	**1,202**	**1,385**	**n/a**
	% sampled	**8.6%**	**n/a**	**n/a**	**46%**	**23%**	**25%**	**n/a**

TABLE A6: OTHER SURVEYS IN STUDY SITES

Site	Group	Focus Group Discussion		Physical location surveys	Health facilities/ hospital	Piped water
		Women	Men			
ECOSORN	Unimproved	1	1	0	0	0
	Improved	1	1	2	2	0
	Sub-total	2	2	2	2	0
Plan International	Unimproved	1	1	1	1	0
	Improved	1	1	2	2	0
	Sub-total	2	2	3	3	0
World Vision	Unimproved	1	1	1	1	0
	Improved	1	1	2	2	0
	Sub-total	2	2	3	3	0
TSRWSSP	Unimproved	1	1	1	1	0
	Improved	1	1	2	2	0
	Sub-total	2	2	3	3	0
Wastewater management project	Unimproved	1	1	0	0	8
	Improved	1	1	3	3	0
	Sub-total	2	2	3	3	8
Total	**Unimproved**	**10**	**10**	**3**	**3**	**0**
	Improved	**10**	**10**	**11**	**11**	**8**
	Total	**20**	**20**	**14**	**14**	**8**

TABLE A7. METHODOLOGY FOR BENEFIT ESTIMATION (CALCULATIONS, DATA SOURCES, EXPLANATIONS)

Impacts included	Variable	Data sources	Specific value/comment
1. HEALTH *(All calculations are made using disaggregated data inputs on disease and age grouping: 0-4 years, 5-14 years, 15+ years)*			
1.1 Health care savings *Calculation: [Prevalence or incidence X Attribution to poor sanitation X ((% seeking outpatient care X visits per case X unit cost per visit (medical and patient)) + (Inpatient admission rate X days per case X unit cost per day (medical and patient))] X Proportion of disease cases averted*	Diarrheal disease incidence (0-4 years)	DHS	
	Diarrheal disease incidence (over 5 years)	WHO stats	
	Helminthes prevalence	Global review	
	Hepatitis A and E incidence	National health statistics	
	Indirect diseases incidence (malaria, ALRI)	WHO statistics	
	Malnutrition prevalence	UNICEF/WHO statistics	
	Scabies and trachoma Incidence	National health statistics	
	Attribution of fecal-oral diseases to poor sanitation	WHO (Prüss et al. 2002)	Value = 88%
	Attribution of helminthes to poor sanitation	Global review	Value = 100%
	% disease cases seeking health care	DHS, SES, ESI household survey, health statistics	
	Outpatient visits per patient	Health facility statistics, ESI household survey	
	Inpatient admission rate		
	Inpatient days per admission		
	Health service unit costs		
	Other patient costs (transport, food)	ESI household survey	
	% disease cases averted	International literature review	See Annex B for review
1.2 Health morbidity-related productivity gains *Calculation: [Prevalence X Attribution to poor sanitation X Days off productive activities X Value of time] X Proportion of disease cases averted*	Days off productive activities	ESI household survey	
	Basis of time value: GDP per capita	National economic data World Bank data	Average product per capita (at sub-national level, where available) – 30% for adults, 15% for children
1.3 Premature mortality savings *Calculation: [Mortality rate X Attribution to poor sanitation X Value of life] X Proportion of disease cases averted*	Mortality rate (all diseases)	WHO statistics	(cross-checked with local stats)
	Basis of time value: GDP per capita	National economic data World Bank data	Annual value of lost production of working adults (human capital approach) , from the time of death until the end of (what would have been) their productive life
	Discount rate for future earnings	National governments	Cost of capital estimate (8%)
	Long-term economic growth	Assumption	
	Value-of-statistical-life	Developed country studies	Adjusted to local purchasing power by multiplying by GDP per capita differential

TABLE A7. METHODOLOGY FOR BENEFIT ESTIMATION (CALCULATIONS, DATA SOURCES, EXPLANATIONS) (CONTINUED)

Impacts included	Variable	Data sources	Specific value/comment
1.4 Disability-adjusted life-years (DALY) averted *Calculation:* *DALY = YLD+YLL* *YLD: discounted disability based on weight and years equivalent time* *YLL: discounted future years of healthy life lost*	Duration of disability	ESI household survey	based on average length of each disease
	Disability weighting	WHO burden of disease project	
	Healthy life expectancy	WHO statistics	
	Discount rate for future disease burdens	National governments	Cost of capital estimate (8%)
	Morbidity and mortality rates	Various: see 1.1 and 1.3 (above)	
2. WATER (for household use) *(weighted average costs were estimated for each water source and for each household water treatment method)*			
2.1 Household water access savings *Calculation:* *Annual costs X % costs reduced, per water source*	Drinking water sources (%) in wet and dry seasons	ESI household survey	
	Annual financial cost per household, per water source	ESI household survey; ESI market survey	
	Annual non-financial cost per household, per water source	ESI household survey	
	Proportion of access cost reduction under scenario of 100% improved sanitation, per water source	ESI household survey; assumption	
2.2 Household water treatment savings *Calculation:* *(% households treating water per method X annual cost) X % households who stop treating*	Proportion of households treating their water, by method	ESI household survey	Validated by other national statistics (DHS, SES)
	Full annual cost per water treatment method	ESI household survey; ESI market survey	
	Proportion of households currently treating who stop treating under scenario of 100% improved sanitation	ESI household survey; assumption	As well as stopping to treat, households may switch to an alternative – cheaper – treatment method if the cleaner water sources enable different water purification methods
3. ACCESS TIME SAVINGS *(weighted average costs estimated for each age category and gender – young children, children and male and female adults)*			
Calculation: *% household members using OD X Time saved per trip due to private toilet X average trips per day X value of time*	Household composition (demographics)	ESI household survey	
	Sanitation practice, by age group	ESI household survey	
	Average round trip time to access site of open defecation	ESI household survey	For households moving from shared to private toilet, access time to shared toilets is used instead of OD
	Average number of round trips to defecation site per day	ESI household survey	
	Basis of time value: GDP per capita	National economic data World Bank data	Average product per capita (at sub-national level, where available) – 30% for adults, 15% for children

ANNEX B: HEALTH IMPACT

TABLE B1: RATES PER POPULATION FOR CASES OF DISEASE

	Average rural sites	Average urban sites	ECOSORN	Plan International	World Vision	TSRWSSP	Wastewater management project
DIRECT DISEASES							
Diarrhea (under 5)	3.58	1.83	3.81	2.97	5.20	2.35	1.83
Diarrhea (5 -14)	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Diarrhea (15+)	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Helminthes (under 5)	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Scabies (all ages)	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Trachoma (all ages)	0.03	0.03	0.03	0.03	0.03	0.03	0.03
INDIRECT DISEASES							
Malnutrition	0.40	0.37	0.35	0.48	0.37	0.39	0.37
Malaria	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ALRI	0.11	0.11	0.10	0.14	0.11	0.11	0.11
Total	**2.31**	**1.69**	**2.32**	**2.21**	**2.82**	**1.89**	**1.69**

TABLE B2: RATES PER 1000 POPULATION FOR DEATHS

	Average rural sites	Average urban sites	ECOSORN	Plan International	World Vision	TSRWSSP	Wastewater management project
DIRECT DISEASES							
Diarrhea (under 5)	5.92	3.02	6.28	4.91	8.59	3.88	3.02
Diarrhea (5 -14)	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Diarrhea (15+)	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Helminthes (under 5)	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Scabies (all ages)	-	-	-	-	-	-	-
Trachoma (all ages)	0.02	0.02	0.02	0.02	0.02	0.02	0.02
INDIRECT DISEASES							
Malnutrition	-	-	-	-	-	-	-
Malaria	0.65	0.61	0.57	0.78	0.61	0.63	0.61
ALRI	1.13	1.07	1.00	1.36	1.07	1.10	1.07
Measles	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Other indirect	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Total	**5.21**	**4.14**	**5.13**	**5.23**	**6.00**	**4.49**	**4.14**

TABLE B3: RATES PER 1000 POPULATION FOR DALYs

	Average rural sites	Average urban sites	ECOSORN	Plan International	World Vision	TSRWSSP	Wastewater management project
DIRECT DISEASES							
Diarrhea (under 5)	0.0806	0.0427	0.0854	0.0674	0.1155	0.0539	0.0427
Diarrhea (5 -14)	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
Diarrhea (15+)	0.0055	0.0004	0.0208	0.0004	0.0004	0.0004	0.0004
Helminthes (under 5)	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043
Scabies (all ages)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Trachoma (all ages)	0.0144	0.0144	0.0144	0.0144	0.0144	0.0144	0.0144
INDIRECT DISEASES							
Malnutrition	0.0004	0.0004	0.0003	0.0005	0.0004	0.0004	0.0004
Malaria	0.0079	0.0074	0.0070	0.0095	0.0075	0.0077	0.0074
ALRI	0.0143	0.0134	0.0126	0.0171	0.0135	0.0139	0.0134
Measles	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030
Other indirect	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110
Total	**0.0842**	**0.0686**	**0.0883**	**0.0826**	**0.0929**	**0.0731**	**0.0686**

TABLE B4: EVIDENCE ON TREATMENT SEEKING BEHAVIOR FOR OTHER DISEASES

Disease	Data source	Total				
		Public provider	Private formal clinic	Private informal care	Pharmacy	Total
Diarrheal disease	CSES 2007	21%	16%	13%	15%	100%
	CSES 2004	11%	9%	16%	Na	100%
ALRI	CSES 2007	5%	0%	50%	0%	100%
	CSES 2004	37.4	11.2	6.7	22.6	
Skin disease	CSES 2007	50%	8%	8%	8%	100%
	CSES 2004	76%	6%	2%	7%	100%
Malaria	CSES 2007	37%	11%	0%	7%	100%
	CSES 2004	54%	11%	4%	20%	100%

TABLE B5: UNIT COSTS ASSOCIATED WITH TREATMENT OF SCABIES (US$, 2008)

Health Provider	Outpatient cost (US$)		Inpatient cost (US$)		
	Health care	Incidentals[1]	ALOS[2]	Health care[3]	Incidentals[1]
PUBLIC/NGO					
Rural	3.9	1.2	1.5	n/a	1.2
Urban	3.9	0.7	1.5	n/a	0.7
PRIVATE FORMAL					
Rural	3.7	1.2	n/a	n/a	n/a
Urban	3.7	0.7	n/a	n/a	n/a
INFORMAL					
Rural	2.4	1.2	n/a	n/a	n/a
Urban	2.4	0.7	n/a	n/a	n/a

[1] Incidentals: non-health patient costs such as transport, food, and incidental expenses, per outpatient visit and per inpatient stay.
[2] ALOS: average length of stay.
[3] Inpatient health care costs are presented per stay.

TABLE B6: UNIT COSTS ASSOCIATED WITH TREATMENT OF MALNUTRITION (US$, 2008)

Health Provider	Outpatient cost (US$)		Inpatient cost (US$)		
	Health care	Incidentals[1]	ALOS[2]	Health care[3]	Incidentals[1]
PUBLIC/NGO					
Rural	1.7	1.2	7.5	5.5	1.2
Urban	1.7	0.7	7.5	5.5	0.7
PRIVATE FORMAL					
Rural	2.6	1.2	7.5	15.2	1.2
Urban	2.6	0.7	7.5	15.2	0.7
INFORMAL					
Rural	1.4	1.2	n/a	n/a	n/a
Urban	1.4	0.7	n/a	n/a	n/a

[1] Incidentals: non-health patient costs such as transport, food, and incidental expenses, per outpatient visit and per inpatient stay.
[2] ALOS: average length of stay.
[3] Inpatient health care costs are presented per stay.

TABLE B7: UNIT COSTS ASSOCIATED WITH TREATMENT OF MALARIA (US$, 2008)

Health Provider	Outpatient cost (US$)		Inpatient cost (US$)		
	Health care	Incidentals[1]	ALOS[2]	Health care[3]	Incidentals[1]
PUBLIC/NGO					
Rural	6.6	1.2	5.3	7.5	1.2
Urban	6.6	0.7	5.3	7.5	0.7
PRIVATE FORMAL					
Rural	3.9	1.2	5.3	17.4	1.2
Urban	3.9	0.7	5.3	17.4	0.7
INFORMAL					
Rural	2.6	1.2	n/a	n/a	n/a
Urban	2.6	0.7	n/a	n/a	n/a

[1] Incidentals: non-health patient costs such as transport, food, and incidental expenses, per outpatient visit and per inpatient stay.
[2] ALOS: average length of stay.
[3] Inpatient health care costs are presented per stay.

TABLE B8: UNIT COSTS ASSOCIATED WITH TREATMENT OF MALNUTRITION (US$, 2008)

Health Provider	Outpatient cost (US$)		Inpatient cost (US$)		
	Health care	Incidentals[1]	ALOS[2]	Health care[3]	Incidentals[1]
PUBLIC/NGO					
Rural	1.4	1.2	6.7	5.6	1.2
Urban	1.4	0.7	6.7	5.6	0.7
PRIVATE FORMAL					
Rural	3.3	1.2	6.7	15.3	1.2
Urban	3.3	0.7	6.7	15.3	0.7
INFORMAL					
Rural	2.0	1.2	n/a	n/a	n/a
Urban	2.0	0.7	n/a	n/a	n/a

[1] Incidentals: non-health patient costs such as transport, food, and incidental expenses, per outpatient visit and per inpatient stay.
[2] ALOS: average length of stay.
[3] Inpatient health care costs are presented per stay.

ANNEX C: WATER QUALITY IMPACT

TABLE C1: FULL WATER QUALITY MEASUREMENT RESULTS

Sample location	Source	E. coli (cfu/ 100mL)	Tot. coli (cfu/ 100mL)	COD (mg/L)	DO	Turbidity (NTU)	Use	Sanitation-related Comments
ECOSORN (Intervention) *Battambang Province Ratanak Mondul District Andeuk Heap Commune Andeuk Heap Village*	Dug Well	180	4580	Yes		2.94	B	Have a big jar for storing rain water, no pen and latrine
	Dug Well	420	2920	Yes		1.29	B	Have a big jar for storing rain water, no pen and latrine
	Dug Well	620	3140	Yes		2.24	B	Have a big jar for storing rain water, no pen and latrine
	Dug Well	1880	5880	Yes		3.4	B	Have latrine about 5m from dug well
	Dug Well	1960	22900	Yes		3.83	BD	Usually they drink the rain water but sometimes from dug well
	Dug Well	120	960	Yes		1.87	B	Have pen 3m from dug well
	Dug Well	260	5120	Yes		1.34	B	Have latrine 5m from dug well
ECOSORN (Control) *Battambang Province Ratanak Mondul District Andeuk Heap Commune Prey Ampor Village*	Dug Well	360	2060	Yes		2.36	CBC	Drink dug well and sometimes rain water
	Dug Well	1900	22200	Yes		1.69	B	Drink rain water, no pen and latrine
	Borehole	0	60	Yes			BD	Maybe 15 families drink borehole well
	Borehole	20	20	Yes			CBD	No pen and latrine
	Borehole	0	0	Yes			CBD	No pen and latrine
	Dug Well	80	12400	Yes		1.76	B	Drink rain water, no pen and latrine
	Dug Well	460	TNTC	Yes		3.94	B	Drink rain water, no pen and latrine
Plan Inter (Intervention) *Siem Reap Province Banteay Srey District Rum Chek Commune Rum Chek Village*	Dug Well	0	1540	Yes		7.34	CBD	4m from house, no pen or latrine
	Borehole	0	0	Yes			CBD	4m from house, no pen or latrine
	Dug Well	0	1140	Yes		4.23	CBD	1m from house, no pen or latine
	Borehole	0	160	Yes			CBD	3m from house, no pen or latrine
	Dug Well	20	160	Yes		1.96	CBD	3m from house, no pen or latrine, rope pump
	Borehole	0	0	Yes			CBD	4m from house, no pen or latrine
	Borehole	0	620	Yes			CBD	7m from house, no pen or latrine
Plan Inter (Control) *Siem Reap Province Banteay Srey District Rum Chek Commune Sala Kravan Village*	Borehole	0	520	Yes			CBD	3m from house, no pen or latrine
	Dug Well	320	4500	Yes		11.1	CBD	4m from house, no pen or latrine
	Borehole	0	700	Yes			CBD	3m from house, no pen or latrine
	Dug Well	880	3820	Yes		12.9	CBD	5m from house, no pen or latrine
	Borehole	0	0	Yes			CBD	5m from house, no pen or latrine
	Dug Well	60	5060	Yes		4.69	CBD	6m from house, no pen or latrine
	Borehole	0	760	Yes			CBD	2m from house, no pen or latrine

TABLE C1: FULL WATER QUALITY MEASUREMENT RESULTS (CONTINUED)

Sample location	Source	E. coli (cfu/ 100mL)	Tot. coli (cfu/ 100mL)	COD (mg/L)	DO	Turbidity (NTU)	Use	Sanitation-related comments
World Vision (Intervention) *Kampong Thom Province Prasath Sambo District Sambo Commune Kon Kaek Village*	Dug Well	0	60	Yes		2.05	CBD	5m from house and 7m from pen, rope pump
	Dug Well	0	180	Yes		2.32	CBD	8m from house, 1m from pen and have dirty water near well
	Dug Well	0	40	Yes		1.56	CBD	5m from house , 4m from cowshed and dirty water 1m from well, rope pump
	Dug Well	0	180	Yes		1.17	CBD	8m from house, 1m from pen and dirty water near well, rope pump
	Dug Well	0	240	Yes		6.84	CBD	8m from house, dirty water and pig animal dung 3m from well, rope pump
	Dug Well	0	0	Yes		3.58	CBD	5m from house, no animals pen, rope pump
	Dug Well	0	740	Yes		3.81	CBD	9m from house, 5m from buffalo pen, rope pump
World Vision (Control) *Kampong Thom Province Prasath Sambo District Sambo Commune Char Village*	Dug Well	80	1900	Yes		3.07	CBD	5m from house, 10m from latrine, 8m from pen, 7m from cowshed
	Dug Well	0	1800	Yes		4.11	CBD	3m from house, 10m from pen
	Dug Well	0	240	Yes		4.12	CBD	4m from house, 6m from pen
	Dug Well	240	TNTC	Yes		10.1	CBD	3m from house, 4m from cowshed, 5m from pen
	Dug Well	20	2260	Yes		1.45	CBD	5m from house, 5m from pen
	Dug Well	500	8000	Yes		4.96	CBD	1m from house and 5m from cowshed, more animals pen near well about 3m
	Dug Well	0	20	Yes		3.58	CBD	5m from house, 5m from pen
Tonlesap (Intervention) *Siem Reap Province Angkor Chum District Kouk Doung Commune Kouk Doung Thmei Village*	Dug Well	40	1920			6.58	B	Household drinks rain water, have pen 3m to dug well
	Borehole	0	1060				CBD	Have latrine 2m, pen 3m to borehole
	Borehole	0	0				CBD	Have pen 5m to borehole
	Borehole	0	0				BD	No pen and latrine
	Borehole	0	0				CBD	No pen and latrine
	Dug Well	0	1960			11.3	BD	Have latrine 3m to borehole
	Borehole	0	0				BD	Have pen 5m to borehole
Tonlesap (Control) *Siem Reap Province Pouk District Prey Chrouk Commune Plaing Village*	Borehole	900	TNTC				BD	Have pen 3m to borehole
	Borehole	80	3280				BD	Have pen 2m to borehole
	Borehole	0	1520				B	Household drinks rain water, no pen and latrine
	Borehole	0	0				CBD	No pen and latrine
	Dug Well	100	6800			4.31	BD	Have pen 3m, latrine 5m to dug well
	Pond	500	9900	6.12	7.9	315		No pen and latrine
	Lake	300	5000	6.15	7.8	8280	BD	No pen and latrine

TABLE C1: FULL WATER QUALITY MEASUREMENT RESULTS (CONTINUED)

Sample location	Source	E. coli (cfu/ 100mL)	Tot. coli (cfu/ 100mL)	COD (mg/L)	DO	Turbidity (NTU)	Use	Sanitation-related comments
Sihanoukville Mittapheap District Sangkat 1 and 3 Commune	Piped Water				3.1		CBD	
	Piped Water				4.8		CBD	
	Piped Water						CBD	
	Piped Water						CBD	
	Borehole	20	940				CBD	1m from house and 1m from toilet
	Borehole	0	0				B	5m from house and 7m from toilet
	Lake	100	34300	0		34		Independence Hotel
	Lake	37000	231000	28.33		89.4		Sokha Hotel
Sihanoukville Mittapheap District Sangkat 2 and 4 Commune	Piped Water				5.1		CBD	
	Piped Water				7.2		CBD	
	Piped Water				0.5		CBD	
	Piped Water				0.1		CBD	
	Borehole	0	0		2.1		CBD	1m from house and 5m from toilet
	Borehole	0	0		1.3		CBD	1m from house and 7m from toilet
	Waste Water	1590000	4360000	48.33	5.6	158		Ou Mouy Bridge
	Waste Water	85000	291000	66.5	1.8	628		Ou Bei Bridge
	Waste Water	10300000	TNTC	134.665	7.2	55.9		flow into treatment plant
	Waste Water	41000	301000	78.66	7.9	19.4		flow into treatment plant
	Waste Water	0	728000	101.33	3.1	35.3		after 1st treatment
	Waste Water	15000	411000	21.33	4.8	59.2		after 2nd treatment
	Waste Water	12500	TNTC	86.33		198		after 3rd treatment
	Waste Water	870000	2870000	74.495		36.05		after treatment mixed with waste water
	Waste Water	16700	261000	314		239		flow into the sea
	Sea Water	2280	4360	820		13.3		Tourist site
Cambodian Drinking Water Standard		0	0	-	-	5		

Notes: C: Cooking, B: Bathing, D: Drinking

TABLE C2: WATER ACCESS AND COSTS (US$, 2008)

Field site	Piped water (treated)		Non-piped protected source (including untreated piped)		Non-piped unprotected source	
	% access	Average monthly cost (US$)	% access	Average monthly cost (US$)	% access	Average monthly cost (US$)
ECOSORN	0%	-	86%	4.3	14%	2.9
Plan International	0%	-	83%	6.9	17%	0.8
World Vision	0%	-	64%	12.9	36%	6.0
TSRWSSP	0%	-	87%	6.5	13%	2.4
Wastewater management project	30%	8.6	56%	3.7	14%	1.6
Average rural	**0%**	**-**	**80%**	**7.7**	**20%**	**3.0**
Average urban	**30%**	**8.6**	**56%**	**3.7**	**14%**	**1.6**

TABLE C3: HOUSEHOLDS CITING POOR WATER QUALITY FROM THEIR PRINCIPAL DRINKING WATER SOURCE

Field site	Piped water (treated)						Non-piped protected source (including untreated piped)						Non-piped unprotected source					
	No	Bad appearance[1] (%)	Bad smell (%)	Bad taste (%)	Contain solids (%)	Any (%)	N	Bad appearance[1] (%)	Bad smell (%)	Bad taste (%)	Contain solids (%)	Any (%)	N	Bad appearance[1] (%)	Bad smell (%)	Bad taste (%)	Contain solids (%)	Any (%)
ECOSORN		0	0	0	0	0		19%	17%	27%	37%	0%		25%	17%	11%	47%	0%
Plan International		0	0	0	0	0		22%	15%	18%	45%	0%		25%	18%	19%	37%	0%
World Vision		0	0	0	0	0		24%	18%	20%	38%	0%		16%	18%	20%	47%	0%
TSRWSSP		0	0	0	0	0		23%	15%	16%	46%	1%		19%	19%	16%	47%	0%
SHV Treatment Plant		0%	14%	0%	86%	0%		5%	10%	13%	72%	0%		0%	0%	20%	80%	0%
Average rural		**0%**	**0%**	**0%**	**0%**	**0%**	**-**	**22%**	**16%**	**20%**	**41%**	**0%**	**-**	**21%**	**18%**	**17%**	**45%**	**0%**
Average urban		**0%**	**14%**	**0%**	**86%**	**0%**	**-**	**5%**	**10%**	**13%**	**72%**	**0%**	**-**	**0%**	**0%**	**20%**	**80%**	**0%**

[1] Bad appearance covers bad color, or containing solids, sediments or particles.

TABLE C4: HOUSEHOLD RESPONSES TO POLLUTED WATER – REASONS FOR USING WATER SOURCES

Field site	Piped water (treated)						Non-piped protected source (including untreated piped)						Non-piped unprotected source					
	Good Taste (%)	Clarity (%)	Sediment (%)	Health safety (%)	Quantity (%)	Cost (%)	Good Taste (%)	Clarity (%)	Sediment (%)	Health safety (%)	Quantity (%)	Cost (%)	Good Taste (%)	Clarity (%)	Sediment (%)	Health safety (%)	Quantity (%)	Cost (%)
ECOSORN	0%	0%	0%	0%	0%	0%	16%	43%	9%	9%	17%	5%	47%	31%	13%	3%	3%	3%
Plan International	0%	0%	0%	0%	0%	0%	36%	33%	5%	16%	9%	0%	42%	39%	3%	6%	6%	3%
World Vision	0%	0%	0%	0%	0%	0%	38%	10%	11%	16%	23%	1%	22%	19%	17%	14%	25%	3%
TSRWSSP	0%	0%	0%	0%	0%	0%	58%	24%	5%	7%	5%	2%	77%	12%	0%	0%	12%	0%
SHV Treatment Plant	55%	21%	5%	6%	12%	1%	54%	21%	4%	4%	12%	5%	75%	7%	5%	5%	7%	2%
Average rural	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**37%**	**28%**	**8%**	**12%**	**14%**	**2%**	**47%**	**25%**	**8%**	**6%**	**11%**	**2%**
Average urban	**55%**	**21%**	**5%**	**6%**	**12%**	**1%**	**54%**	**21%**	**4%**	**4%**	**12%**	**5%**	**75%**	**7%**	**5%**	**5%**	**7%**	**2%**

TABLE C5: WATER TREATMENT PRACTICES AT HOUSEHOLD LEVEL

Field site	Boiling	Official filter	Solar	Chemicals	Home made device	Stand or settle	Other	Nothing
ECOSORN	39%	9%	5%	0%	6%	0%	0%	45%
Plan International	49%	6%	0%	2%	7%	0%	1%	41%
World Vision	24%	69%	0%	0%	1%	0%	0%	16%
TSRWSSP	48%	5%	0%	0%	4%	0%	0%	45%
Wastewater management project	78%	3%	2%	0%	0%	0%	0%	16%
Average rural	**40%**	**22%**	**1%**	**1%**	**5%**	**0%**	**0%**	**37%**
Average urban	**78%**	**3%**	**2%**	**0%**	**0%**	**0%**	**0%**	**16%**

TABLE C6: WATER TREATMENT COSTS AT HOUSEHOLD LEVEL (US$, 2008)

Field site	Boiling	Official filter	Solar
ECOSORN	11.5	6.0	0.6
Plan International	9.5	4.3	-
World Vision	8.9	4.3	
TSRWSSP	11.7	4.3	-
Wastewater management project	16.2	0.2	1.4
Average rural	**10.4**	**4.8**	**0.1**
Average urban	**16.2**	**0.2**	**1.4**

TABLE C7: WATER ACCESS AND HOUSEHOLD TREATMENT COSTS INCURRED AND AVERTED (US$, 2008)

Field site	Annual average costs per household (US$)		Annual average costs saved per household following 100% sanitation coverage (US$)	
	Water source access	Water treatment	Water source access	Water treatment
ECOSORN	85.87	5.09	9.09	2.18
Plan International	93.02	4.85	5.20	1.56
World Vision	226.75	5.15	14.98	0.56
TSRWSSP	106.90	5.84	6.85	2.81
Wastewater management project	167.51	12.73	1.49	0.56
Average rural	**128.14**	**5.23**	**9.03**	**1.78**
Average urban	**167.51**	**12.73**	**1.49**	**0.56**

ANNEX D: ACCESS TIME

TABLE D1: DAILY TIME SPENT ACCESSING TOILET FOR THOSE WITH NO TOILET

	Women		Men		Children	
	Time per trip and waiting	No. of times per day	Time per trip and waiting	No. of times per day	Time per trip and waiting	No. of times per day
ECOSORN	11.40	1.34	11.40	1.34	5.90	1.64
Plan International	13.53	1.46	13.53	1.46	6.77	1.48
World Vision	14.33	1.32	14.33	1.32	7.17	1.75
TSRWSSP	3.35	1.34	6.70	1.34	6.70	1.48
Wastewater management project	2.00	1.37	4.00	1.37	4.00	1.44
Average rural	**10.65**	**1.36**	**11.49**	**1.36**	**6.63**	**1.59**
Average urban	**2.00**	**1.37**	**4.00**	**1.37**	**4.00**	**1.44**

TABLE D2: PRACTICES RELATED TO YOUNG CHILDREN

	Parents accompanying young children	Of which:	
		% outside plot	No. of times per day
ECOSORN	44%	39%	1.76
Plan International	31%	45%	1.57
World Vision	12%	17%	1.50
TSRWSSP	31%	52%	1.75
Wastewater management project	9%	22%	1.00
Average rural	**30%**	**38%**	**1.65**
Average urban	**9%**	**22%**	**1.00**

TABLE D3: PREFERENCES RELATED TO TOILET CONVENIENCE, FROM HOUSEHOLD QUESTIONNAIRE

Site	Perceived benefits of sanitation: proximity cited as satisfied or very satisfied		Those without toilet: reasons to get a toilet	
	Those with toilet	Those without toilet	Saves time	Proximity is an important characteristic
ECOSORN	80%	78%	73%	78%
Plan International	77%	83%	88%	83%
World Vision	81%	79%	76%	79%
TSRWSSP	85%	83%	81%	83%
Wastewater management project	77%	78%	77%	78%
Average rural	**81%**	**81%**	**80%**	**81%**
Average urban	**77%**	**78%**	**77%**	**78%**

ANNEX E: INTANGIBLE USER PREFERENCES FOR SANITATION

TABLE E1: RESPONDENTS' UNDERSTANDING OF SANITATION - TOP 3 RANKED RESPONSES PER SITE

	Focus Group Discussions			
	With sanitation		Without sanitation	
	Men	Women	Men	Women
ECOSORN	1. Have toilet 2. Cleaning around the house and inside 3. Drink clean water	1. Clean the house and surrounding areas 2. Clean water containers and toilets 3. Washing plates and clothes 4. Washing hands and taking baths 5. No muddy places around the house 6. Wash hands before eating and after defecation	1. It is about eating with good hygiene 2. Clean the house and body with soap	1. Wash hands with soap after defecation 2. Clean toilet and house, and burn garbage around the house
Plan International	1. Washing hands 2. Garbage cleaning 3. Drink boiled water	1. Clean toilet and yards around the house 2. Washing hands with soap 3. Drink boiled water, cover food, clean dishes 4. Clean water containers regularly, and put some chemicals in to get rid of virus 5. Washing hands after defecation and before eating	1. It is about cleaning and hygiene 2. Drink and eat with hygiene 3. Washing and clean around the house	1. Eat food with hygiene and drink boiled water 2. Wash hands before eating 3. Use toilet 4. Wash clothes and dishes
World Vision	1. Clean toilet and bathroom 2. Good drinking water 3. Good environment	1. Clothes washing 2. No fly 3. Drink boiled water 4. Taking baths regularly	1. It is about cleaning 2. Clean the yards	1. Using toilet 2. Washing hands with soap after defecation 3. Drink boiled water and use well water 4. Clean vegetables
TSRWSSP	1. Wash hands 2. Drink boiled water and filtered water 3. Clear garbage and animal excreta around the house	1. Clean around the house and toilet 2. Drink boiled water and filtered water 3. Wash hands with soap after defecation 4. Washing clothes and taking showers 5. Use masks when riding	1. Have toilet 2. Eat and drink with good hygiene 3. Clean around the house and body with soap	1. Washing hands before eating and after defecation 2. Use toilet 3. Wash clothes and dishes 4. Taking showers and sleep in mosquito net 5. Drink boiled water

TABLE E1: RESPONDENTS' UNDERSTANDING OF SANITATION - TOP 3 RANKED RESPONSES PER SITE (CONTINUED)

	Focus Group Discussions			
	With sanitation		Without sanitation	
	Men	Women	Men	Women
Wastewater management project	1. Good living standard 2. Eat and drink well 3. Clear garbage around the house or community	1. Wash hands 2. Clean house and surroundings	1. Have good living standard 2. Eat and drink with good hygiene 3. Clear garbage around the house	1. Clean hands and legs 2. Clean house
Average rural	**1. Drink boiled and clean water 2. Clean house and its surroundings 3. Washing hands before eating and after defecation 4. Clear garbage and animal excreta around the house and community**	**1. Clean the house and surrounding areas 2. Washing hands with soap after defecation and before eating 3. Drink boiled water 4. Clean water tanks and toilets 5. Washing clothes and taking baths 6. Eat clean food**	**1. It is about eating with good hygiene 2. Clean the house and body with soap 3. Eat and drink with good hygiene 4. Clean around the house**	**1. Wash hands with soap after defecation and before eating 2. Wash clothes and dishes 3. Drink boiled water 4. Use toilet 5. Take showers and sleep in mosquito net**
Average urban	**1. Good living standard 2. Eat and drink well 3. Clear the garbage around the house or community**	**1. Wash hands 2. Clean the house and surroundings**	**1. Have good living standard 2. Eat and drink with good hygiene 3. Clear garbage around the house**	**1. Clean hands and legs 2. Clean house**

TABLE E2: REASONS FOR CURRENT SANITATION COVERAGE - TOP 3 RANKED RESPONSES PER SITE

	Focus Group Discussions			
	Why families with toilet have a toilet		Why families without toilet do not have a toilet	
	Men	Women	Men	Women
ECOSORN	1. Saves time 2. Be convenient	1. Saves time 2. Not smelling	1. We cannot afford a toilet	1. It is our habit and nobody used toilet before 2. We need NGO to support
Plan International	1. Improved health 2. Saves time 3. Saves money	1. Not smelling to the neighbor 2. Is safe and healthy 3. Saves time	1. We cannot afford a toilet	1. It is our habit and nobody used toilet before 2. It smells to be in the toilet 3. We are not accustomed to nice toilet
World Vision	1. Saves time 2. Improved health 3. Good environment	1. Not smelling to the neighbor 2. Good health 3. Saves time 4. Is safe	1. We cannot afford a toilet	1. Toilet is not important and it is not habit 2. No NGOs provide us the latrine 3. No space is available near the house
TSRWSSP	1. Save time 2. Save money 3. Good sanitation	1. Not smelling 2. Be more convenient	1. We cannot afford a toilet	1. No money to build 2. We need NGO to support 3. We never used toilet before
Wastewater management project	1. Not smelling to the neighbor 2. Is safe	1. Is convenient 2. Is safe 3. Saves time 4. Improved health	n/a	n/a
Average rural	**1. Saves time 2. Is safe 3. Improved health 4. Good environment**	**1. Is convenient 2. Is healthy 3. Is safe 4. Saves time 5. Not smelling**	**1. Toilet is expensive 2. We cannot afford a toilet**	**1. No money to build 2. We need NGOs to support 3. It is our habit to practice OD**
Average urban	**1. Not smelling to the neighbor 2. Is safe 3. Good environment**	**1. Is convenient 2. Is safe 3. Saves time 4. Improved health**	**n/a**	**n/a**

TABLE E3: LEVEL OF SATISFACTION WITH CURRENT TOILET OPTION, BY OPTION TYPE (1 = NOT SATISFIED; 5 = VERY SATISFIED)

Characteristic	Those with improved sanitation			
	Sewer/septic tank	Wet pit latrine	Dry pit latrine	Average
Toilet position	3.9	4.1	3.9	4.0
Cleanliness	3.8	4.0	3.2	3.7
Status	3.7	3.8	3.4	3.6
Visitors	4.0	4.1	3.5	3.9
Maintaining	3.7	3.6	3.3	3.5
Health	3.7	3.8	3.7	3.7
Conflict avoidance	3.4	3.7	3.5	3.5
Convenience for children	3.8	3.7	3.6	3.7
Convenience for elderly	3.9	4.0	3.6	3.8
Night use of toilet	4.4	4.3	4.0	4.3
Avoid rain	4.3	4.3	3.9	4.2
Showering	3.9	3.4	2.5	3.3
Dangerous animals	3.9	4.1	3.7	3.9

Source: ESI 2 Household interview

TABLE E4: IMPORTANT CHARACTERISTICS OF A TOILET FOR THOSE CURRENTLY WITHOUT (1 = NOT IMPORTANT; 5 = VERY IMPORTANT)

Characteristic	No. responses	Average score	%
Comfortable toilet position	385	3.9	79%
Cleanliness and freedom from unpleasant odors and insects	384	4.0	80%
Having a toilet not needing to share with other households	385	3.9	78%
Having privacy when at the toilet	385	4.0	79%
Proximity of toilet to house	384	4.0	81%
Pour-flush compared to dry pit latrine	385	4.3	86%
Having a toilet disposal system that does not require emptying (piped sewer vs septic tank)	19	2.9	58%
Having a toilet disposal system that does not pollute your, neighbors', or your community's environment	371	2.9	59%
Clean environment	368	3.4	68%
Willingness to pay for improved toilet?	-	-	-
Type of toilet they would get		**% dry pit**	**2%**
		% wet pit	**98%**

ANNEX F: EXTERNAL ENVIRONMENT

TABLE F1: PROPORTION OF HOUSEHOLDS WITH AND WITHOUT TOILET WITH UNIMPROVED SANITATION PRACTICE

Site	Households with toilet			Households with no toilet	
	Open defecation (sometimes, often)	Open urination (sometimes, often)	Disposal child stool in environment[1]	Disposal child stool in environment[1]	See children defecating in yard[2]
ECOSORN	26%	68%	18%	93%	81%
Plan International	85%	94%	41%	92%	78%
World Vision	38%	88%	33%	96%	80%
TSRWSSP	27%	73%	15%	96%	72%
Wastewater management project	7%	17%	2%	80%	58%
Average rural	**44%**	**81%**	**27%**	**94%**	**78%**
Average urban	**7%**	**17%**	**2%**	**80%**	**58%**

[1] Answering "put in drain or ditch," "thrown in garbage," "buried in ground" and "left in open"
[2] Answering "sometimes" or "often"

TABLE F2: IMPLICATION OF CURRENT TOILET OPTION FOR EXTERNAL ENVIRONMENT (1 = NOT SATISFIED; 5 = VERY SATISFIED)

Site	Improved sanitation			
	Sewer/septic tank	Wet pit latrine	Dry pit latrine	Average
POLLUTION OF YOUR OR NEIGHBORS' ENVIRONMENT (QUESTION B6.1)				
ECOSORN	n/a	3.70	n/a	3.70
Plan International	n/a	n/a	3.41	3.41
World Vision	n/a	n/a	2.48	2.48
TSRWSSP	n/a	3.69	n/a	3.69
Wastewater management project	3.77	n/a	n/a	3.77
Average rural	**-**	**3.70**	**2.94**	**3.32**
Average urban	**3.77**	**n/a**	**n/a**	**3.77**
SMELL AROUND HOUSE (QUESTION B6.1)				
ECOSORN	n/a	3.80	n/a	3.80
Plan International	n/a	n/a	3.53	3.53
World Vision	n/a	n/a	3.54	3.54
TSRWSSP	n/a	3.83	n/a	3.83
Wastewater management project	3.74	n/a	n/a	3.74
Average Rural	**-**	**3.82**	**3.53**	**3.68**
Average urban	**3.74**	**-**	**-**	**3.74**

Source: Household interview

TABLE F3: PERCEPTIONS OF ENVIRONMENTAL SANITATION STATE, BY OPTION TYPE (1 = VERY BAD; 5 = VERY GOOD)

Site	Perceptions of environmental sanitation state								
	Rubbish	Sewage	Standing water	Smoke	Smell	Dirt outside	Dirt inside	Rodents	Insects
ECOSORN	2.50	2.87	2.69	2.96	2.96	2.51	2.64	2.64	2.67
Plan International	2.64	2.89	2.80	2.89	2.96	2.36	2.69	2.53	2.55
World Vision	2.15	2.45	2.22	2.72	2.47	2.25	2.28	2.29	2.26
TSRWSSP	2.60	2.89	2.74	2.93	2.94	2.43	2.74	2.61	2.62
Wastewater management project	2.47	2.66	2.74	3.12	2.40	3.03	2.97	2.77	2.93
Average rural	**2.47**	**2.78**	**2.61**	**2.87**	**2.83**	**2.39**	**2.59**	**2.52**	**2.52**
Average urban	**2.47**	**2.66**	**2.74**	**3.12**	**2.40**	**3.03**	**2.97**	**2.77**	**2.93**

TABLE F4: RANKING IMPORTANCE OF ENVIRONMENTAL SANITATION MANAGEMENT, BY OPTION TYPE (1 = NOT IMPORTANT; 5 = VERY IMPORTANT)

Site	Perceived importance of environmental sanitation management								
	Rubbish	Sewage	Standing water	Smoke	Smell	Dirt outside	Dirt inside	Rodents	Insects
ECOSORN	3.67	3.43	3.54	3.23	3.50	3.63	3.58	3.60	3.52
Plan International	4.04	3.99	4.24	3.85	3.98	4.28	4.10	4.25	4.31
World Vision	4.23	3.69	3.75	3.27	3.68	3.67	3.48	3.59	3.61
TSRWSSP	3.81	3.66	3.79	3.51	3.64	3.95	3.81	3.85	3.90
Wastewater management project	3.95	3.84	3.40	3.13	3.81	3.15	3.38	3.24	3.13
Average rural	**3.94**	**3.69**	**3.83**	**3.47**	**3.70**	**3.88**	**3.74**	**3.82**	**3.84**
Average urban	**3.95**	**3.84**	**3.40**	**3.13**	**3.81**	**3.15**	**3.38**	**3.24**	**3.13**

ANNEX G: TOURISM IMPACT

TABLE G1: PLACES VISITED BY TOURISTS (% RESPONDENTS) AND ENJOYMENT OF STAY (SCORE: 5 = VERY MUCH; 1 = NOT AT ALL)

Category	Hotel tariff (in US$)	Phnom Penh		Historical Sites		Beach		Natural/Forest		Within Cambodia	
		%	Score	%	Score	%	Score	%	Score	%	Score
Tourist	01 - 29	30%	3.9	27%	4.4	44%	3.9	36%	4.0	34%	4.0
	30 - 59	17%	4.0	16%	4.4	19%	3.3	16%	3.7	15%	3.7
	60 - 89	7%	4.0	8%	4.9	9%	3.5	5%	4.7	5%	4.7
	90 - 119	3%	4.0	4%	4.6	4%	4.0	5%	4.4	5%	4.4
	120+	30%	3.9	39%	4.6	12%	2.2	32%	3.8	30%	3.8
	Sub-total	**87%**	**4.0**	**94%**	**4.6**	**88%**	**3.4**	**95%**	**4.1**	**89%**	**4.1**
Business	01 - 29	2%	4.3	1%	3.5	1%	4.0	1%	4.0	1%	5.0
	30 - 59	2%	4.2	1%	3.7	2%	2.5	2%	2.5	2%	3.7
	60 - 89	2%	3.8	1%	4.5	1%	2.0	1%	2.0	1%	3.5
	90 - 119	2%	3.8	0%	Na	2%	3.0	2%	3.0	1%	2.0
	120+	5%	3.8	3%	3.1	5%	3.4	1%	4.0	4%	4.0
	Sub-total	**13%**	**4.0**	**6%**	**3.7**	**12%**	**3.0**	**5%**	**3.1**	**11%**	**3.6**
TOTAL		**100%**	**4.0**	**100%**	**4.1**	**100%**	**3.2**	**100%**	**3.6**	**100%**	**3.9**

TABLE G2: GENERAL SANITARY EXPERIENCE OF FOREIGN TOURISTS (SCORE: 5 = VERY GOOD; 1 = VERY POOR)

Category	Hotel tariff	N	General sanitary condition	Hotel	Swimming pool	Open water	Restaurant	Capital city	Other cities
Tourist	01 - 29	-	2.4	3.6	4.0	2.6	3.7	2.6	3.3
	30 - 59	-	2.8	3.8	4.0	2.8	3.7	2.9	3.1
	60 - 89	-	2.9	4.5	4.6	2.9	3.8	3.1	3.3
	90 - 119	-	2.8	4.2	4.2	3.2	4.0	3.5	3.3
	120+	-	2.7	4.4	4.5	2.4	4.0	2.8	3.3
	Sub-total		**2.7**	**4.1**	**4.3**	**2.8**	**3.8**	**3.0**	**3.2**
Business	01 - 29	-	1.7	3.5	4.0	2.5	3.0	3.0	2.0
	30 - 59	-	2.2	3.4	3.5	3.0	3.5	3.2	3.0
	60 - 89	-	2.7	3.8	4.0	2.8	3.8	3.0	3.0
	90 - 119	-	n/a	4.2	3.8	2.5	3.3	3.0	-
	120+	-	2.7	4.4	3.5	2.3	3.5	1.0	2.0
	Sub-total		**2.3**	**3.9**	**3.8**	**2.6**	**3.4**	**2.6**	**2.5**
TOTAL			**2.5**	**4.0**	**4.0**	**2.7**	**3.6**	**2.8**	**2.9**

TABLE G3: SANITARY EXPERIENCE OF TOURISTS IN RELATION TO TOILETS AND HAND WASHING (SCORE: 5 = VERY GOOD, 1 = VERY POOR)

Category	Hotel tariff	N	Quality of toilets in					Water and soap for hand washing		
			Hotel	Restaurant	Airport	Bus station	City	Restaurant	Bus station	City
Tourist	01 - 29	89	3.6	3.2	4.3	2.3	2.3	3.4	2.1	2.3
	30 - 59	60	3.9	3.5	4.2	2.4	2.3	3.6	2.6	2.5
	60 - 89	30	4.5	4.0	4.5	2.6	2.1	4.5	2.6	3.2
	90 - 119	18	4.4	3.4	4.2	2.3	2.6	4.0	3.0	2.8
	120+	55	4.4	3.6	4.3	2.7	2.5	3.9	2.6	2.8
	Subtotal	**252**	**4.2**	**3.6**	**4.3**	**2.4**	**2.4**	**3.9**	**2.6**	**2.7**
Business	01 - 29	5	3.8	2.8	4.3	2.0	2.7	3.5	3.0	2.0
	30 - 59	7	3.6	3.4	3.6	2.3	2.3	2.6	2.3	2.0
	60 - 89	7	3.8	3.4	3.8	2.0	2.0	4.0	2.0	2.0
	90 - 119	9	3.8	3.2	-	2.5	3.0	3.0	1.0	-
	120+	4	4.2	3.3	4.0	1.5	1.5	2.8	1.4	1.7
	Subtotal	**32**	**3.8**	**3.2**	**3.9**	**2.1**	**2.3**	**3.2**	**1.9**	**1.5**
TOTAL		**284**	**4.0**	**3.4**	**4.1**	**2.3**	**2.3**	**3.5**	**2.3**	**2.1**

TABLE G4: SANITARY FACTORS OF MOST CONCERN TO FOREIGN TOURISTS (% CITING, 3 RESPONSES PER RESPONDENT)

Category	Hotel tariff	N	Drinking water	Tap water	Swimming pool water	Food	Currency notes	Shaking hands	Unsanitary toilets	Public toilets	Other objects
Tourist	01 - 29	215	6.3%	3.1%	3.1%	6.3%	0.0%	0.0%	6.3%	3.1%	3.1%
	30 - 59	108	6.3%	6.3%	0.0%	3.1%	3.1%	0.0%	9.4%	12.5%	3.1%
	60 - 89	58	6.3%	6.3%	0.0%	15.6%	9.4%	3.1%	9.4%	3.1%	0.0%
	90 - 119	23	3.1%	9.4%	0.0%	9.4%	9.4%	0.0%	6.3%	6.3%	0.0%
	120+	148	12.5%	12.5%	3.1%	9.4%	3.1%	0.0%	12.5%	6.3%	0.0%
	Subtotal	**552**	**34.4%**	**37.5%**	**6.3%**	**43.8%**	**25.0%**	**3.1%**	**43.8%**	**31.3%**	**6.3%**
Business	01 - 29	10	7.3%	18.9%	0.7%	12.7%	8.0%	0.0%	17.5%	9.8%	2.5%
	30 - 59	14	6.9%	9.1%	2.5%	7.6%	1.8%	0.7%	5.5%	3.6%	0.7%
	60 - 89	17	3.3%	3.6%	0.7%	3.3%	1.1%	0.4%	3.3%	4.0%	0.7%
	90 - 119	14	0.4%	1.8%	0.7%	2.2%	0.4%	0.0%	1.8%	0.7%	0.0%
	120+	19	14.2%	20.7%	0.0%	5.1%	1.1%	1.1%	5.5%	2.2%	0.0%
	Subtotal	**74**	**32.0%**	**54.2%**	**4.7%**	**30.9%**	**12.4%**	**2.2%**	**33.5%**	**20.4%**	**4.0%**
TOTAL		**626**	**32.2%**	**52.4%**	**4.9%**	**32.2%**	**13.7%**	**2.3%**	**34.5%**	**21.5%**	**4.2%**

TABLE G5: HEALTH TROUBLES OF FOREIGN TOURISTS

Hotel tariff	N	Gastrointestinal tract disorders								Average number of days of:		Medical care (%)				
		N	%	Drinking Water	Water Hygiene	Food	Another person	Dirty Environment	Weather	Symptoms	Incapacitation	No	OP	IP	Shop	Av. cost (US$)
TOURISTS																
1 - 29	89	29	32.6%	8	2	16	3	5	8	3.3	0.7	66%	10%	3%	3%	14
30 - 59	60	13	21.7%	4	1	7	1	2	3	2.3	0.5	69%	8%	n/a	n/a	17
60 - 89	30	5	16.7%	1	1	4	1	2	1	2.6	1.2	80%	n/a	n/a	n/a	10
90 - 119	18	4	22.2%	1	n/a	3	0	n/a	2	6.2	-	100%	n/a	n/a	n/a	-
120+	55	10	18.2%	2	n/a	7	1	1	1	1.7	0.6	22%	n/a	n/a	n/a	10
Subtotal	**252**	**61**	**24.2%**	**16**	**4**	**37**	**6**	**10**	**15**	**3.0**	**0.6**	**80%**	**7%**	**3%**	**3%**	**14**
BUSINESS VISITORS																
1 - 29	5	1	20.0%	n/a	n/a	1	n/a	n/a	n/a	5	n/a	100%	n/a	n/a	n/a	n/a
30 - 59	7	0	0.0%	n/a	n/a	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
60 - 89	7	3	42.9%	1	2	3	n/a	1	n/a	4.3	3	33%	33%	n/a	n/a	25
90 - 119	9	0	0.0%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
120+	4	0	0.0%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Subtotal	**32**	**4**	**12.5%**	**1**	**2**	**5**	**0**	**1**	**0**	**4.5**	**3**	**50%**	**33%**	**0%**	**0%**	**25**
TOTAL	**284**	**65**	**22.9%**	**17**	**6**	**42**	**6**	**11**	**15**	**3.1**	**0.7**	**78%**	**8%**	**3%**	**3%**	**13**

TABLE G6: INTENTION TO RETURN OF FOREIGN TOURISTS (%)

Category	Hotel tariff	N	Return to Cambodia? (%)				Advise friends to come?			
			Yes	No	Maybe	Do not know	Yes	No	Maybe	Do not know
Tourist	01 - 29	85	87.1%	2.4%	10.6%	0.0%	92.9%	0.0%	7.1%	
	30 - 59	52	80.8%	1.9%	17.3%	0.0%	94.2%	1.9%	3.8%	
	60 - 89	26	80.8%	0.0%	11.5%	7.7%	92.3%	0.0%	7.7%	
	90 - 119	11	100.0%	0.0%	0.0%	0.0%	81.8%	0.0%	18.2%	
	120+	124	78.2%	2.4%	13.7%	5.6%	100.0%	0.0%	0.0%	
	Subtotal	**298**	**82%**	**2%**	**13%**	**3%**	**93.5%**	**0.5%**	**6.0%**	
Business	01 - 29	4	25.0%		75.0%		50.0%	25.0%	25.0%	0.0%
	30 - 59	5	100.0%				100%			
	60 - 89	6	100.0%				66.7%	0.0%	33.3%	0.0%
	90 - 119	7	85.7%		14.3%		85.7%	0.0%	14.3%	0.0%
	120+	14	100.0%				100.0%			
	Subtotal	**36**	**89%**	**0%**	**11%**	**0%**	**80.0%**	**4.0%**	**16.0%**	**0.0%**
TOTAL		**334**	**82.9%**	**1.8%**	**12.6%**	**2.7%**	**92.0%**	**0.9%**	**7.1%**	**0.0%**

TABLE G7: REASONS FOR HESITANCY TO RETURN OF FOREIGN TOURISTS (%)

Category	Hotel tariff	N	Reasons for hesitancy in returning (% cited)							
			Main factor				Contributory factor			
			Sanitation	Cost	No need	Not safe	Sanitation	Cost	No need	Not safe
Tourist	01 - 29	15	6.7%	13.3%	6.7%	0.0%	6.7%	13.3%	26.7%	26.7%
	30 - 59	13	7.7%	0.0%	30.8%	0.0%	7.7%	7.7%	23.1%	23.1%
	60 - 89	3	0.0%	33.3%	0.0%	0.0%	33.3%	0.0%	33.3%	0.0%
	90 - 119	0								
	120+	15	6.7%	0.0%	20.0%	0.0%	40.0%	13.3%	20.0%	0.0%
	Subtotal	**46**	**6.5%**	**6.5%**	**17.4%**	**0.0%**	**19.6%**	**10.9%**	**23.9%**	**15.2%**
Business	01 - 29	2					50.0%	0.0%	0.0%	50.0%
	30 - 59	0								
	60 - 89	0								
	90 - 119	3					0.0%	33.3%	33.3%	33.3%
	120+	0								
	Subtotal	**5**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**20.0%**	**20.0%**	**20.0%**	**40.0%**
TOTAL		**51**	**5.9%**	**5.9%**	**15.7%**	**0.0%**	**19.6%**	**11.8%**	**23.5%**	**17.6%**

ANNEX H: BUSINESS IMPACT

TABLE H1: RATING OF ENVIRONMENTAL SANITATION CONDITIONS IN THE LOCATION OF THE BUSINESS SURVEY INTERVIEW (1 = BEST; 5 = WORST) (IN COLUMNS: MAIN SECTORS REPRESENTED)

Variable	Travel agency	Hotel	Restaurant	Other commercial	Pure drinking water	Food producer	Total
Number of companies	5	2	3	1	5	3	19
Number of responses	5	2	3	1	5	4	20
Water quality in rivers	4.0	1.0	5.0	4.0	2.0	4.0	20.0
State of canals and rainwater drainage	3.0	1.0	2.0	n/a	2.0	3.0	11.0
Management of sewage	2.0	2.0	1.0	n/a	2.0	3.0	10.0
Management of industrial wastewater	3.0	2.0	1.0	n/a	3.0	4.0	13.0
Household coverage with private toilets	1.0	1.0	1.0	2.0	1.0	2.0	8.0
Toilets in public places	4.0	2.0	4.0	n/a	1.0	2.0	13.0
Household/office solid waste	1.0	1.0	1.0	2.0	1.0	2.0	8.0
Management of industrial solid waste	2.0	2.0	1.0	2.0	2.0	2.0	11.0
Air quality from vehicles	2.0	3.0	2.0	1.0	2.0	2.0	12.0
Air quality from solid waste	1.0	2.0	2.0	1.0	2.0	2.0	10.0
Air quality from excreta	1.0	1.5	1.7	1.0	1.0	2.0	8.2

TABLE H2: IMPORTANCE OF ENVIRONMENTAL SANITATION CONDITIONS FOR LOCATING THE COMPANY (1 = UNIMPORTANT; 5 = IMPORTANT) (IN COLUMNS: MAIN SECTORS REPRESENTED)

Variable	Travel agency	Hotel	Restaurant	Other commercial	Pure drinking water	Food producer	Total
Workforce health	4.2	4.5	5.0	5.0	4.8	5.0	4.8
Water quality directly available from nature	n/a	5.0	3.0	5.0	4.0	5.0	3.7
Pleasant environment for your staff	4.2	5.0	4.7	5.0	5.0	5.0	4.8
Availability of cheap and good land	2.8	5.0	3.5	5.0	5.0	5.0	4.4

ANNEX I: COST OF IMPROVED SANITATION AND HYGIENE

TABLE I1: PROPORTION OF TOTAL (ECONOMIC) COSTS WHICH ARE FINANCIAL

		Hygiene	CLTS dry pit	Concrete dry pit	Pour-flush pit	Septic tank	Sewerage
Investment	Financial	0%	97%	97%	98%	99%	100%
	Non-financial	100%	3%	3%	2%	1%	0%
Recurrent	Financial	100%	100%	100%	100%	100%	100%
	Non-financial	0%	0%	0%	0%	0%	0%
Annual equivalent	Financial	0%	97%	95%	99%	99%	99%
	Non-financial	100%	3%	5%	1%	1%	1%

ANNEX J: PROGRAM APPROACH ANALYSIS

TABLE J1: HOUSEHOLD CHOICES AND OTHER INTERVENTIONS

Site	Rural/ urban	Number of households interviewed	Households with Toilet	Was household given a choice to participate? (%)		Was household given a choice of options? (%)		Hygiene awareness (%)		Water intervention offered (%)	
				Yes, voluntary	No, not voluntary	Yes, choice available	No, choice not available	Yes	No	Yes	No
ECOSORN	Rural	230	120	99%	1%	68%	32%	81%	19%	39%	61%
Plan International	Rural	245	165	100%	0%	67%	33%	100%	0%	44%	56%
World Vision	Rural	170	120	97%	3%	95%	5%	98%	2%	97%	3%
TSRWSSP	Rural	250	159	100%	0%	84%	16%	79%	21%	37%	63%
Wastewater management project	Urban	285	266	100%	0%	52%	48%	76%	24%	29%	71%

TABLE J2: FINANCING FROM HOUSEHOLD AND PROJECT SOURCES

Site	Rural/ urban	Number of households interviewed	Household contribution		Value of household inputs (US$)			Total (US$)	Project value input (US$)
			Yes	No	Cash	Labor	Materials		
ECOSORN	Rural	120	56%	44%	28	3	-	31	136
Plan International	Rural	165	27%	73%	20	2	-	22	54
World Vision	Rural	120	23%	78%	15	2	-	17	139
TSRWSSP	Rural	159	73%	27%	26	2	-	28	145
Wastewater management project	Urban	266	83%	17%	23	17	-	40	17,550

TABLE J3: APPROPRIATE TECHNOLOGY

Site	Rural/ urban	Number of households interviewed	% households with insufficient water for flushing		% households with pit flooding		% households with pit overflow	
			Sometimes	Often	Sometimes	Often	Sometimes	Often
ECOSORN	Rural	120	4.2%	0.0%	n/a	n/a	n/a	n/a
Plan International	Rural	165	n/a	n/a	21.8%	18.8%	4.8%	22.9%
World Vision	Rural	120	n/a	n/a	10.9%	3.0%	1.9%	3.8%
TSRWSSP	Rural	159	4.0%	0.0%	n/a	n/a	n/a	n/a
Wastewater management project	Urban	266	0.0%	0.0%	n/a	n/a	n/a	n/a

TABLE J4: ACTUAL PROGRAM PERFORMANCE IN RELATION TO KEY SELECTED INDICATORS FOR PROGRAM EFFECTIVENESS

Impact	Indicator	ECOSORN	Plan International	World Vision	TSRWSSP	Wastewater management project
Health (sanitation intervention)	% household members using improved toilet regularly	74%	15%	62%	73%	93%
Health (hygiene intervention)	% households washing hands after defecation	80%	54%	57%	66%	95%
	% latrines with signs of feces around toilet					
Water source	Rural: % of tubewells and dug wells tested which have zero E. coli	0%	60%	100%	80%	
	Urban: % tested samples in which Chlorine is at adequate levels					50%
Water treatment	% households using non-boiling household water treatment methods	33%	16%	71%	30%	5%
Access time	% household members using own toilet instead of off-plot options	74%	15%	62%	73%	95%
Reuse	Own use: % households applying human excreta in own land or using human excreta for biogas	0%	0%	0%	0%	0%
	Sales: % households selling human excreta or biogas	0%	0%	0%	0%	0%
Intangibles	Average score (as % of maximum score of 5) of satisfaction questions	76%	71%	72%	79%	80%
External environment	Average score (as % of maximum score of 5) of external environment questions relating to sewage	57%	58%	49%	58%	75%


wsp
water and
sanitation program