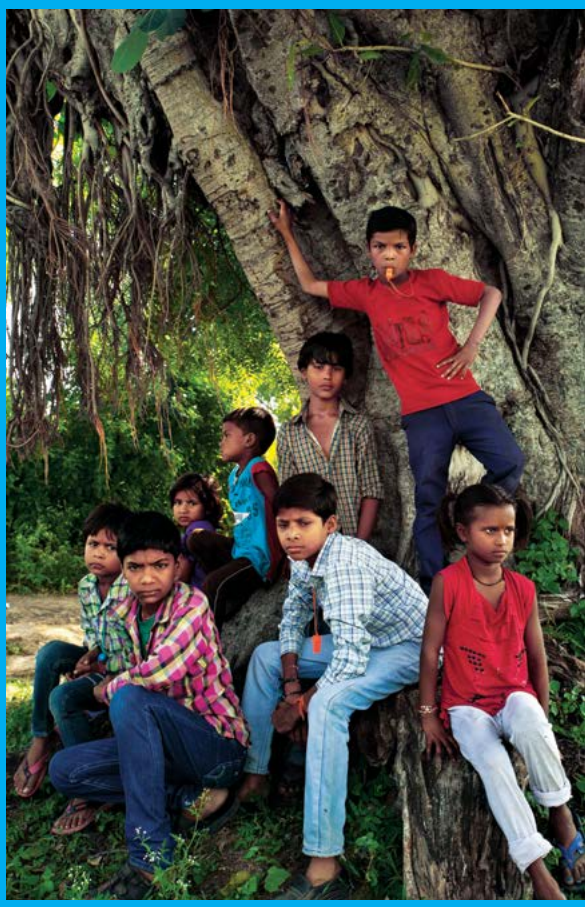


Financial and Economic Impacts of the Swachh Bharat Mission in India

unicef | for every child

Financial and Economic Impacts of the Swachh Bharat Mission in India


मोर भाई नं. 1
स्वच्छ भारत
स्वच्छ भारत
शौ चा ल य

Summary

UNICEF was requested by the Ministry of Drinking Water and Sanitation to conduct a study to assess the economic impacts (benefits) of the Swachh Bharat Mission (Gramin) (SBM(G)) i.e., covering rural areas of India. Together with the Ministry of Drinking Water and Sanitation, UNICEF formed a Steering Group comprising sector experts and selected stakeholder representatives (see Acknowledgements).

Specifically the study sought to answer:

1. What are the household and community financial and economic benefits of improved sanitation and hygiene in rural areas, implemented under the SBM(G)?
2. What are the household and community costs of improved sanitation and hygiene in rural areas, implemented under the SBM(G)?
3. What is the cost compared with the benefit of improved sanitation and hygiene, in rural areas? How long does it take a rural household to pay back the toilet costs through saved financial costs?

The study adopted standard economic modelling methods for estimating the efficiency of development interventions. Costs included both investment and operational costs for toilet and handwashing station, including subsidies or resources provided by government or non-state actors, as well as financial and non-financial costs to households. Benefits included financial savings due to less disease cases from using a toilet and practising handwashing (health care and productive costs) and the value of time savings due to a closer toilet. Cost-benefit ratios were presented under different perspectives, thus allowing conclusions according to the directness of impact of the intervention on households, each with different policy conclusions (see Table D). In addition, results are presented by wealth quintiles using the asset index methodology, to assess how SBM(G) affects different population groups.

To ensure a solid evidence base for the study, UNICEF implemented an independent survey on a sample of 18,376 respondents representing 10,051 rural households, randomly selected from 550 Gram Panchayats across 12 states accounting for 90 per cent of open defecation in India[1]. The survey was carried out from 20 July – 11 August 2017.

Costs per wealth quintile

Costs of implementing SBM(G) at household level are summarized as follows:

1. Financial costs paid by household from own funds. On an average: INR 9,942 (US $154) was the out-of-pocket contribution of those receiving government support, and INR 29,900 (US $463) by those not receiving any government support, thus averaging INR 16,262 (US $252) across all households. Spending on operations and maintenance (O&M) costs averaged INR 2,359 (US $36) per year (see columns labelled 1. in Table A).
2. Financial investment from the government, received by households. 70 per cent of sampled households reported to have received support for capital investment. The financial incentive to these households averaged INR 11,800 (US $183) per household, or an average of INR 8,199 (US $127) per household across all households obtaining toilets. In addition, the average software cost is estimated at INR 249 (US $4) per household (which is an upper value based on maximum of 2 per cent of total subsidy of INR 12,000
(US $186) being used for information, education and communication activities).
3. Non-financial costs covered by household include time in building, cleaning and maintaining the toilet (see columns labelled 3. in Table A). Time is valued at the rural wage rate of INR 250 (US $4) per day.

[1]Andhra Pradesh, Assam, Bihar, Jharkhand, Bihar, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana and Uttar Pradesh.

Table A. Costs to households and government per household sampled, by wealth quintile

Group	1. Financial costs paid by household from own funds		2. Financial costs paid by government or other financier	3. Non-financial costs (time) covered by household	
	Investment	Annual O&M	Investment	Investment	Annual O&M
All	INR 16,626	INR 2,359	INR 8,199	INR 1,007	INR 6,082
Poorest	INR 6,971	INR 1,743	INR 9,691	INR 1,192	INR 4,189
Q2	INR 13,874	INR 2,286	INR 8,825	INR 917	INR 5,104
Q3	INR 16,499	INR 2,397	INR 8,382	INR 803	INR 5,958
Q4	INR 19,160	INR 2,653	INR 7,803	INR 744	INR 6,772
Richest	INR 26,613	INR 2,752	INR 6,229	INR 895	INR 8,650

[a] *Conversion to US $ is made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.*

Table A shows cost data for five quintiles as well as overall. It is clear that households from poorer quintiles spent less of their own resources and received more government support: 82 per cent of households in poorest quintile received government support compared to 53 per cent in the richest quintile. Consequently,
the poorest households received about INR 3,500 (US $54) more, on average, than the richest households. Poorer households also invested more of their own time in toilet construction (see investment column labelled 3. in Table A).

Benefits per wealth quintile

The study considered four types of benefit that accrue to households from having a household toilet and using it. A fifth type, reuse/recycling of excreta and organic waste, is also expected to provide an important benefit, but it has not been possible to quantify with sufficient robustness for this present study[2].

1. Medical costs averted: financial savings from paying less medical costs based on reductions in illness episodes (average INR 8,024 (US $124) per household per year).
2. Value of time savings: reduced time lost from sickness and seeking a place for open defecation (average INR 24,646 (US $382) per household per year)[3].
3. Value of saved lives: economic value of saved lives due to lower mortality rates (average INR 17,622 (US $273) per household per year).
4. Property value: INR 18,991 (US $294) per household was estimated as the average increase in property value from having a toilet. In the cost-benefit analysis, a one-off cash benefit of this value is assumed to accrue at the end of a 10-year period.

[2]There is indeed considerable potential to safely reuse human excreta in India, given the survey found 40 per cent of households to have a double pit latrine. However, when asked, only 14.5 per cent of households said they plan to use it as a compost in their plot and 0.6 per cent plan to sell it. Currently 80 per cent of households with animals reuse the animal excreta in some way, and 40 per cent of households compost their organic waste. Hence there is still some potential for closing the sanitation value chain, and reusing more household and farm waste. However, it will need more in-depth scientific study to value these waste accurately.

[3]For adults, if they say they lost income, then that income was recorded. For other adults, value of time was INR 250 (US $3.87) per day (rural unskilled wage, NREGS). For children of school age, 50 per cent of rural wage was used.

Table B. Average benefits per household sampled at 100 per cent toilet use, by wealth quintile

Group	Annual benefits at 100% toilet usage				Addition to property value (one-off benefit)
	Medical costs averted	Value of time savings	Value of saved lives	Total	
All	INR 8,024	INR 24,646	INR 17,622	INR 50,292	INR 18,991
Poorest	INR 6,599	INR 21,466	INR 20,184	INR 48,249	INR 11,757
Q2	INR 5,940	INR 24,869	INR 18,853	INR 49,662	INR 16,884
Q3	INR 7,278	INR 23,361	INR 16,650	INR 47,289	INR 18,698
Q4	INR 8,961	INR 26,337	INR 15,665	INR 50,964	INR 20,808
Richest	INR 13,182	INR 28,614	INR 16,813	INR 58,609	INR 26,144

b Conversion to US $ is made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.

Despite the availability of a functioning household toilet, some household members do not (always) use it, as habits can be hard to change. Out of a sample of >40,000 individuals across >10,000 households, it was found that 15 per cent do not always use a toilet when they are at home. Note that this does not represent the entire rural population of India, but the sample of households that were interviewed and have obtained a toilet since October 2014. The implications for the health impacts are potentially greater than the 15 per cent non-use rate implies, due to externalities[4]. There is limited global evidence on the exact relationship between toilet coverage/use rates and reductions in sanitation-related diseases. Drawing on the only study available for India that maps this relationship[5], a 85 per cent toilet use rate would imply a disease reduction of 34 per cent (instead of 50 per cent when everyone uses a toilet). The consequent benefits under 85 per cent toilet usage are presented in Table C. As shown, the annual benefits reduce from an average of INR 50,292 (US $780) at 100 per cent toilet use to INR 37,126 (US $575) at 85 per cent toilet use.

Table C. Average benefits per household sampled at 100 per cent toilet use, by wealth quintile

Group	Annual benefits at 85% toilet usage				Addition to property value (one-off benefit)
	Medical costs averted	Value of time savings	Value of saved lives	Total	
All	INR 5,296	INR 20,200	INR 11,631	INR 37,126	INR 18,991
Poorest	INR 4,355	INR 17,431	INR 13,321	INR 35,108	INR 11,757
Q2	INR 3,921	INR 20,340	INR 12,443	INR 36,703	INR 16,884
Q3	INR 4,803	INR 19,167	INR 10,989	INR 34,959	INR 18,698
Q4	INR 5,915	INR 21,734	INR 10,339	INR 37,988	INR 20,808
Richest	INR 8,700	INR 23,499	INR 11,097	INR 43,296	INR 26,144

c Conversion to US $ is made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.

Drawing on the estimated total number of households without improved sanitation In India in 2015 (from the WHO/UNICEF Joint Monitoring Programme), the total economic damages are estimated to be INR 12.2 trillion (US $189 billion), or 7.9 per cent of GDP[6]. The damage cost as a proportion of GDP is higher than the estimate of 6.4 per cent from the previous World Bank study because this current study draws on field studies, which have identified higher medical and time costs than previously reported.

[4]Given that everyone is still exposed to the fecal matter of the 15 per cent of people not using a toilet.

[5]Andres LA, Briceño B, Chase C, Echenique JA (2011). Sanitation and externalities: evidence from early childhood health in rural India. Policy Research Working Paper 6737. The World Bank: Washington DC.

[6]This calculation assumes that damage costs in urban households who do not own a toilet are the same as the rural household damage costs estimated in this study.

If SBM achieved its aim of ending open defecation, with improved sanitation, the damage costs would be reduced to INR 4.1 trillion (US $64 billion), or 2.7 per cent of GDP, meaning savings of INR 8.1 trillion (US $126 billion) from the current situation. The damages do not fully disappear under 100 per cent toilet use rate because this level of sanitation intervention is not expected to mean the end of the transmission of diarrhoea and other diseases via the faecal-oral route. To reduce the health impacts further, more advanced water, sanitation and hygiene infrastructure and practices would be needed.

Cost-benefits per wealth quintile

When costs and benefits are compared over a 10-year time period[7], and when 100 per cent of households in a community use a toilet, the financial savings exceed the financial costs to the household by 1.7 times, on average. For the poorest households, the value is higher at 2.4 times (see column 1. in Table D). When household time savings (from closer toilet access and less sickness) and the time for cleaning and maintaining the toilet are valued, the benefits exceed costs by 3.0 times (see column 2. in Table D). When benefits of lives saved are included, the benefits exceed costs by 4.7 times (see column 3. in Table D). If the government contribution to the toilet cost is included, reflecting a broader societal perspective, the benefits exceed costs by 4.3 times (see column 4. in Table D).

Under all these scenarios, the benefit-cost ratios are higher for poorer households than for richer ones. The annual internal rate of return (IRR) on the financial investment is 32 per cent for all population groups, which is well above what households would earn from putting their money into savings accounts. For the poorest households, the financial IRR is higher at 69 per cent. Taking into account the government financial contributions, the average financial IRR is 18 per cent (24 per cent for poorest households). The net financial return on the household expenditure on the toilet and handwashing station averages INR 21,390 (US $332) over 10 years. The average financial payback period is two years for all households, and only one year for the poorest group.

When calculating benefit-cost ratios under conditions of actual toilet use (of 85 per cent on average from the entire sample), the benefits are adjusted downwards while the costs remain the same. The amount by which the benefits exceed costs reduces accordingly to 1.1 times (from the household financial perspective) and 3.4 times (from the societal perspective). For the poorest quintile, the household financial savings exceed costs by 1.6 times.

Table D. Benefit-cost ratios from different perspectives, and at rate of toilet use of 100 per cent

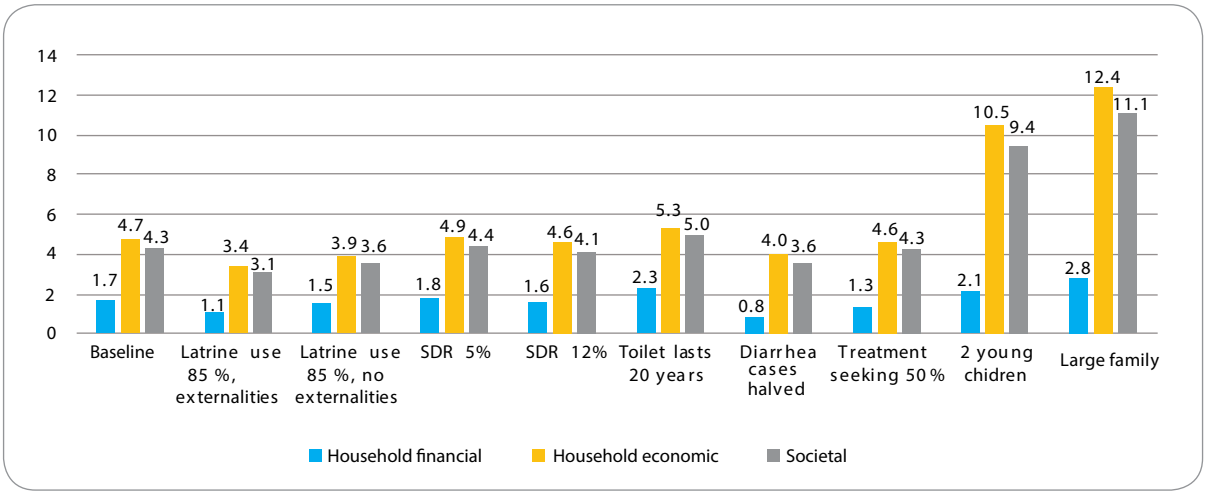
Group	Perspective[a]			
	1. Household financial perspective	2. Household financial perspective + time impacts	3. Household financial perspective + time impact + lives saved	4. Societal perspective (includes government subsidy)
All	1.7	3.0	4.7	4.3
Poorest	2.4	4.0	7.0	5.8
Q2	1.4	3.3	5.4	4.7
Q3	1.6	2.9	4.5	4.0
Q4	1.7	2.9	4.3	3.9
Richest	2.1	2.8	4.0	3.7

[a] (1) household financial perspective – involving only household medical spending; (2) household financial perspective plus impacts on time use includes the implications for actual or potential productivity of household members; (3) household economic perspective, takes into account (2) plus the value of lives saved; and (4) societal perspective, takes into account the above plus non-household spending on the intervention (e.g. government, civil society organizations and others).

[7] Future values (years 2 to 10) are deflated to the year 2017 using an annual discount rate of 8 per cent. Household latrines are assumed to last for at least 10 years, and with the annual O&M costs it is assumed that the toilet functions properly over (at least) this 10 year period.

The results are relatively robust to changes in assumptions (see Figure A). When the social discount rate is changed, the impact is relatively minor. With larger family sizes and more children, the BCR increases. When health externalities are assumed the household financial BCR reduces to close to unity, but when no externalities are assumed it only decreases to 1.5. When treatment seeking is reduced to only 50 per cent of cases, the financial BCR reduces to 1.3. However, when the baseline rate of diarrheal disease cases per person per year are halved, the BCR reduces below 1.0 (from the household financial perspective).

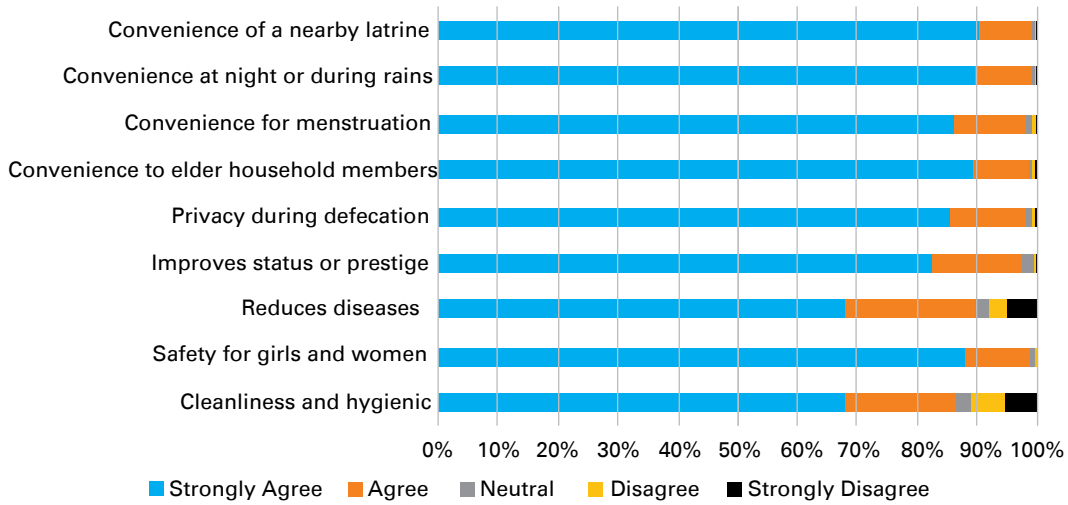
Figure A. Benefit-cost results under alternative data inputs and scenarios



SDR – social discount rate. '2 young children' family includes 3 adults. Large family is 2 young children, 2 school-age children and 3 adults.

Figure B shows the intangible benefits which are hard to quantify in monetary terms, but are largely in addition to the benefits evaluated above. The results indicate very strongly that household toilets have a range of important benefits, as perceived by households, covering convenience, privacy, safety and status aspects. The two impacts over which approximately 10 per cent of households raised some doubts are the disease and cleanliness aspects.

Figure B. Intangible benefits of owning a toilet as perceived by households



In conclusion, this study has shown that the Swachh Bharat Mission (Gramin) is highly cost-beneficial from both a financial and an economic perspective. Even households that invest INR 16,000 (US $248) of their own money in a toilet and handwashing station will see those funds repaid in 2 years from the medical costs saved. The financial payback period could be sooner given that some sanitation-related diseases were not included in the study, such as Hepatitis A and E, soil-transmitted helminthes and enteropathy. Childhood stunting and its consequences on long-term health and educational outcomes were also not included in this study, but would add considerably to the benefits of owning and using a toilet. However, when household members do not use their toilet and they defecate in the open, the benefits can be reduced considerably, thus emphasizing the importance of strengthening behaviour change components of the SBM(G).

It should also be noted that some other benefits of improved sanitation have not been quantified and valued in this study, such as reuse value, tourism value, the impact of improved management of fecal matter on water quality and the social benefits (some of the latter were assessed qualitatively and shown in Figure B). Hence the financial and economic benefits will be greater than those presented here.

The results presented in this household-based study also confirm previous studies conducted in India. In preparing for the recent sanitation loan, the World Bank estimated a benefit-cost ratio (including both financial and non-financial benefits) of around 4.0 – for a toilet that was assumed to cost INR 15,000 (US $232). Indeed, in this current study it was found that households – even poor households – make their own investments on top of the government subsidy, valued at many thousand rupees. Hence as well as identifying the true costs to households of implementing SBM, this survey has found increased benefits than previously – in particular for the medical costs saved.

Acknowledgments

This report was prepared by Dr. Guy Hutton, Mr. Francis Odhiambo and Mr. Nicolas Osbert (UNICEF), and Ms. Avni Kumar and Dr. Sumeet Patil (NEERMAN). The authors acknowledge and thank the numerous field team members as well as the families and village functionaries who participated in the survey. The authors are also grateful to members of the Steering Committee for this study, who provided comments on the study scope, design and draft report: Mr. Parameswaran Iyer, Secretary; Ms. Mahima Vashisht, and Mr. Vineet Jain (Ministry of Drinking Water and Sanitation); Dr. Meera Mehta (CEPT University, Ahmedabad); Mr. P. C. Mohanan (National Statistical Commission); Dr. Anjali Chikersal (Center for Policy Research, New Delhi); Mr. Xavier Chauvot De Beauchene (World Bank) and Ms. Therese Dooley (UNICEF). We would also like to thank Kanchan Dyuti Maiti (UNICEF) for his contributions on sampling methodology.

Contents

Abbreviations

BCR	Benefit-cost ratio
CBA	Cost-benefit analysis
GP	Gram Panchayat
IRR	Internal rate of return
MIS	Management information system
NGO	Non-governmental organization
NPV	Net present value
O&M	Operations and maintenance
PBP	Payback period
SBM	Swachh Bharat Mission (clean India mission)
SDR	Social discount rate
UN	United Nations
VOSL	Value of a statistical life
WASH	Water, sanitation, and hygiene
WHO	World Health Organization


शौचालय

1 Introduction

On 2 October 2014, Prime Minister Narendra Modi announced India's Swachh Bharat (Clean India) targets to be met by 2 October 2019, coinciding with the 150th birthday of the leader of India's independence movement, Mahatma Gandhi. Gandhi was a fierce advocate of sanitation, saying that sanitation was more important than political independence, and he often spoke out against the practice of manual scavenging which reinforced the caste system of 'untouchability'. He once wrote: "An ideal village will be so constructed as to lend itself to perfect sanitation…The very first problem the village worker will solve is its sanitation."

The enormity of this challenge cannot be underestimated. In 2014, there were 111 million rural and about 10 million urban households in India still without a sanitary toilet, with a staggering 564 million still practising open defecation. This latter number represented 60 per cent of open defecation globally. However, the goal was no doubt premised on the belief that if India can develop the atomic bomb, send a mission to Mars and be a world leader in Information Technology, then why could it not ensure every household has, and uses, a simple piece of infrastructure such as a toilet? Indeed, the Prime Minister made the Swachh Bharat Mission (SBM) one of his government's priority policy goals, claiming that a clean India is the very foundation of India's future development successes.

The response has indeed been equal to the challenge. All stakeholders have mobilized around the Prime Minister's vision, from national government and development partners, through states, down to the very furthest reaches of government and community. Very significant government funds have been mobilized, including INR 334 billion (US $518 Wmillion) from national level as well as matching funds from state level. In three years, it is claimed that 48 million household toilets have been constructed and five states have declared themselves open defecation free. To substantiate the claims of Gram Panchayats declaring themselves ODF, plans are underway to initiate ODF verification surveys.

From a development perspective, the natural question to ask is "Has the Swachh Bharat Mission had its intended impacts, in terms of toilet coverage and use, as well as socio-economic benefits that are claimed to come from improved sanitation and hygiene?" It is therefore critical to be able to measure the impact of the Swachh Bharat Mission in order to decide what level of continued policy and financial prioritization it deserves, as well as to fine-tune the way it is implemented for greater impact.

Prior studies have shown how important sanitation and hygiene are in economic terms in India, as well as what it will cost India to implement. For example, the World Bank estimated the economic impacts of inadequate sanitation in India in the year 2006 – showing an annual economic impact of INR 2.4 trillion (US $53 billion), implying a per capita annual loss of INR 2,180 (US $48) or 6.4 per cent of the GDP in the same year[8]. Hence, the costs of inadequate sanitation, and the expected gains from improved sanitation, are known to be very considerable.

However, given that these impacts were modelled based on a range of data sources and the estimates are now 11 years out of date, further detailed study is required to specifically answer what are the actual costs and socio-economic gains to households of implementing the Swachh Bharat Mission after three years. Furthermore, policy makers and implementers need to know with greater precision what further costs and gains are likely if SBM implementation is to be completed by the

[8] World Bank (2011). The economic impacts of inadequate sanitation in India. Water and Sanitation Program: New Delhi.

2019 targets. In this context, UNICEF was requested by the Ministry of Drinking Water and Sanitation to undertake research to provide answers to these questions. Given the predominance of the open defecation challenge is in rural areas, the study focused on SBM (G). Specifically the study sought to answer:

1. What are the household and community economic and financial benefits of improved sanitation and hygiene in rural areas, implemented under the Swachh Bharat Mission (Gramin)?
2. What are the household and community costs of improved sanitation and hygiene in rural areas, implemented under the Swachh Bharat Mission (Gramin)?
3. What is the cost compared with the benefit of improved sanitation and hygiene, in rural areas? How long does it take a rural household to pay back the toilet costs through saved financial costs?

This report describes the methods and data used to answer these questions, and the results of the investigation.


सामाजिक मानचित्र

2 Approach

The study adopted standard economic modelling methods used widely for estimating the efficiency of development interventions[9]. Together with the Ministry of Drinking Water and Sanitation, UNICEF formed a Steering Group comprising sector experts and selected stakeholder representatives (see Acknowledgements). The Steering Group advised on the objectives and design of the study, and reviewed the draft report.

2.1 Study objectives and perspectives

The study aims to measure the household and community costs and benefits of improved sanitation and hygiene implemented under the Swachh Bharat Mission, and to compare these in cost-benefit analysis. Costs include both financial and non-financial (in-kind) contributions of different parties. Costs and benefits are presented under four perspectives:

1. Household financial perspective – involving only household medical spending.
2. Household financial perspective plus impacts on time use and actual or potential productivity.
3. Household economic perspective, taking into account 2. above plus the value of lives saved.
4. Societal perspective, taking into account 3. above plus non-household spending on the intervention (e.g. government, civil society organizations and other stakeholders).

These different perspectives allow conclusions according to the directness of impact of the intervention on households, each with different policy conclusions.

2.2 Study design

Given the short timeframe of the study, it was not possible to conduct an impact evaluation of SBM to separate out the benefits of SBM over time from those that would have been achieved without SBM[10]. Hence, a study design was proposed and agreed that primarily uses data collected from field research (household surveys) in selected states with high numbers of population practicing open defecation, and supplementing these data with evidence from literature review and official sources that could not be reliably obtained from a household survey conducted at a single point in time. Major other data sources included official government statistics on demographics and economic variables, the National Family Health Survey (NFHS) of 2015-16, other surveys reporting disease rates and mortality and research studies (impact evaluations) reporting reductions in disease rates resulting from sanitation.

The data on the different variables were combined in an economic model to estimate the economic and financial impacts of unimproved sanitation and hygiene, and the expected economic and financial benefits as a result of implementing SBM. The impacts of SBM were assessed by comparing the situation of households obtaining a toilet under SBM with their

[9] E Mishan. Cost Benefit Analysis. 1975: 2nd edition. London: Allen and Unwin.

[10] An impact evaluation typically includes identification of random allocation of communities to different treatment arms (i.e. SBM versus non-SBM), prospective follow-up of a cohort of households and communities from pre-intervention to post-intervention, and finally comparison follow-up of socio-economic and health outcomes for at least one year between the two arms. Also, given SBM is being implemented country-wide, it would have been difficult to isolate communities not implementing SBM. The timeline of the study also precluded any design that required follow-up of a cohort and observing them over time. Furthermore, to understand the impacts across at least half the States of India with high numbers of open defecation, the number of locations from which evidence is drawn needs to be significantly greater than the few sites that can be studied with an impact evaluation design.

recalled situation prior to obtaining a toilet. For the majority of households, the comparison compared a new household toilet versus open defecation, while for a minority it was use of previous household toilet, neighbour's toilet or community toilet versus the new household toilet. Given the uncertainties in many of the model variables, a sensitivity analysis was conducted to explore the impact of using different values for a few input variables into the economic model.

2.3 Cost estimation

The majority of SBM(G) interventions and their associated costs occur at community and household level. Approximately 8 per cent of the national government's overall contribution is allocated to social and behaviour change communication costs associated with programme delivery, while the remaining 92 per cent is required to be spent on incentivising household toilets and handwashing stations. The hardware costs were captured by the household surveys implemented as part of this study (see section 2.4). To fully capture the government contribution, the estimated actual software costs allocated by national government through the subsidy were added to the hardware costs – in the absence of reported nationwide data, it was estimated that approximately 2 per cent of the incentive fund is currently being spent on IEC activities (until July 2017).

The household questionnaire included questions to distinguish between construction costs covered by the government incentive (either financial reimbursement or in-kind support) and those paid for by the household itself, either financial cost or in-kind contribution (i.e. household labour). Households were also asked if and how the expected government incentive funds were received, to inform on the extent to which the expected support is being received.

Table 1. Cost data sources and valuation methods

Cost variable	Data source(s)	Valuation method	
		Financial perspective	Non-financial perspective
Investment cost – infrastructure	Household questionnaire	Cash outlay	Time inputs of household members
Investment cost – software	Official sources	Government spending on software[a]	
Operations cost – water, soap, cleaning materials, labour	Household questionnaire	Cash outlay on materials and labour	Time inputs of household members
Maintenance cost – emptying, repair, renovation	Household questionnaire	Cash outlay on materials and labour	Time inputs of household members

[a] In cost-benefit analysis, this cost is only included in the societal perspective as it is not paid by the household.

Average costs of toilet and handwashing station infrastructure are presented separately for households receiving government support and those not receiving government support, as well as aggregated. Costs are distinguished between paid-for inputs and unpaid labour inputs of household members. Operating costs are also presented with a distinction between paid-for inputs and unpaid labour inputs of household members. Households were also asked how they financed their own spending on toilet construction, such as from their own resources (income or savings) or borrowing from external sources.

2.4 Benefit estimation

2.4.1 Selection of benefits

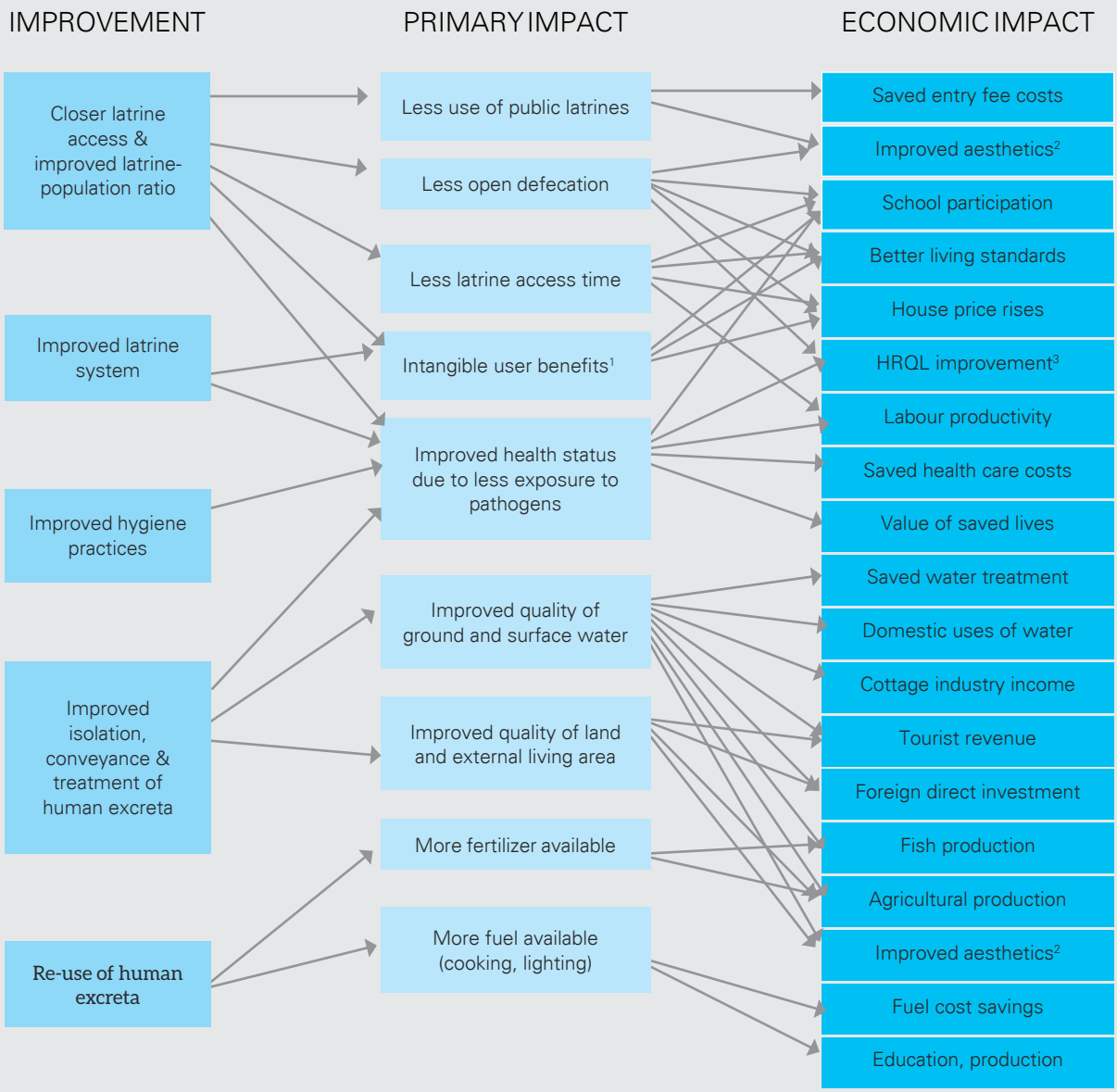
The interventions included under SBM(G) potentially lead to a large number of economic benefits, given the scope of SBM includes the toilet, handwashing station, solid and liquid waste, and can also lead to an improvement in water supply. Previous studies on the economic impacts of sanitation have measured health, environmental, productive, social and personal benefits[11]. The range of economic impacts of improved sanitation and hygiene are shown in Figure 1. The figure draws the links between the sanitation or hygiene intervention, the primary impact and the ultimate economic impact. In addition to the five sanitation and hygiene improvements shown on the left-hand side, the SBM(G) also includes interventions on the safe management of animal excreta and solid waste management as well as greywater and storm water management.

In selecting which impacts to evaluate, it is necessary to determine which impacts are the most important in India, and which can be robustly documented from field studies in a short timeframe. A previous study in India evaluated four main impacts, and found that health impacts and time impacts accounted for 90 per cent of the total benefits, while impacts on water resources and tourism accounted for the remaining 10 per cent[12]. As well as these impacts, poor sanitation affects the aesthetics of the external environment, dignity, life choices (schooling and work-related) and school outcomes (both attendance and health-related). There is also a loss of value due to discarding rather than reusing 'waste' products such as excreta, organic waste, plastic, paper and metal waste. Table 2 presents the relevance of different economic impacts in India and their inclusion in this present study. In summary, health impacts, time use and property value are all valued in monetary terms in this study, and intangible outcomes are assessed in qualitative terms (see final column in Table 2). Other impacts not measured are certainly worthy of further investigation in future tailored research studies.

[11]Refer to the World Bank Economics of Sanitation Initiative (ESI), implemented in over 50 countries globally www.wsp.org/esi.

[12]World Bank (2011). The economic impacts of inadequate sanitation in India. Water and Sanitation Program: New Delhi.

Figure 1. Primary impacts and resulting economic impacts associated with improved sanitation options ("disposal of human excreta")[13]



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

[13]World Bank (2008). The economic impacts of sanitation in Southeast Asia. Water and Sanitation Program: Jakarta.

Table 2. Selection of which economic and financial impacts to include

Impact	Detail	Degree of importance	Measurability (quantifiable)	Decision
Health care costs, health- related productive time, and mortality	Poor sanitation and hygiene cause diseases and premature mortality, hence improved sanitation leads to savings in treatment costs, less lost time in income-earning, school or other productive activities; and better life expectancy and saved costs associated with premature mortality.	Important	Yes	Include with Value in INR
Time and convenience	Using open spaces or public toilet facilities requires time and are not always convenient. Hence a private household toilet saves time, which can be spent doing other useful activities.	Important	Yes	Include with Value in INR
External environment	Neighbourhoods and households with poorly managed sanitation are less pleasant to live in, and population welfare is affected.	Moderately important	Partial (property value change)	Include with Value in INR
Personal dignity and social	Those unable to use private toilet facilities are affected socially in the way people view them and how they feel about themselves; women, girls and those with disabilities are particularly affected.	Important	Poor	Include with Qualitative Measurement
Resource reuse	Human and animal faeces and human urine can be captured and either converted to energy (via biogas digesters), or composted/pelletized and used as fertilizer.	Moderately important	Yes	Exclude[a]
Water for drinking and other uses	Released human and animal excreta pollutes water resources, which affects their usability or productivity and leads to costly averting behaviour or impacts production.	Context-specific	Partial	Exclude[b]
Life choices and opportunities	Women are affected by lack of sanitation facilities in workplaces, and may not take jobs where there are inadequate facilities.	Context-specific	Poor	Exclude[b]
School outcomes	Poor sanitation in schools leads to absenteeism and lower enrolment rates, and combined with missed days due to sickness, affects school outcomes.	Important	Yes	Exclude[b]
Tourism	Poor sanitation affects the attractiveness of tourist destinations and thus affects tourist arrivals. It also causes sickness for tourists.	Context-specific	Partial	Exclude[b]
Wage impacts	Poor sanitation depresses long-term wages due to the low productivity resulting from health impacts of poor sanitation.	Important	Partial	Exclude[b]

[a] Reuse value is not quantified in this study, for two reasons. First, the extent to which reuse practices have changed since 2014 are minimal – only 13 per cent of interviewed households indicated that they had changed their reuse patterns. Second, given the limited market for human excreta and organic waste, it is difficult to determine the value of reuse on the basis of this study. The average value given by households who sell their waste is under INR 200 per year, which is relatively insignificant compared with the health and time benefits.

[b] Other outcomes are not captured in this study due to not being measurable in the household survey, and/or evidence on the causal relation between sanitation and the observed outcome is not sufficiently robust.

It is important to distinguish between impacts with a known direct consequence on the cash balance or finance of a household, potential financial impacts not known with certainty, and non-financial impacts. Table 3 distinguishes these impacts for different benefits. Given the difficulty of distinguishing whether potentially financial impacts turn into actual impacts on the cash situation, they are valued in this study as non-financial, and should be interpreted accordingly. The overall economic benefit of sanitation interventions is the summation of the financial and non-financial benefits.

Table 3. Financial versus non-financial benefits from the perspective of a household

Benefit	Valued as financial benefit	Valued as non-financial benefit	
		Potentially financial	Non-financial
Medical care	Cash outlay saved due to less treatment seeking		
Health-related productivity		Gain in productive time of a wage-earner due to averted disease	Gain in time of a non-wage-earner due to averted disease
Mortality		Loss in earnings of a wage earner	Value of lives lost from VOSL methodology[a]
Access time		Gain in productive time of a wage earner due to a closer toilet	Gain in time of a non-wage-earner due to a closer toilet
Property value		Increase in value of own property due to SBM interventions	

[a]See section 2.3.2 for a description of the value-of-a-statistical-life (VOSL) methodology

The aggregate benefits and the benefit-cost ratios are presented under two scenarios. The first scenario assumes that every household member or visitor uses the household toilet when they are at home. Under this scenario the health and time impacts are maximized, as no one is practising open defecation. The second scenario recognises that there is still some open defecation practice occurring even after a household possesses a functioning toilet, either due to convenience of not having to travel back to a household toilet (e.g. when household members are in their distant fields) or due to difficulty in forming new habits around using the toilet and handwashing. Hence the overall proportion of household members using a toilet when at home is estimated from the responses in the household survey. Under this scenario the health and time impacts are reduced according to the proportion of surveyed population not using their household toilet (see section 2.3.3)[14]. The costs will be the same under both these scenarios.

[14]However, it should be noted that this proportion reflects the surveyed population, which were those households obtaining a toilet since SBM initiation in October 2014, and not the overall rural population of India.

2.4.2 Data sources

Table 4 shows the variables for estimating health economic benefits. Health data are more available for more common diseases related to sanitation such as diarrhoeal disease and malnutrition; hence other diseases such as Hepatitis A and E, soil transmitted helminths and trachoma are excluded. The average number of cases of diarrhoea in children under five years of age is 3.2 per year (based on 9.6 per cent prevalence rate in the NFHS 2015-16), and for all ages above five years it is taken as 1.23 cases per year[15]. It is estimated that 88 per cent of diarrhoeal disease cases are due to the faecal-oral pathway, hence related to poor sanitation and hygiene[16]. Also, acute lower respiratory infection (ALRI) is indirectly related to lack of sanitation through the malnutrition pathway, especially for the vulnerable population of children under five years of age. There are 0.96 ALRI cases per year (from NFHS 2015-16), and one-third of these are estimated to be WASH-related, drawing on a methodology previously applied in ESI studies to estimate the attributable fractions[17]. Drawing on the NFHS 2015-16, the proportion of under-five diarrhoeal cases seeking medical care at a formal health facility was 66 per cent and for ALRI it was 71 per cent.

There are estimated to be 221,000 diarrheal deaths per year among the under-five population due to poor sanitation and hygiene each year in rural India[18], giving an annual mortality risk of 2.54 per 1,000. In the age group 5-14 years the annual mortality risk is 2.4 per 10,000[19], and in the age group above 15 years it is 2.6 per 100,000[20]. Deaths in the under-five population for malaria, measles, ALRI and other causes are taken from estimates made in the global cost-benefit study of WASH interventions, which estimated attributable fractions for these diseases[21].

The monetary value of saved lives from use of a toilet and practice of handwashing is estimated using the economic methodology called value-of-a-statistical-life (VOSL). From VOSL studies in India, observations are made on the behaviour in the labour market with respect to what individuals are willing to accept for an increase in the risk of death (i.e. a compensating wage differential for risky jobs). The most recent study in 2010 estimated the value of life to be INR 20 million per premature death[22]. Adjusted to 2017 prices, the value used in this study is INR 30.2 million.

[15]Taken from the study Clasen T, Boisson S, Routray P, Torondel B, Bell M, Cumming O, Ensink J, Freeman M, Jenkins M, et al (2014). Effectiveness of a rural sanitation programme on diarrhoea, soil-transmitted helminth infection and malnutrition in India. Impact Evaluation Report No. 38. International Initiative for Impact Evaluation (3ie).

[16]Pruss A, Kay D, Fewtrell L, Bartram J (2002). Estimating the global burden of disease from water, sanitation, and hygiene at the global level. Environmental Health Perspectives 110(5): 537–542.

[17]World Bank (2008). The economic impacts of sanitation in Southeast Asia. Water and Sanitation Program: Jakarta.

[18]Prüss-Üstun A, Bartram J, Clasen T, Colford J, Cumming O, Curtis V, Bonjour S, Dangour A, De France J, Fewtrell L, et al (2014). Burden of diarrheal disease from inadequate water, sanitation and hygiene in low- and middle-income countries: A retrospective analysis of data from 145 countries. Trop. Med. Int. Health 19: 894–905.

[19]Morris SK, Bassani DG, Awasthi S, Kumar R, Shet A, Suraweera W, Jha P (2011). Diarrhea, pneumonia, and infectious disease mortality in children aged 5 to 14 years in India. PLoS One 6(5): e20119.

[20]Estimated by subtracting the deaths in 0-14 years population from the total diarrhea deaths in India, using numbers from the Global Burden of Disease study (2012), World Health Organization.

[21]Hutton G (2013). Global costs and benefits of reaching universal coverage of sanitation and drinking-water supply. Journal of Water and Health 11(1): 1-12.

[22]Shanmugam KR (2011). Discount rate for health benefits and the value of life in India. Economics Research International. Article ID 191425. http://dx.doi.org/10.1155/2011/191425.

Table 4. Variables required for estimation of health economic benefits of improved sanitation

Variable	Data source(s)
Health care	
▪ Population demographics (household composition)	Household questionnaire
▪ Prevalence and incidence of each disease	NFHS and research literature (see text)
▪ Attribution of diarrhoeal disease to faecal-oral pathway	Research literature (see text)
▪ Reduction in WASH-related disease cases and fatality due to sanitation improvement	Research literature (see text)
▪ Changes in practices when households invest in their own toilet and handwashing facilities	Household questionnaire
▪ Proportion of disease cases seeking medical care	NFHS 2015-16
▪ Outpatient visits per disease case ▪ Proportion of cases being admitted to inpatient care ▪ Length of inpatient stay per disease	Household questionnaire
▪ Unit costs of out- and inpatient health care per visit/ day ('hotel', pharmacy and transport costs)	Household questionnaire
Health-related productivity	
▪ Days of productive activity loss due to sickness for patients and caregivers	Household questionnaire
▪ Value of time	Household questionnaire for income-earning adults to estimate daily earnings Minimum wage rate in rural areas for non-income earning adults 50% of minimum wage for school age children No value given to time of children 5 years and under, but value of time considered for carers
Mortality	
▪ Premature mortality rate for diseases related to sanitation	WHO estimates (see text)
▪ Unit economic value of a premature death	Research literature (see text)

Table 5 lists the variables for assessment of time benefits. To estimate these benefits, detailed questions in the household questionnaire explored toilet use and access time before and after the toilet was constructed under SBM.

Table 5. Variables required for estimation of access time benefits of improved sanitation

Variable	Data Sources
Household member composition	Household questionnaire
Changes in sanitation practices of household members after household invests in toilet	Household questionnaire
Time taken per visit before and after having access to a household toilet	Household questionnaire
Number of visits per day before and after having access to a household toilet	Household questionnaire

Variable	Data Sources
Value of time	Household questionnaire for income-earning adults to estimate daily earnings Minimum wage rate in rural areas for non-income earning adults 50% of minimum wage for school age children No value given to time of children 5 years and under, but value of time considered for accompanying adults

Property value increases are based on the response of the heads of household when asked what they consider to be the change in value of their property due to the presence of the toilet facility and handwashing station.

2.4.3 Determination of impact

Economic benefits will depend on the pathway of impact and type of intervention, shown in Table 6. Hence different impacts will be affected by different aspects of the sanitation and hygiene interventions. For example, time benefits depend on the location and use of the toilet facility; health benefits depend on the degree of isolation of human faeces and the pathogens they contain from re-contact with humans; reuse benefits depend on how excreta is reused. The magnitude of benefits also depends on the mix of SBM interventions that are included, and the extent to which these interventions are successfully implemented and adopted by communities and households.

Table 6. Summary of how benefits are estimated to determine impact of SBM(G)

Benefit	Determination of impact with SBM programme
Health	Reduction in diarrheal disease risk from sanitation and hygiene interventions available from global meta-analyses and from impact evaluations and analyses conducted in India. Mortality risk assumed to be same as disease risk. Used household survey data to estimate the cost of illness.
Access time	Calculated as the total access time per day (per household member) prior to having a household toilet minus the total access time per day (per household member) after toilet access due to SBM implementation
Property value	Household asked if property value changed due to having a toilet (under SBM), and if so, by how much
Intangibles	Household responses to questions on the perceptions of toilet access and use on convenience, dignity, safety, health and cleanliness, compared to having no toilet

A key variable which determines the economic impact is the estimation of the impact of WASH interventions on disease rates and mortality. Globally, an increasingly robust evidence base confirms the effectiveness of sanitation and hygiene interventions on health outcomes[23]. The majority of intervention studies evaluate the impacts of sanitation and hand washing separately, with average protective effect (i.e. reduced disease) of improved sanitation of 28 per cent[24] and hand washing of 40 per cent[25]. When the interventions are combined, it is

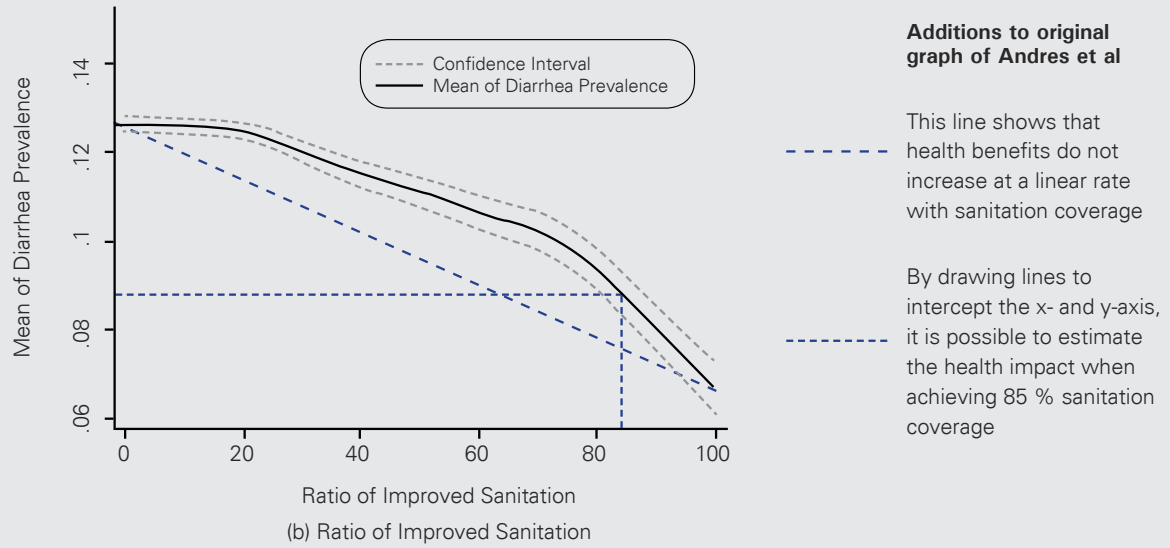
[24]Wolf J, Prüss-Üstun A, Cumming O, Bartram J, Bonjour S, Cairncross S, Clasen T, Colford JM, Curtis V, France J, et al (2014). Assessing the impact of drinking-water and sanitation on diarrhoeal disease in low- and middle-income countries: A systematic review and regression analysis. Trop. Med. Int. Health 8: 928–942.

[25]Freeman M, Stocks M, Cumming O, Jeandron A, Higgins J, Wolf J, Prüss-Üstun A, Bonjour S, Hunter P, Fewtrell L, et al (2014). Hygiene and health: Systematic review of handwashing practices worldwide and update of health effects. Trop. Med. Int. Health 19: 906–916.

likely to have a greater impact; and when interventions guarantee isolation of faeces from human contact (such as sewerage) the evidence points to over 60 per cent protective effect. Evidence emerging from India in terms of health impact of sanitation interventions is mixed. Recent impact evaluations from Odisha[26] and Madhya Pradesh[27] show with no statistically significant health impacts of sanitation programmes. One major reason put forward for the findings of limited or no health impact in these studies is because sanitation practices did not increase sufficiently for health effects to be observed. However, when higher coverage is achieved, the health impacts have been demonstrated in observational analyses of cross-sectional datasets[28]. For example, the World Bank assessed India-wide risk reductions in diarrheal prevalence in children under 48 months, finding an average protective effect of 47 per cent of children living in a village with complete toilet coverage[29].

There is limited global evidence on the exact relationship between toilet coverage/use rates and reductions in sanitation-related diseases. Drawing on the only study available for India that maps this relationship[30], at an average toilet use rate of 85 per cent, the predicted reduction in disease rates is 34 per cent instead of 47 per cent (see Figure 2).

Figure 2. Estimation of health impact at 85 per cent toilet use taking into account health externalities



Note to Figure 2: The straight lines have been added by the authors. Original graph source: Andres et al (2011).

[26]Clasen T, Boisson S, Routray P, Torondel B, Bell M, Cumming O, Ensink J, Freeman M, Jenkins M, Odagiri M, Ray S, Sinha A, Suar M, Schmidt W-P (2014). Effectiveness of a rural sanitation programme on diarrhoea, soil-transmitted helminth infection, and child malnutrition in Odisha, India: a cluster-randomised trial. The Lancet Global Health 2: e645–53.

[27]Patil SR, Arnold BF, Salvatore AL, Briceno B, Ganguly S, et al., Colford JM, Gertler PJ (2014). The effect of India's Total Sanitation Campaign on defecation behaviors and child health in rural Madhya Pradesh: A cluster randomized controlled trial. PLoS Med 11(8): e1001709.

[28]Wolf et al (2014). Ibid.

[29]Andres LA, Briceño B, Chase C, Echenique JA (2011). Sanitation and externalities: evidence from early childhood health in rural India. Policy Research Working Paper 6737. The World Bank: Washington DC.

[30]Andres LA, Briceño B, Chase C, Echenique JA (2011). Sanitation and externalities: evidence from early childhood health in rural India. Policy Research Working Paper 6737. The World Bank: Washington DC.

2.4.4 Estimation of total household benefits

For estimation of health benefits and time savings, first the economic and financial costs were estimated of what the losses (or damages) were prior to ownership and use of a household toilet (i.e. the costs due to the diseases and the time use for travelling to place of defecation). For health cost damages, this was done by estimating the average cost of a disease case seeking treatment per quintile (refer to section 5.1) and multiplying it by the number of disease cases per age group, the health seeking rate (refer to section 2.3.2) and the number of family members per age group (refer to section 2.4). The health cost savings were obtained by multiplying the health cost damages by the proportion of cases expected to be averted (refer to section 2.3.3). For time savings due to less disease, the average length of a disease case was multiplied by the proportion of disease cases averted and the cost per case (depending whether it was an income-earning adult, a non-income earning adult or a child of school age). For averted mortality, the mortality rate per age group was multiplied by the family members per age group, the proportion of deaths averted due to the intervention and the value-of-a-saved-life (refer to section 2.3.3).

2.5 Sampling

In order to estimate the national economic and financial benefits resulting from SBM in rural areas, the present study took the national level as its reference frame for sampling. Twelve states were included that collectively contributed to 90 per cent of open defecation in 2017, according to the government monitoring system. These states were: Andhra Pradesh, Assam, Bihar, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana and Uttar Pradesh. In each of these states, 50 villages from 10 blocks (5 villages per block) were sampled, giving a total of 600 villages across India. Within each village, only households were sampled that had constructed a toilet post - October 2014 and have been using it for at least 30 days prior to the survey.

Two types of respondent were selected to answer the range of questions covered in different modules of the questionnaire[31]. One respondent was the principal caregiver, who was usually the senior woman and/or the woman taking care of children. A second respondent was the chief wage earner, who was usually the head of household. In each village, a sample of 15 principal caregivers and 15 chief wage earners were interviewed, representing 15 equivalent households[32]. A total sample size of 18,376 respondents was achieved, representing 10,051 household equivalents across the 12 states. Approximately two-thirds of these households were classified as below poverty line.

For sampling of villages, the MDWS Management Information System (MIS) data were used to construct a sample frame of all the villages in the 12 states. Overall, there were 445,452 villages from 4,770 blocks. Information was then used on the coverage of household toilets at the SBM baseline (2014) and the current coverage of household toilets in 2017 to restrict

[31]The questionnaire is available on the UNICEF India website that hosts this study: http://unicef.in/Uploads/Publications/Resources/pub_doc20161.docx

[32]The principal caregivers and chief wage earners answered different modules, and hence did not need to come from the same households. This overcame the problem of non-availability of both respondents when a household was selected for the sample, which would have led to a sample loss if both respondents had to come from the same household.

the sample frame to households who built a toilet after October 2014. Villages were then excluded that had no population information and those with duplicate names. Villages at risk of Naxalite violence and flood-affected areas were excluded in the states of Assam, Bihar, Jharkhand, Maharashtra, and Odisha, resulting in a further loss of 4 per cent of villages[33]. Finally, villages with less than 35 households who built a toilet since October 2014 and villages where the toilet coverage increased by less than 20 percentage points were excluded to ensure adequate sample size of qualifying households when the research teams visited a village. Villages were not excluded based on not being open defecation free, given less than 15 per cent GPs have been declared ODF to date and the fact that only a small percentage of declarations have been verified to date. After the exclusions, the sample frame consisted of 159,248 villages from 2,413 blocks, with the state numbers ranging from 3,408 villages in Bihar to 29,136 villages in Madhya Pradesh. Furthermore, due to the requirement to select five villages per sampled block, blocks were excluded that had fewer than five villages that met the above criteria. The final sample frame consisted of 157,853 villages from 2,317 blocks across the 12 states. Annex 1 presents the numbers per state of the excluded blocks and villages and those available for sampling.

For selection of villages, the Probability Proportional to Size (PPS) method was used to select 10 blocks in each of the 12 states, where the size of the population was the number of households building a toilet since October 2014. In the next stage, 5 villages were selected from each block, again using the PPS method.[34]

For selection of households in the sampled villages, villages were divided into between three and six segments, depending on the spread of households who built a toilet since October 2014. The field teams consulted the GP office, ward members or knowledgeable elders in the sampled villages to identify the locations within the villages where the toilets were predominantly built after October 2014. In each segment, 6-10 respondents were interviewed by selecting households at fixed intervals using a right-hand survey rule. In addition, a minimum quota of 12 Above Poverty Line (APL) respondents and 12 Below Poverty Line (BPL) respondents per village of 30 respondents. In blocks where either APL or BPL was above 70 per cent, this quota could not always be met. However, because BPL status has become a poor measure of a household's poverty status, the results are presented for wealth quintiles based on an asset index applied in the household questionnaire.

[33]Given the small proportional loss in sample size, this exclusion does not significantly affect the nationwide findings and conclusions of the study.

[34]http://unicef.in/Uploads/Publications/Resources/pub_doc20160.docx

Table 7 below shows the average household composition and size by age group.

Table 7. Key characteristics of sampled households, by state

Population group	Number of Household members			
	0 - 4	5 - 14	15+	Total
All	0.32	0.88	3.40	4.60
Poorest	0.37	1.08	3.00	4.45
Q2	0.35	0.96	3.29	4.60
Q3	0.30	0.85	3.37	4.52
Q4	0.28	0.75	3.53	4.57
Richest	0.31	0.75	3.80	4.86

In the data analysis and presentation, households are presented by wealth quintile, given households with different wealth status were likely to have significantly different costs and benefits from each other. A wealth index was constructed using principal component analysis, which is a commonly used method[35]. In the principal component analysis, correlations between a set of variables is estimated and a vector of components that can explain these correlations fully is developed[36]. Additive wealth scores are predicted using the first principal components as weights for each of the wealth related variable included in the analysis, resulting in a normally distributed score with a mean of zero.

The following household wealth related variables were used to construct the wealth index[37]: (1) BPL status; (2) ownership of the house; (3) primary cooking fuel; (4) availability of electrical connection; (5) ownership of consumer durables (pressure cooker, watch or clock, colour television, mobile phone, bicycle, motorcycle or scooter, car or tractor, computer, refrigerator); (6) number of owned animals (cows, bulls, buffaloes, camels, goats, sheep, lambs, pigs, horses, mules, donkeys, and poultry); and (7) ownership of agricultural land, and surface area. Finally, wealth quintiles were estimated by dividing the whole sample in five equal parts after ordering households by their wealth score. Therefore, at national (overall sample) level 20 per cent of the population is in each wealth quintile, but the same is not true at the state levels.

[35]It is commonly used in NFHS and described in Rutstein et al., 1999, 2000.

- Rutstein S (1999). Wealth versus expenditure: Comparison between the DHS wealth index and household expenditures in four departments of Guatemala. Calverton, Maryland: ORC Macro.
- Rutstein S, Johnson K, Gwatkin D (2000). Poverty, health inequality, and its health and demographic effects. Paper presented at the 2000 Annual Meeting of the Population Association of America, Los Angeles, California.

[36]Anderson TW (1963). Asymptotic theory for principal component analysis. The Annals of Mathematical Statistics 34(1): 122-148.

[37]NFHS 2005-06 used a different set of 33 variables related to household assets and characteristics to estimate the wealth index using principal components whereas we collected and used data on a smaller and overlapping set of 21 variables. To assess the effect of using different sets of variables on the wealth score, we estimated the scores using NFHS 2005-06 data with both the 33 variables used by NFHS and 21 variables used in this study. Both wealth indices were highly comparable with correlation coefficient of 0.94, both means ~0 and standard deviations of 2.10 and 2.96.

2.6 Cost-benefit analysis

Cost-benefit analysis (CBA) is a methodology for combining economic costs and benefits in a way that allows assessment of value-for-money. CBA compares costs and benefits of one intervention with the costs and benefits of at least one other Intervention, or business-as-usual (no intervention). In this study, the costs and benefits of having a household toilet under SBM are compared with not having a household toilet (in which case, the majority practice open defecation).

Due to the time preference for money, indicated by a positive interest rate in the Indian banking sector, a future Rupee is worth less than a current Rupee. A social discount rate (SDR) of 8 per cent is used in the baseline estimates, which was varied between 5 per cent and 12 per cent in sensitivity analysis. This relatively high discount rate is appropriate for fast growing economies (above 5 per cent), where investment rates are high, but this is likely to diminish over time as economic growth rates slow down. A higher discount rate leads to a more conservative assessment of economic returns. Given the diminishing values a positive SDR leads to over time, the time period chosen for this analysis covers the average lifespan of a toilet constructed under SBM, which is conservatively assumed to be 10 years.

Different measures of efficiency have been used to characterize the level of economic viability of an intervention, each giving different perspectives on the value to the beneficiary. The benefit-cost ratio (BCR) identifies the amount of times the overall benefits exceed the overall costs. A BCR is the ratio of the benefits of a project, expressed in monetary terms, relative to its costs, also expressed in monetary terms. In general, the higher the BCR, the better the investment. If the benefit is higher than the cost, the project is considered a good investment. However, because available public and private funds are not enough to cover all such interventions, it is common to rank interventions by their BCR or other technical efficiency measure, and, ceteris paribus, funds are allocated first to the high efficiency projects or interventions.

The internal rate of return (IRR) identifies the average annual return on expenditure (investment and O&M). The IRR is the annual return offered by the project—the rate of return at which the NPV of all project cash flows is zero. Generally speaking, the higher a project's IRR, the more desirable it is to undertake it. It makes more economic sense to invest in a project than elsewhere if the project IRR is greater than alternate investments. The IRR can therefore be used to rank alternative interventions. As an initial indication of attractiveness, the IRR of a project or intervention is compared with the interest rate on safe investments, such as savings deposit accounts (whose rate will vary depending on national conditions and the maturity period).

The net present value (NPV) shows the total returns net of the costs. The NPV is the net discounted value of all project cash flows. Costs or outflows are deducted from benefits or inflows in each time period and discounted to present value using the social discount rate, before being aggregated across years. The NPV does not provide an indication of the relative return—hence a larger investment may have a larger NPV but its rate of return might be lower than a smaller investment.

The payback period (PBP) identifies after what period of time the returns start to exceed the expenditure, based on the fact that the intervention requires a larger up-front cost while the benefits accrue over time. The PBP refers to the time required for net cash flows to become positive, or more simply put, the length of time required to recover the costs of an investment. The PBP of a given investment or project is an important determinant of whether to undertake it, because projects with long PBPs are typically less desirable for investors. Cash outflows after the initial investment, such as operational costs, must also be taken into account in the calculation.

2.7 Data analysis

2.6.1 Sensitivity analysis

Table 8 shows the alternative scenarios used in sensitivity analysis, based on different assumptions around the presence of health externalities and social discount rate, length of use of a toilet before it is replaced, and disease rates. Also, the cost-benefit results are modelled under different assumptions on family size, indicating how the return on investment varies when there are larger families than the average.

Table 8. Alternative scenarios and values used in sensitivity analysis

Scenario in sensitivity analysis	Alternative values used
Externalities present under actual toilet use	Under actual toilet use of 85% (average), health impacts diminish by 34%, according to community effects[a]
Externalities not present under actual toilet use	Under actual toilet use of 85% (average), health impacts diminish by same proportion
Social Discount Rate 5%	Opportunity cost of time diminishes to 5% from 8%
Social Discount Rate 12%	Opportunity cost of time increases to 12% from 8%
Longer duration of toilet	Toilets last for 20 years before replacement
Rates for diarrhoea cases	Diarrhoea cases reduced by half from baseline rate to 1.6 cases (≤5 years) and 0.6 cases (>5 years) per year
Treatment seeking rates	Treatment seeking rate is reduced to 50% for all diarrheal and ALRI disease cases (from baseline rates of 65.8% for diarrhoea and 70.8% for ALRI, sourced from NFHS 2015-16).
Family with young children	A household consists of 3 adults and 2 children under five years
Large family	A household consists of 3 adults, 2 children of school age (5-14) and 2 children under five years

[a] From Andres LA, Briceño B, Chase C, Echenique JA (2011). Sanitation and externalities: evidence from early childhood health in rural India. Policy Research Working Paper 6737. The World Bank: Washington DC.

2.7.2 Extrapolation to India-wide estimates

Based on the average household costs and benefits obtained from this study resulting from SBM implementation, it is possible to estimate the overall economic losses for India given the current rates of open defecation, as well as the expected costs and benefits from achieving the goals of SBM. Variables used in the calculations are shown in Table 9. For India-wide estimates, estimates of costs and benefits would also be required from urban areas. As the household survey was only carried out in rural areas, it was conservatively assumed that the damage costs and the benefits per household are the same in urban areas as in the rural areas. The toilet coverage and use rates are sourced from JMP estimates, which refer to the year 2015. The damage costs are also modelled under 70 per cent and 100 per cent usage of toilets across India (both rural and urban).

Table 9. Key variables and assumptions for estimating India-wide numbers

Variable	Year	All India	Rural	Urban
Population size	2016	1,324,171,350	885,208,547	438,962,803
Sanitation use	2015		34%	65%
Average household size	2017		4.6	4.6
Number of households not using sanitation	2015		126,988,859	33,394,261
National GDP	2016	INR 154 trillion (US $2.38 billion)		
Economic losses and savings from not using/using sanitation	2017		As per survey (refer to chapter 5)	Same as rural
Investment and O&M costs for sanitation	2017		As per survey (refer to chapter 4)	Same as rural

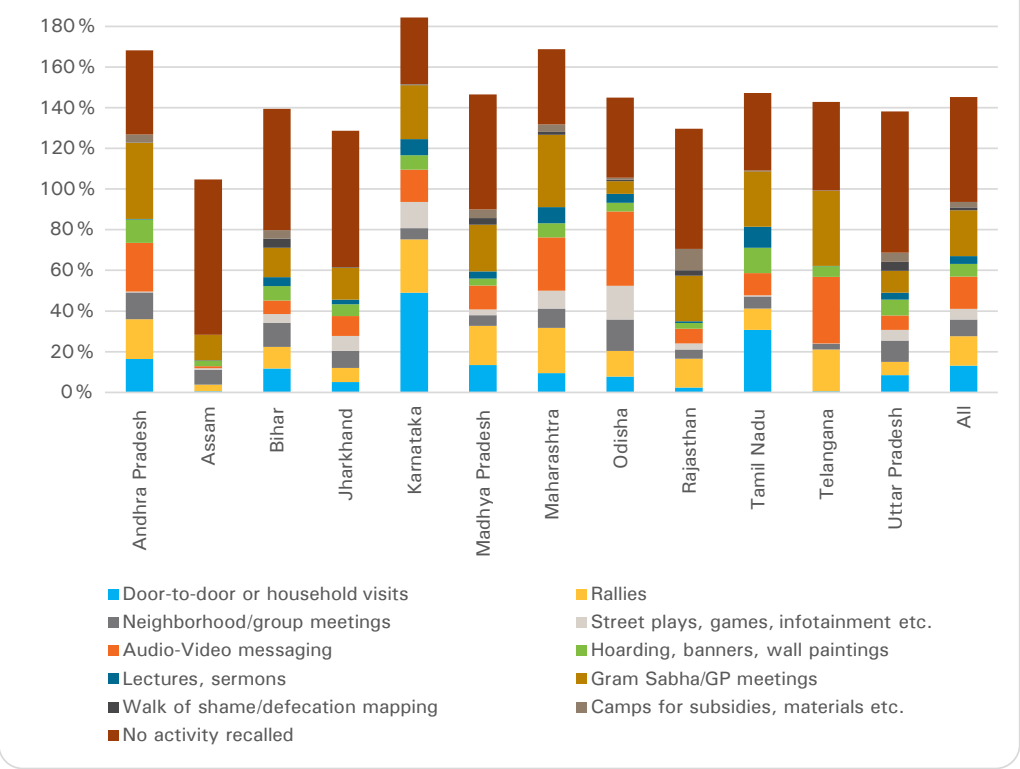
3 Implementation of the SBM

In applying a survey in more than 10,000 households across India – households that have been exposed to the SBM campaign and have constructed a toilet – it is possible to build a picture of the extent of activities and awareness of the different components of the SBM programme. This chapter briefly reports the results on awareness of SBM activities, toilet coverage and use, handwashing infrastructure, practices around water management for sanitation and hygiene, solid and liquid waste management, and farm waste among households that built and are using toilets since October 2014. The results may not be applicable to households who did not build or use toilets post - October 2014 or those who had toilets prior to October 2014.

3.1 Awareness of SBM implementation

Overall, of 10,051 primary caregivers interviewed, 63.3 per cent had explicitly heard of the Swachh Bharat Mission. This varied significantly between wealth quintile, from 44.8 per cent in the poorest quintile with linear progression to the richest quintile of 78.1 per cent. When asked specifically about community activities taking place related to SBM, 51.7 per cent of primary caregivers could not recall an activity, while all those who recalled an activity stated GP meetings (22.5 per cent), audio-visual messaging (15.8 per cent), rallies (14.5 per cent) and door-to-door visits (13.8 per cent). However, there were quite large variations across states, shown in Figure 3.

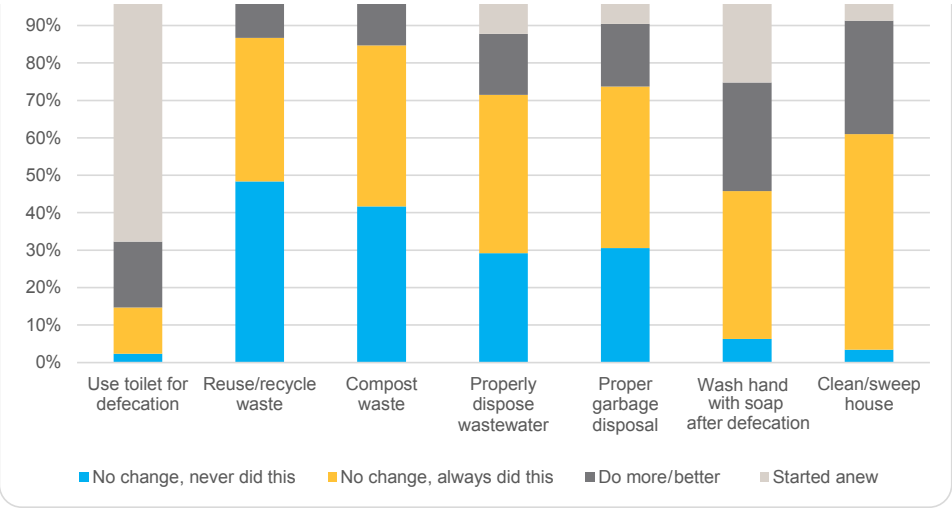
Figure 3. SBM activities recalled by principal caregivers[a]



[a] Note that some totals exceed 100% because respondents could provide more than one answer

Respondents were asked how the SBM has changed their sanitation practices related to key aspects of SBM, with four response options on the extent of change. For toilet use, 67.5 per cent said they started this practice anew, 17.5 per cent said they did it before but now do it better, 12.3 per cent said they still practice as before SBM(G), and 2.3 per cent said they did not do it before and still do not do it. For handwashing, while practices existed before for many households, there have also been significant changes since SBM with at least 50 per cent of households doing more handwashing or starting the practice. Figure 4 shows these responses and also relating to waste reuse, composting waste, and cleaning the house.

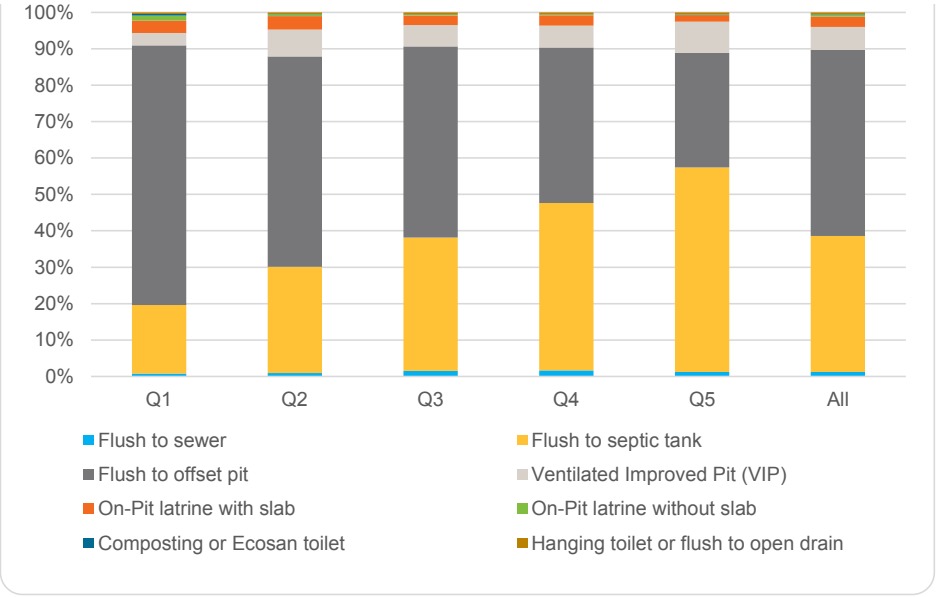
Figure 4. Stated changes in household sanitation practices as a result of SBM



3.2 Toilet coverage and use

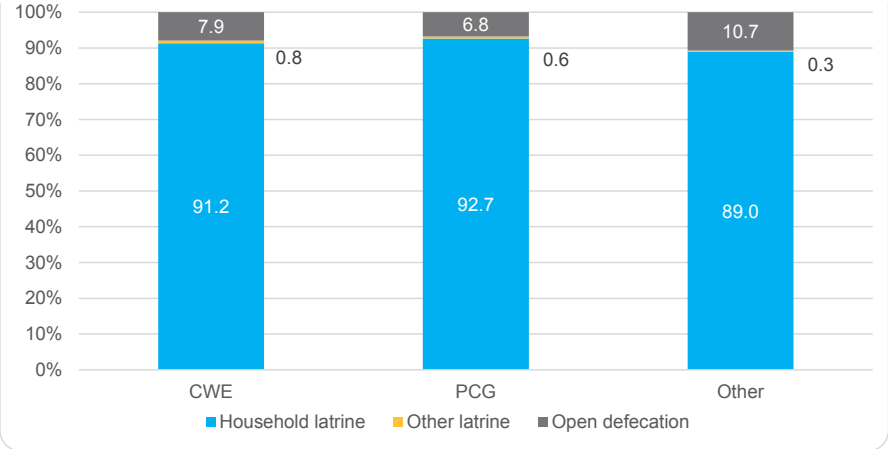
Given the households interviewed (n = 10,051) were households that had built a toilet in the past 3 years during the SBM(G) period, the rate of toilet coverage was 100 per cent among these households. The majority (51.1 per cent) had a flush toilet to offset pit, and most of the remaining had a septic tank (37.7 per cent). Half a per cent of households stated they use some form of unimproved toilet option. The proportions varied by wealth quintile, as shown in Figure 5. Of those with a pit (excluding septic tanks), about two-thirds of those households had a double pit (63.6 per cent). About one household in three (36.7 per cent) had their toilet as part of a bathroom, from 15.2 per cent of poorest households to 51.4 per cent of richest households.

Figure 5. Toilet options of households interviewed



Respondents were asked about their own sanitation behaviour, as well as that of other household members. 91.2 per cent of chief wage earners used the household toilet when at home, compared with 92.7 per cent of primary caregivers and 89.0 per cent of other household members (see Figure 6). Hence, overall 90.7 per cent of the sample claimed to use their own toilet when at home, and 0.5 per cent another toilet (such as work or a neighbour's). 80 per cent of households claimed none of the other household members (other than caregivers and wage earners) had no-one practising open defecation. Hence, with this mix of information, it is estimated that approximately 85 per cent of the sample regularly used an improved toilet either at their home, workplace or a neighbour's. It should be noted that these population proportions do not represent the entire rural population, but only the surveyed population in this study, who were households obtaining a toilet since October 2014.

Figure 6. Sanitation practices of household members

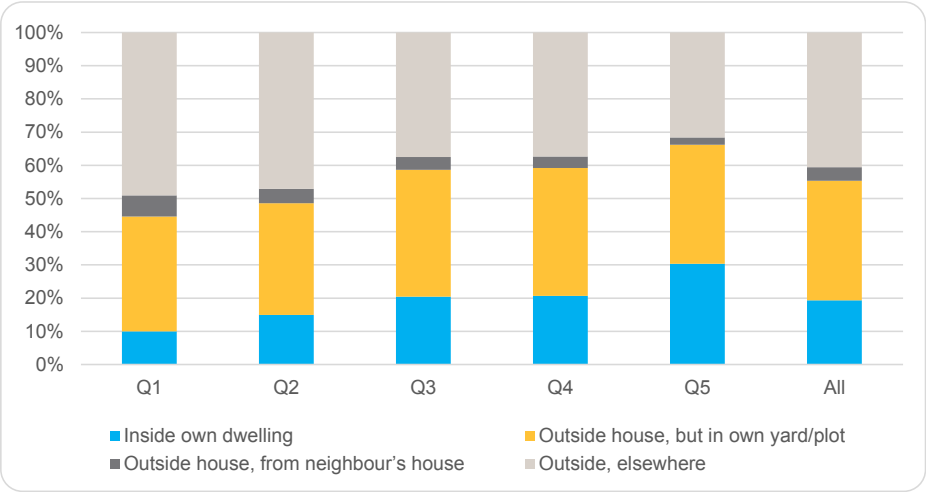


CWE – chief wage earner; PCG – primary caregiver; other – all other household members

3.3 Water source for toilet flushing

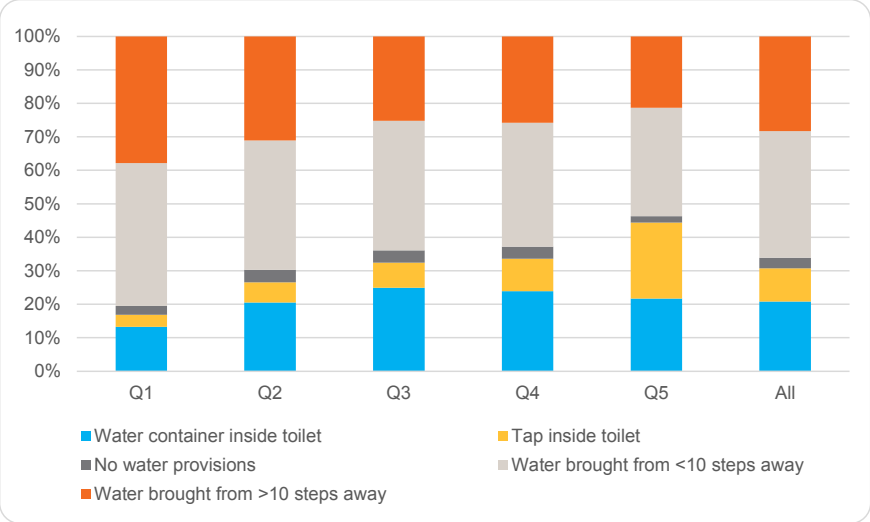
For toilet flushing purposes, the availability, cost and location of the water are important, while the quality of that water is not as important. Figure 7 shows the physical location of the water used for flushing, with 44.7 per cent of households collecting water from outside the dwelling or plot, either from a neighbour or a community source. For those accessing water off their own plot, 39.5 per cent responded that household members themselves collect the water. Of those, 90.9 per cent said that an adult woman was responsible, 30.4 per cent an adult man, 7.4 per cent a girl and 6.2 per cent a boy (sums greater than 100 per cent due to multiple people being responsible). Of those collecting water, an average of 48 minutes per day across 3,956 responding households. This collection time cannot necessarily be attributed to toilet flushing, as part of the water might be used for other domestic purposes. Hence, this time is not included in the cost of the toilet operations.

Figure 7. Physical source of water for toilet flushing



In terms of the water availability for those using the toilet, 30.7 per cent have a water container or tap inside the toilet, with the rest having a container or tap outside the toilet. 3.1 per cent of households have no water provision for the toilet. Source of water for toilet use is shown in Figure 8.

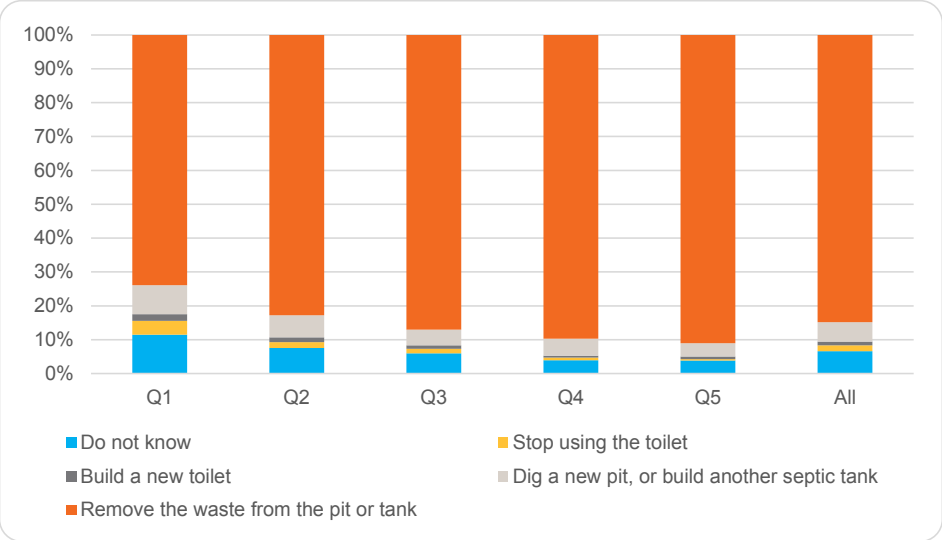
Figure 8. Location of water for toilet use



3.4 Toilet emptying and reuse practices

Given that toilet ownership is new for the majority of households interviewed in the survey, only few will have experienced having a full pit or septic tank. In asking households how they intend to deal with a full pit or tank, the majority (84.8 per cent) replied that they would empty the pit so that the pit can be reused. Some – 8.6 per cent - did not expect to continue using the toilet, while 6.6 per cent replied that they did not know. Figure 9 shows the variation between wealth quintiles. Of those expecting to empty the pit or septic tank, 93.5 per cent expected it would be an external service provider, varying from 88.8 per cent of poorest to 97.4 per cent of richest households. About 14.5 per cent of households expected to use the waste as a compost.

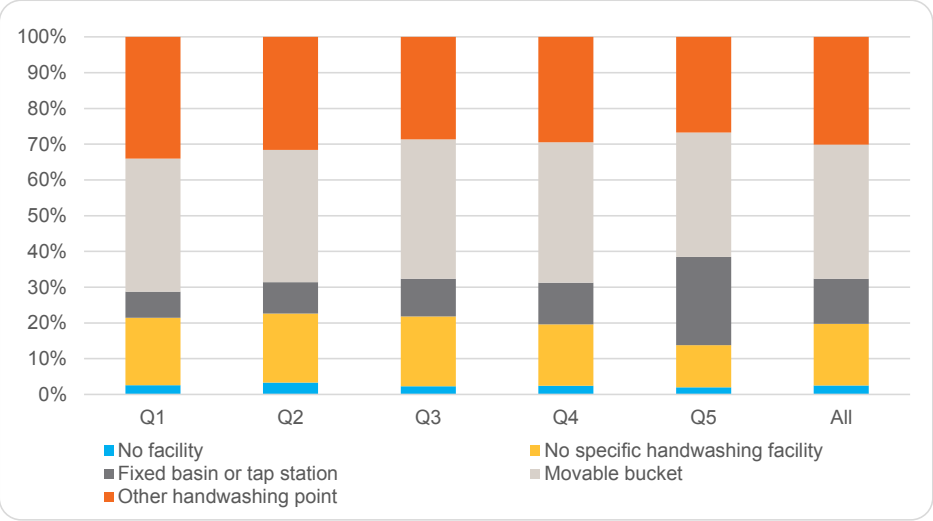
Figure 9. Intentions of households of dealing with a full pit or septic tank



3.5 Handwashing infrastructure

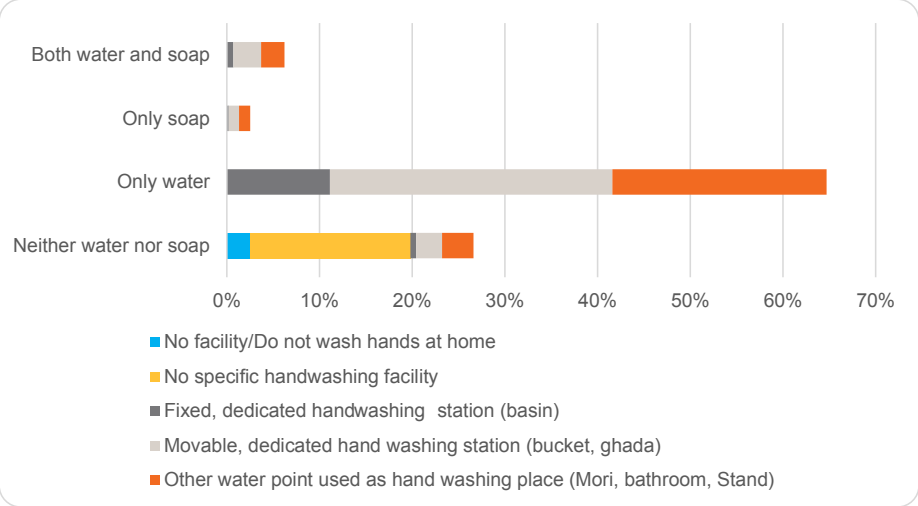
Handwashing practice at critical moments[38] is fundamental for reducing disease transmission, including diarrheal diseases, acute respiratory infections, intestinal worms, and eye and skin diseases. The majority (96.3 per cent) of households do not have a dedicated handwashing station by the toilet with readily available soap and water, based on interviewer observations. However, 97.5 per cent of households did have a handwashing station somewhere else in the house, whether fixed (12.6 per cent) or other (85 per cent) (see Figure 10). To dig deeper and explain the differences between the lack of dedicated handwashing station in most households but the high handwashing rates, Figure 11 provides further details on types of handwashing station and materials present – revealing that the majority of households (65 per cent) had water but no soap present.

Figure 10. Location and types of handwashing stations



[38]The critical moments for handwashing with soap in the household context are after using the toilet or cleaning a child's bottom and before handling food.

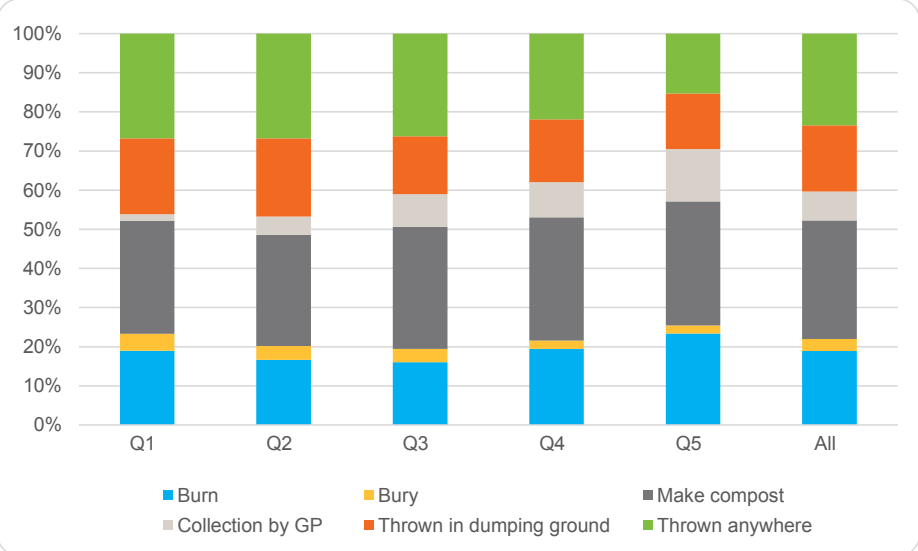
Figure 11. Availability of soap and water by type of handwashing station



3.6 Solid and liquid waste management

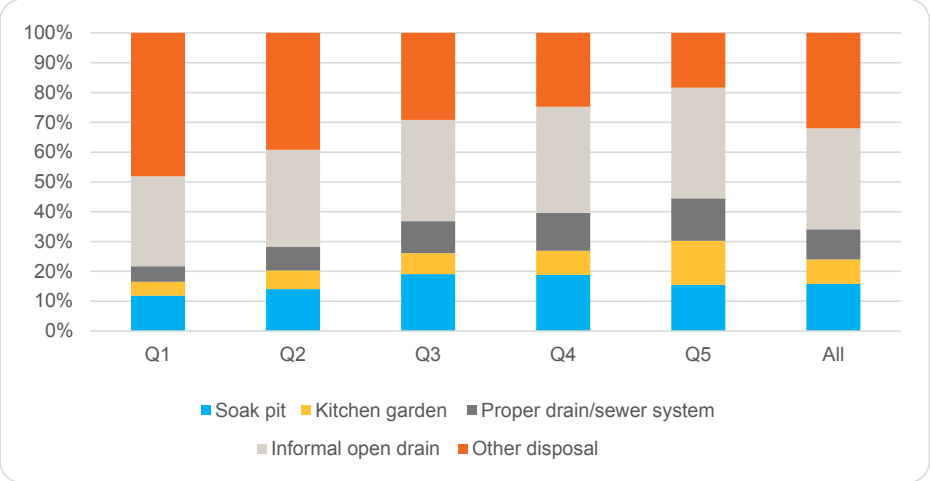
Households indicate quite a diversity of practices in relation to solid waste disposal (see Figure 12). Only 7.4 per cent of households indicate there is any kind of organized collection service (by the Gram Panchayat or other) and hence the majority of households have to take matters into their own hands. An important proportion of households burn, bury, take to dumping ground or dispose their waste elsewhere; while 30.8 per cent claim that they compost their household waste. When asked specifically about their organic waste, 40 per cent say they compost it. Of these, the majority (84.4 per cent) say they use in their own garden or farm, 7.6 per cent give it away and
7.7 per cent sell it. An average of 8 kg per household per day is generated as compost, earning an average INR 188 (US $3) per year for those who sell it.

Figure 12. Disposal or reuse of solid waste



In terms of liquid waste, the majority (about 75 per cent) is likely to be offsite, through proper or informal drainage systems (see Figure 13). A smaller proportion channel their liquid waste to the garden or soak pit, and of these the rate of on-site disposal is higher for richer households, at 30 per cent.

Figure 13. Proportion of households with different liquid waste management systems



3.7 Farm waste management

Out of the households interviewed, 59.3 per cent have livestock, and the majority of these use the animal excreta either for compost (61 per cent) or for energy (dung cakes) (34.5 per cent). A small proportion (5.5 per cent) sell the waste, while 19 per cent do not have any specific measures for disposal of animal waste[39]. An average 51kg per day of animal excreta is generated per household keeping animals.

[39]These percentages add to >100 per cent because multiple answers were chosen by some households.


ODF

4 Costs of the SBM

The household survey conducted as part of this study provided a unique opportunity to find out how much households spend on their toilet, handwashing station and other sanitation practices promoted under SBM, as well as the proportion receiving financial or other support from government, community or NGOs. In addition to the infrastructure costs, the survey also asked about operating costs, of which little is currently known. As well as investment and operating costs, this chapter also explores how households financed their own investments in their toilet.

4.1 Investment costs

SBM total investments are the sum of what the household plus the government has financed, plus any other organisations operating in the field. In many instances, households and community members contribute unpaid time, or another agency such as an NGO provides supports. Figure 14 shows that overall, 69.5 per cent of 9,143 responding households received government support (free materials, free labour, financial subsidy, or even direct construction of the toilet), and overall 63.8 per cent made their own contribution to the costs of the toilet (either with or without government support). There is a clear relationship between financing option and wealth status, as shown in Figure 14: the poorer households are more likely to receive government incentive and less likely to make their own financial contribution to both the toilet and handwashing station.

Figure 14. Proportion of households receiving government subsidy and investing their own resources

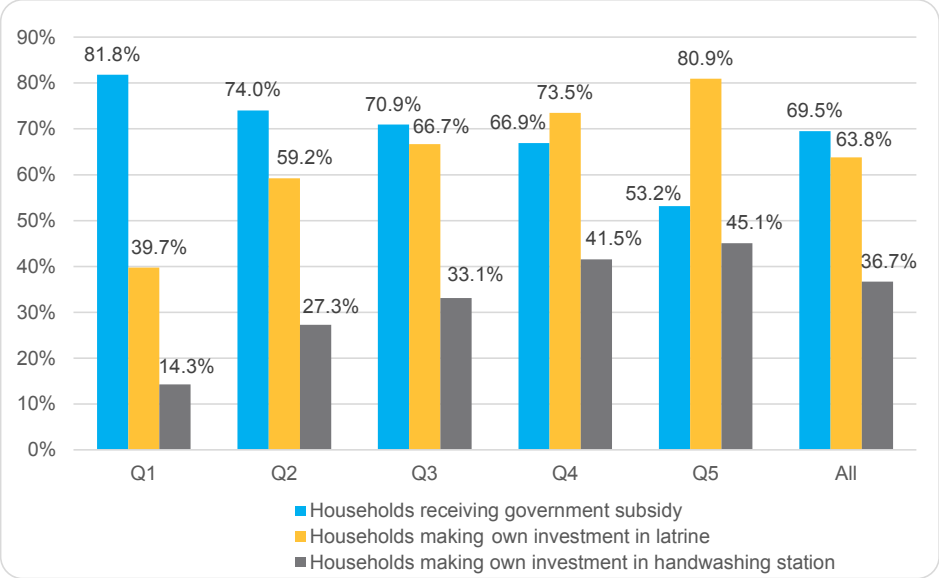


Table 11 shows the investments from different sources for different subgroups, with mean (average) values and standard deviations to give an idea of inter-household variation. For those 69.5 per cent of households receiving government support, the average contribution from the government is INR 11,796 (US $183), which is similar across wealth quintiles (point 1 in Table 11); and practically the same as the INR 12,000 (US $186) incentive budgeted per household in SBM(G).

Table 11. Mean costs of investment by government and household, with standard deviation, by wealth quintile (Indian Rupees[a])

Variable	Poorest	Q2	Q3	Q4	Richest	All
1. Total value of government support: households receiving government support (n = 6,355)						
Mean value	11,847	11,921	11,817	11,665	11,714	11,796
Standard deviation	1,906	2,693	3,042	3,219	2,601	2,707
2. Household own investment in toilet: households receiving government support (n = 5,799)						
Mean rupees spent	4,224	8,463	11,359	12,190	16,710	9,942
Standard deviation	10,708	15,864	18,313	15,840	22,628	17,041
Mean value of time	438	637	669	619	668	595
3. Household own investment in toilet: households not receiving government support (n = 3,294)						
Mean rupees spent	19,150	28,432	27,884	31,205	35,396	29,936
Standard deviation	18,855	23,707	24,041	24,774	30,757	26,302
Mean value of time	1,007	1,192	917	803	744	895
4. Household own investment in handwashing station: all households investing (n = 920)						
Mean rupees spent	163	743	923	1,569	2,512	1,540
Standard deviation	798	3,446	3,568	4,541	7,903	5,682
Mean value of time	56	80	94	54	44	60
5. Average cost per household of toilet and handwashing station: across all households (n = 9,143)						
Government only	9,691	8,825	8,382	7,803	6,229	8,199
Household financial	6,963	13,853	16,468	19,137	26,593	16,604
Household non-financial	549	803	773	702	723	709
All	**17,204**	**23,481**	**25,623**	**27,643**	**33,545**	**25,511**

[a] Conversion to US $ is made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.

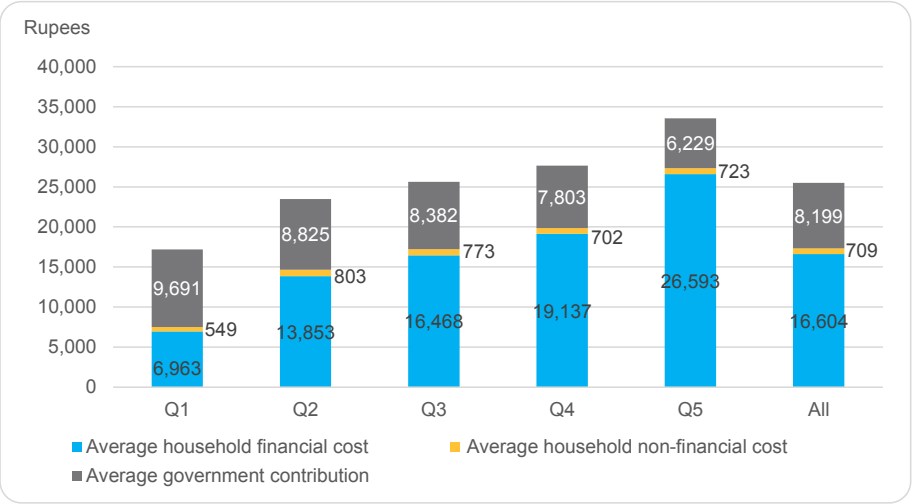
When a household receives government support, households invest an average further INR 9,942 (US $154) in their toilet, plus INR 595 (US $9) worth of their own labour time (point 2 in Table 11). The financial investment varies from INR 4,224 (US $65) for the poorest households to INR 16,710 (US $259) for the richest households.

When a household does not receive any government support, households invest an average INR 29,936 (US $464) in their toilet, plus INR 895 (US $14) worth of their own labour time (point 3 in Table 11). Poorer households invest marginally more of their time than richer households. The financial investment varies from INR 19,150 (US $297) for the poorest households to INR 35,396 (US $549) for the richest households.

About one-third of households (36.7 per cent) spent their own resources constructing handwashing stations. For many, these costs were included in their responses on the toilet costs. For 920 households, an average additional amount of INR 1,540 (US $24) was spent on the handwashing station, plus INR 60 (US $1) worth of their own labour time (point 4 in Table 11).

When costs were summated across all categories and averaged over all the households, the average financial cost is INR 24,825 (US $385), with about one-third of the investments being financed by the Government of India and two-thirds by households themselves (point 5 in Table 11). These proportions vary by wealth status, with government financing exceeding household investment for poorest households, and household spending accounting for over 80 per cent of the cost for richest households. When household labour time is valued and included, it increases the average cost to INR 25,511(US $395). Figure 15 provides a summary of household and government contributions for each wealth quintile.

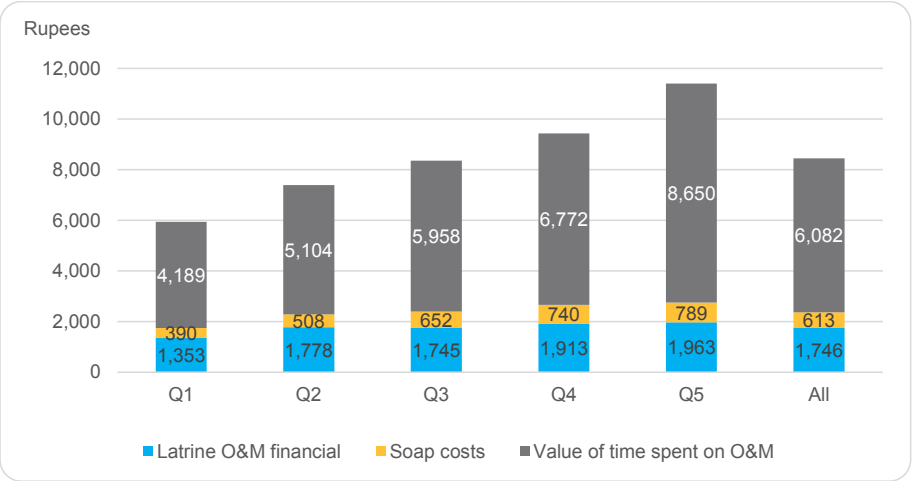
Figure 15. Average investment cost per household toilet across entire sample, by wealth quintile (Indian Rupees)



4.2 Operations and maintenance

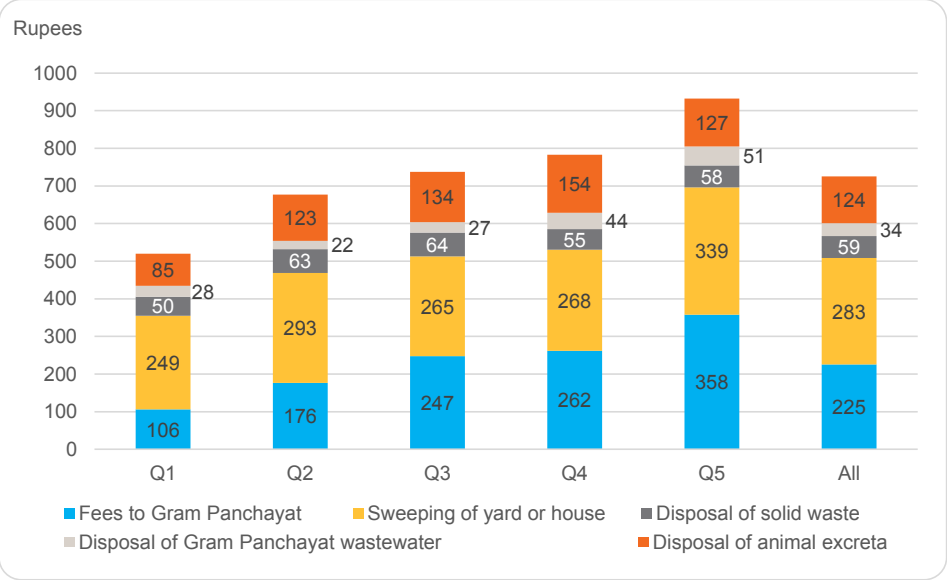
Money and time spent by households on operations and maintenance is key for the functioning of toilets and handwashing infrastructure. Figure 16 presents these costs, based on 9,082 responding households. Financial costs per year are INR 1,745 (US $27) for the toilet and INR 612 (US $9)for soap. Financial costs include materials for cleaning and paying for others to take care of cleaning. Given most of the toilets constructed under SBM are still relatively new, it is unlikely that the costs of maintenance and emptying are reflected in the numbers. The major cost is non-financial in nature at INR 6,082 (US $94) per household per year, estimated as the time of household members in cleaning the toilet. Annual value of time spent operating the household toilet varies from INR 4,189
(US $65) for poorer households to INR 8,650 (US $134) for richer households.

Figure 16. Average operations and maintenance cost per household across entire sample, by wealth quintile (Indian Rupees per year)



In addition to direct toilet and handwashing costs, some households pay for other costs for SBM-promoted sanitation activities, shown in Figure 17. Note that these costs are excluded from the cost-benefit analysis in Chapter 6. 87.8 per cent of households stated that they spent money on cleanliness and waste management practices. The sum of activities is estimated at INR 725 (US $11) per household per year, ranging from INR 520 (US $8) for poorer households to INR 932 (US $14) for richer households. The main costs are wages paid for sweeping the yard or house, followed by fees paid to the GP. In addition, 98 per cent of households say they spend their own time on these activities. When time is valued at the rural wage, the costs to households are INR 7,862 (US $122) for regular sweeping of the yard and house, INR 1,236 (US $19) for disposal of solid waste, INR 515 (US $8) for disposal of wastewater and INR 1,968 (US $30) for disposal of animal excreta.

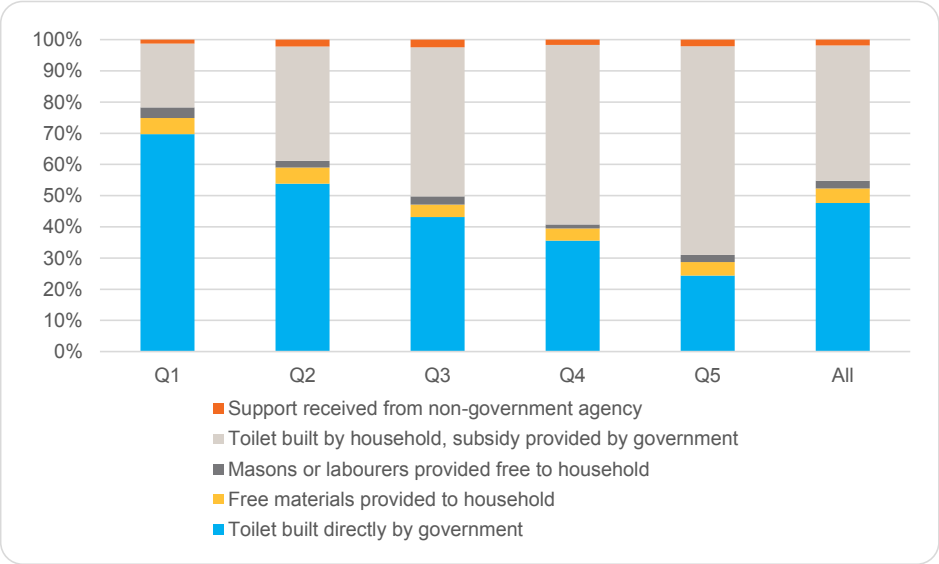
Figure 17. Financial costs per household of other SBM(G) activities, by wealth quintile (Indian Rupees per year)



4.3 Financing of investment cost

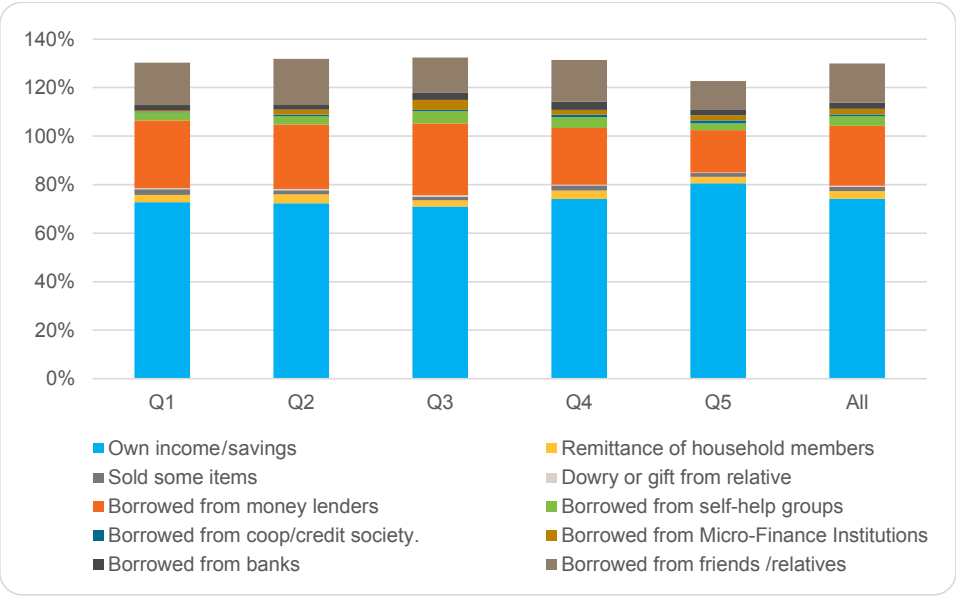
For those 69.5 per cent of households saying they received support to build their toilet, the majority either arranged it themselves (42.4 per cent) or they had the toilet built directly by a government contractor (46.6 per cent) (see Figure 16). A smaller proportion had the materials or the labour provided free to the household, or support was received from a non-governmental organization. Whether the household built or had built by the government was highly correlated with the wealth status, as shown in Figure 18. For those receiving a cash subsidy, 82 per cent received it after completion of the toilet, 12.5 per cent received the subsidy both during and after construction, 2.7 per cent received all of it during construction and 2.6 per cent received some or all of it before construction. The main modes of payment of cash subsidy was direct transfer to bank (69.5 per cent), a cheque (22.1 per cent) and cash (9.1 per cent). The average time between completing the toilet and receiving the payment was 3.3 months, with a median of 2 months.

Figure 18. Type of support received by households, by wealth quintile



As shown earlier in Table 11 and Figure 15, significant investments were made by households in their own toilets, even the poorest households who invested an average INR 7,000 (US $108) of their own money (see Figure 15, Q1). The survey indicates that a variety of funding sources were used, shown in Figure 19. For about 80 per cent of households, the main source of funds was own income or savings, a remittance from a household member or gift from a relative. Around 50 per cent of households borrowed funds. The most common source of borrowed funds was a money lender (25 per cent) with the rest being self-help groups, banks, micro-finance institutions and friends.

Figure 19. Sources of funds for own expenditures on toilet construction[a]



[a] Some households responded more than one category hence the sum exceeds 100 per cent.

5 Benefits of the SBM

This chapter presents the survey findings on the different benefits that are expected at household level from implementation of the Swachh Bharat Mission. The annual benefits per household are estimated using the modelling approach, described in Chapter 2 and scaled up to estimate the total benefits expected from reaching SBM targets.

5.1 Medical expenditure

The primary caregivers were asked whether they remember a gastrointestinal infection of a household member, which was treated at a health facility and for which the costs of treatment could be recalled. Of the 10,051 households interviewed, 20.9 per cent could recall a case which they could report the costs. Of these, 77 per cent stated there were 3 or more watery stools in a day, 47 per cent identified vomiting or nausea and 32 per cent mentioned abdominal cramps. The average duration of the disease was 1.8 days, with an average 1.34 visits per case to a medical facility. Treatment seeking was predominantly in private facilities in both outpatient care (69 per cent) and inpatient care (57 per cent). The proportion of cases out of the entire sample seeking care from government and private health facilities are shown by wealth quintile in Figure 20. A discernible relationship is shown between wealth quintile and use of private facilities for outpatient care, while for inpatient care it is less clear (except for the richest quintile).

Figure 20. Proportion of households who seek any care who receive their services from a private health facility, outpatient care and inpatient care, by wealth quintile

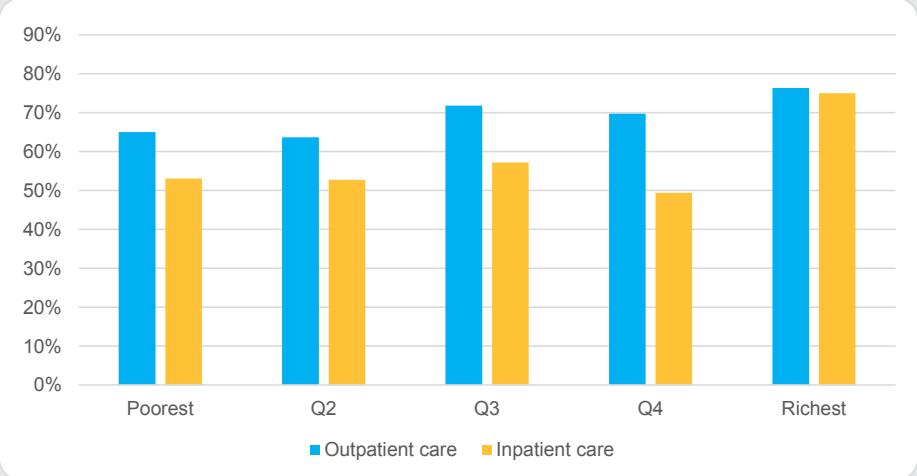
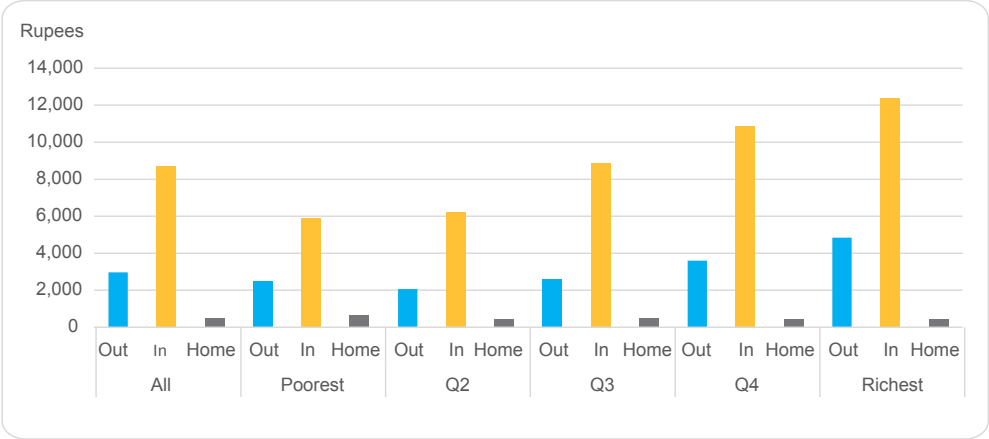


Figure 21 presents the costs per outpatient visit, per inpatient admission and for home care, for the entire sample of respondents[40].

[40]Conversion to US $ should be made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.

Figure 21. Cost per patient for outpatient visits, inpatient admissions and treatment at home[a], by wealth quintile (Indian Rupees[b])

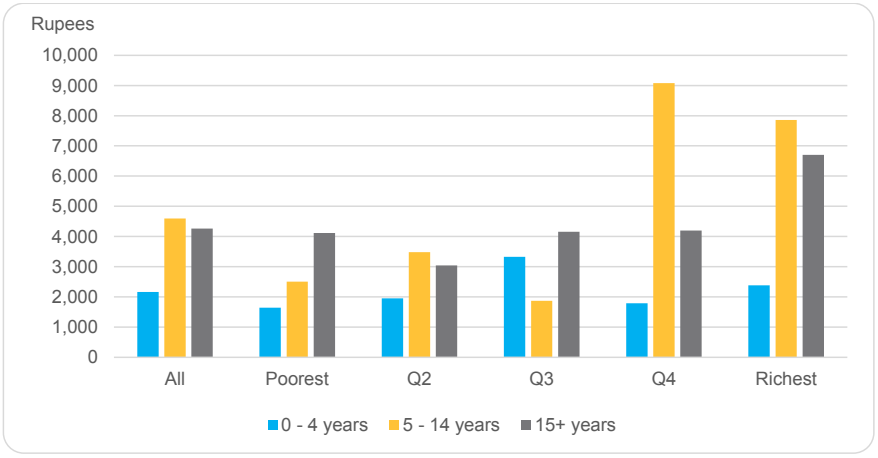


[a] Sample as follows: n=1,234 outpatients, n=279 inpatients, n=1,635 home care

[b] Conversion to US $ should be made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.

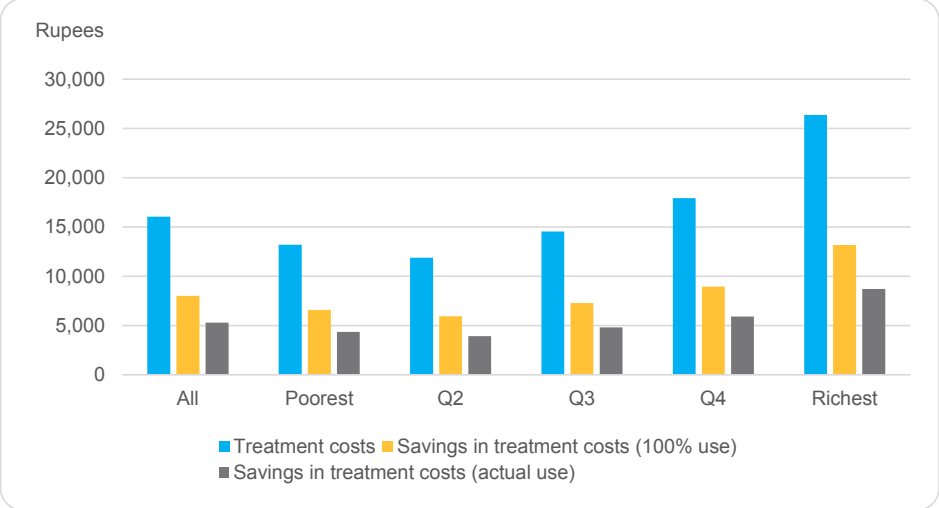
When combined, the overall average cost per case seeking care at any type of medical facility is INR 4,058 (US $63). The cost per case is almost twice as high for richer households compared to the poorer households. Also, the cost varies by age group – for young children (5 years or less) the average cost is INR 2,161 (US $33), for older children it is INR 4,595 (US $71) and for adults it is INR 4,260 (US $66). Results are shown in Figure 22.

Figure 22. Average cost per disease case seeking care, including all types of visit, by wealth quintile (Indian Rupees)



When the average costs per case of diarrhoea and respiratory infection are combined with the estimates of prevalence, attribution of disease to poor sanitation and hygiene, treatment seeking rates, average household members per age grouping, the average annual costs per household are calculated. By applying the disease risk reductions, medical expenditure savings are also calculated. Figure 23 presents the results, showing the treatment costs per year are INR 16,048 (US $249) for the average household, varying from INR 11,881 (US $184) for the second poorest quintile to
INR 26,365 (US $409) for the richest households. The cost savings are based on an estimated 50 per cent reduction in disease cases due to sanitation and hygiene; however, the savings depend critically on what proportion of household members use the toilet and wash their hands. At 100
per cent usage, INR 8,024 (US $124) is saved per household, while at actual usage of 85 per cent the saving is INR 5,296 (US $82).

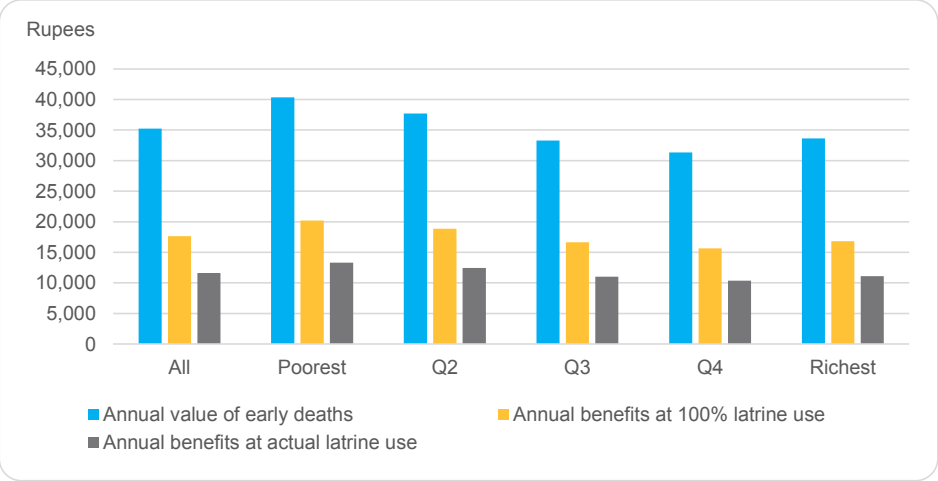
Figure 23. Treatment costs and savings per household, under two scenarios, by wealth quintile (Indian Rupees per year)



5.2 Avoided deaths

The economic gains from reduced the number of deaths were estimated based on mortality rates due to poor sanitation and hygiene from the WHO Global Burden of Disease study, expected reductions in deaths due to less diarrheal and other disease episodes, and the economic value associated with averting death. The economic costs and economic gains are shown in Figure 24.
The average value of deaths due to WASH-related diseases is INR 35,244 (US $546), varying between INR 31,000 (US $481) and INR 40,000 (US $620) among wealth quintiles. The difference in these values is due to a slightly higher number of young children in poorer households, in which age group the risks of mortality are highest.

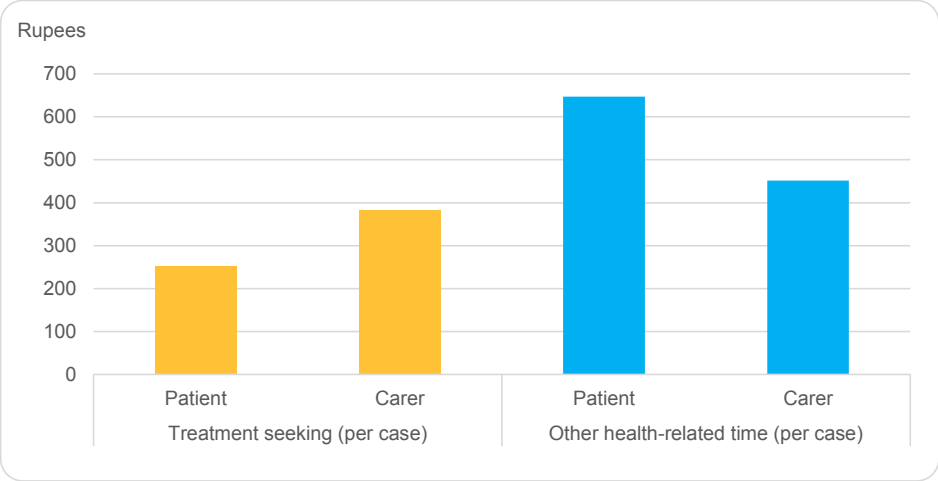
Figure 24. Annual value of early deaths and benefit of sanitation and hygiene, per household, by wealth quintile (Indian Rupees per year)



5.3 Time use

Households were asked separately about the loss of time due to treatment seeking and the loss of time spent at home due to being ill, with questions distinguishing between the patient and the carer. Respondents to the questions about medical expenditures were also asked about the time spent traveling to and staying at the medical facilities. An average of 13.5 hours of patient time and 16 hours of carer time was spent seeking any kind of medical care per disease case[41]. More patient time was lost from productive activities at home, while there was relatively less carer time as the patient did not always need to be tended to. A total of 67.8 hours of time of household members was lost during an average illness episode, valued at INR 1,502 (US $23). Figure 25 shows the value of time spent sick from treatment seeking and time spent sick at home, per illness case.

Figure 25. Value of time lost for household members for health-related reasons, per case (Indian Rupees)



[41]Carer time exceeded patient time as there were more than one carer in some cases.

Significant time is spent by those who do not have or use a household toilet accessing a site of defecation and urination. To gather robust evidence on these losses of time, detailed questions were asked to primary caregivers and chief wage earners on the practices of each household member before and after the construction of a new household toilet under SBM. Based on their actual changes in practice, the number of hours saved per year was calculated, and the value of these were estimated. Figure 26 presents the value for different household members, varying from INR 2,000 (US $31) for caregivers, INR 6,166 (US $95) for chief wage earners, INR 6,258 (US $97) for other adults and INR 4,291 (US $66) for children of school age.

Figure 26. Economic value of time losses travelling to open defecation prior to investing in own toilet, for different individuals (Indian Rupees per year)

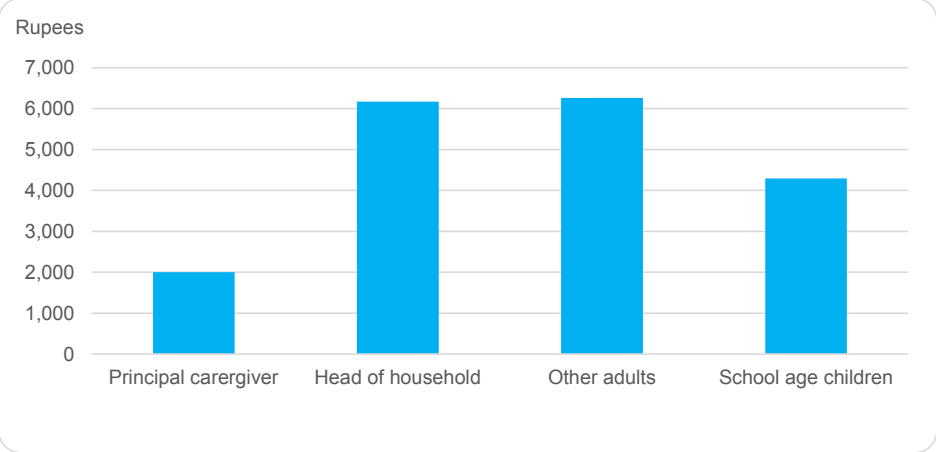
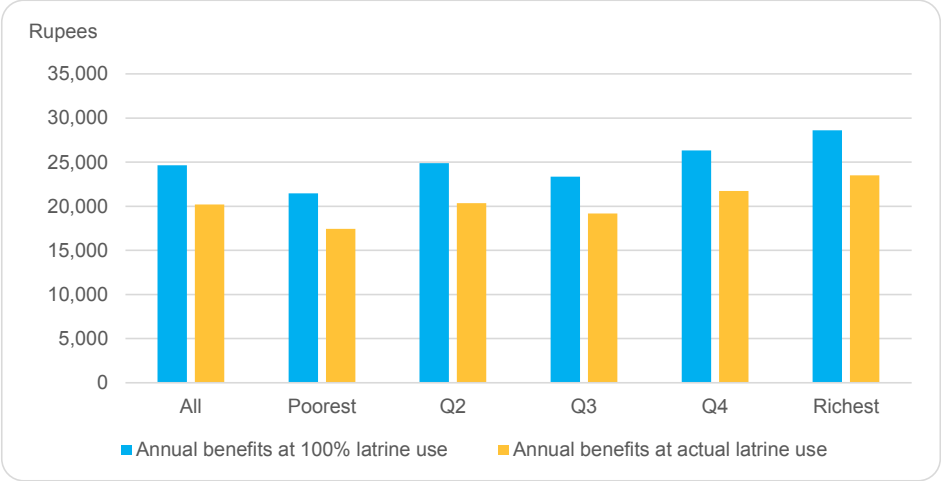


Figure 27 presents the estimated annual economic gains including the time savings in sanitation access plus the productive time gains based on reduction in number of disease cases. The economic gains are INR 24,646 (US $382) at 100 per cent toilet usage and INR 20,200 (US $313) at 85 per cent toilet usage. The annual gains at 100 per cent toilet use range from INR 21,466 (US $333) for poorest households to INR 28,614 (US $444) for richest households.

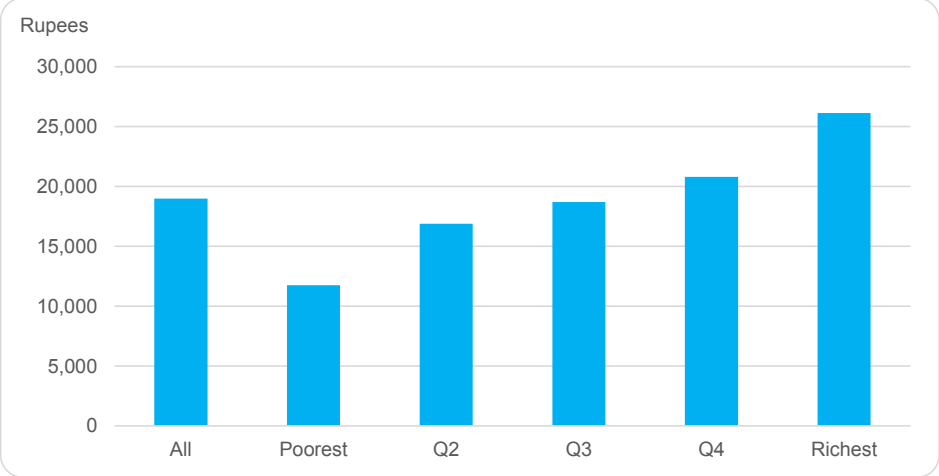
Figure 27. Value of travel and health-related time savings from owning a household toilet, under different toilet use scenarios, by wealth quintile (Indian Rupees per year)



5.4 Property value

Investment in a toilet not only brings health, time and reuse benefits which extend over the lifetime of the toilet, but the toilet brings value to the property on which it is located. This value will be closely linked with the investment cost of the toilet, but its value will diminish over time due to wear and tear of the toilet facility. Chief wage earners were asked what impact they thought the toilet would have on the property value, if they were to sell the property now. Responses were received from 76 per cent of chief wage earners. Of those responding, the average value increase is INR 18,991 (US $294). Figure 28 shows the variation between wealth quintiles. The value given corresponds to 70-80 per cent of the total investment cost of the toilet for all wealth quintiles, and to about 5 per cent of the estimated property value. To include the property value rise in the cost-benefit analysis, it was conservatively assumed that this value would be received at the close of the 10 year period taken for the CBA.

Figure 28. Property value gains per household associated with having a toilet, by wealth quintile (Indian Rupees)



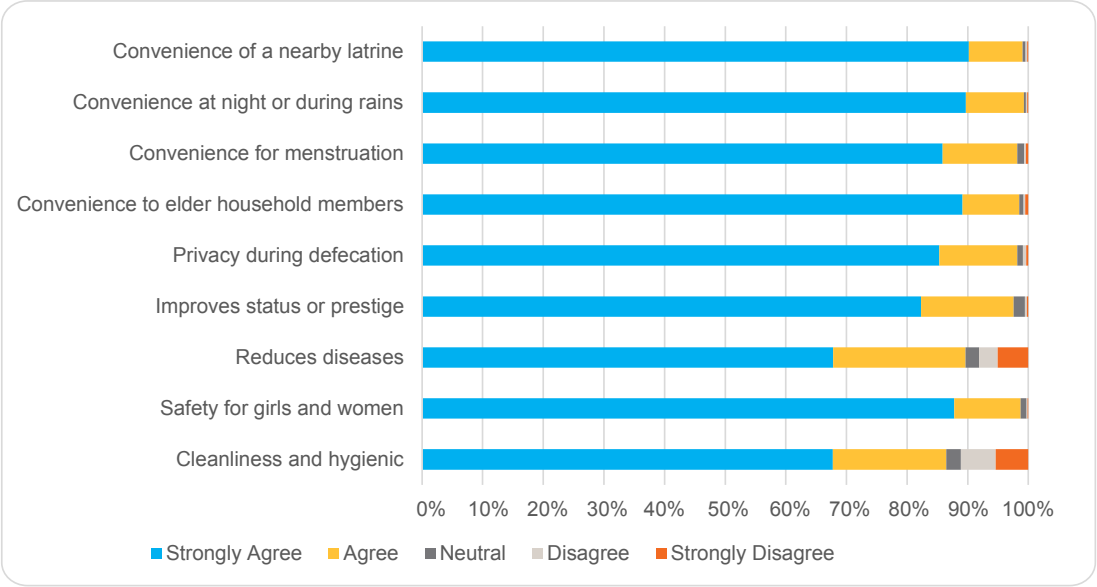
5.5 Intangible benefits

Respondents were asked to answer statements about the perceived benefits of the new household toilet, compared to what they used before. Most of these benefits are aspects not covered in the benefits evaluated above, except aspects of health and convenience. However, convenience goes beyond the time savings, but indicate a quality of life gain of having a nearby and clean toilet facility, especially for children, elderly people, women, and at night or when it rains. For girls and women dealing with their menstrual period, a toilet with a tap might offer the best place for them to clean themselves (if there is no bathroom). The results indicate very strongly that household toilets have a range of important benefits, as perceived by households, covering convenience, privacy, safety and status aspects. A blue bar in Figure 29 means they strongly agree with a positive statement about their new toilet, while yellow bar means they agree.

Figure 29 indicates that there is an overwhelmingly positive response on the intangible benefits of having a household toilet. From the various perspectives that convenience aspects were explored, respondents strongly agreed with 80 per cent to 90 per cent of positive statements about the toilet, over 85 per cent strongly agreed that it is safer for girls and women, 85 per cent strongly agreed with the privacy aspect and over 80 per cent strongly agreed with the status or prestige of owning a toilet.

There were two impacts explored which had a lower proportion of respondents strongly agreeing with the statements and approximately 10 per cent of households disagreeing with the positive statements. These were the disease and cleanliness aspects. These aspects are unlikely to perform well if the toilet is not cleaned properly. These responses were cross-tabulated with the costs the household spent on operating the toilet facility, and it was found that those strongly agreeing or agreeing with the positive statement were likely to spend 1.8 times on the operating costs those respondents who disagreed, and in terms of time spent cleaning the different was 1.2 times. Hence, it is feasible that those finding that cleanliness and disease impact were not a benefit were not spending enough resources maintaining a clean facility.

Figure 29. Intangible benefits of owning a toilet as perceived by households



5.6 Aggregate benefits at household level

The study results presented above covered four types of benefit that accrue to households from having a household toilet and using it, shown in Table 12 for 100 per cent toilet usage.

1. Medical costs averted: financial savings from paying less medical costs based on reductions in illness episodes (average INR 8,024 (US $124) per household per year).
2. Value of time savings: reduced time lost from sickness and seeking a place for open defecation (average INR 24,646 (US $382) per household per year).

3. Value of saved lives: economic value of saved lives due to lower mortality rates (average INR 17,622 (US $273) per household per year).

4. Property value: Rs 18,991 per household was estimated as the average increase in property value from having a toilet, made by the household occupants.

Table 12. Annual value of benefits from having and using a household toilet (Indian Rupees[a])

Group	Annual benefits at 100% toilet usage				Addition to property value (one-off benefit)
	Medical costs averted	Value of time savings	Value of saved lives	Total	
All	8,024	24,646	17,622	50,292	18,991
Poorest	6,599	21,466	20,184	48,249	11,757
Q2	5,940	24,869	18,853	49,662	16,884
Q3	7,278	23,361	16,650	47,289	18,698
Q4	8,961	26,337	15,665	50,964	20,808
Richest	13,182	28,614	16,813	58,609	26,144

[a] Conversion to US $ is made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.

Despite the availability of a functioning household toilet, some household members do not (always) use it, as habits can be hard to change. Out of a sample of >40,000 individuals across >10,000 households, it was found that 15 per cent do not always use the readily available and fully functional toilet when they are at home. Note that this does not represent the entire rural population of India, but the sample of households that were interviewed and have obtained a toilet since October 2014. The implications for the health impacts are potentially greater than the 15 per cent non-use rate implies, due to externalities (given that everyone is still exposed to the faecal matter of the 15 per cent of surveyed people not using a toilet). The consequent benefits under 85 per cent toilet usage are presented in Table 13. As shown, the annual benefits reduce from an average of INR 50,292 (US $780) at 100 per cent toilet use to INR 37,126 (US $575) at 85 per cent toilet use.

Table 13. Annual value of benefits from 85 per cent usage rates of household toilets, by wealth quintile (Indian Rupees[a])

Group	Annual benefits at 85% toilet usage				Addition to property value (one-off benefit)
	Medical costs averted	Value of time savings	Value of saved lives	Total	
All	INR 5,296	INR 20,200	INR 11,631	INR 37,126	INR 18,991
Poorest	INR 4,355	INR 17,431	INR 13,321	INR 35,108	INR 11,757
Q2	INR 3,921	INR 20,340	INR 12,443	INR 36,703	INR 16,884
Q3	INR 4,803	INR 19,167	INR 10,989	INR 34,959	INR 18,698
Q4	INR 5,915	INR 21,734	INR 10,339	INR 37,988	INR 20,808
Richest	INR 8,700	INR 23,499	INR 11,097	INR 43,296	INR 26,144

[a] Conversion to US $ should be made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.

It should be noted that the 15 per cent non-usage rate was among households who obtained a toilet since October 2014, and that (1) non-use rates will be different amongst households already with a toilet in October 2014; and (2) there might still be households in communities declared ODF that do not have a toilet and do not use one.

5.7 Total benefits at national level

Drawing on the estimated total number of households without improved sanitation nationally in 2015 (from the WHO/UNICEF Joint Monitoring Programme), the total economic damages are estimated to be INR 12.2 trillion (US $189 billion), or 7.9 per cent of GDP. The disaggregation between rural and urban is shown in Table 14. The damage cost as a proportion of GDP is higher than the estimate of 6.4 per cent from the previous World Bank study because this current study draws on field studies, which have identified higher medical and time costs than previously reported.

The potential economic benefits of sanitation and hygiene measures implemented under the SBM are significant. If the coverage and use of toilets would be 70 per cent nationwide, the damage costs would be INR 7.3 trillion (US $113 billion) or 4.7 per cent of GDP, and hence the savings would be in the order of INR 4.9 trillion (US $76 billion). If SBM achieved its aim of ending open defecation, with improved sanitation, the damage costs would be reduced to INR 4.1 trillion (US $64 billion), or 2.7 per cent of GDP, meaning savings of INR 8.1 trillion (US $126 billion) from the current situation. The damages do not fully disappear under 100 per cent toilet use rate because this level of sanitation intervention is not expected to mean the end of the transmission of diarrhoea and other diseases via the faecal-oral route. To reduce the health impacts further, more advanced water, sanitation and hygiene infrastructure and practices would be needed.

Table 14. National damage costs and benefits, total (Indian Rupees[a]) and as per cent of GDP

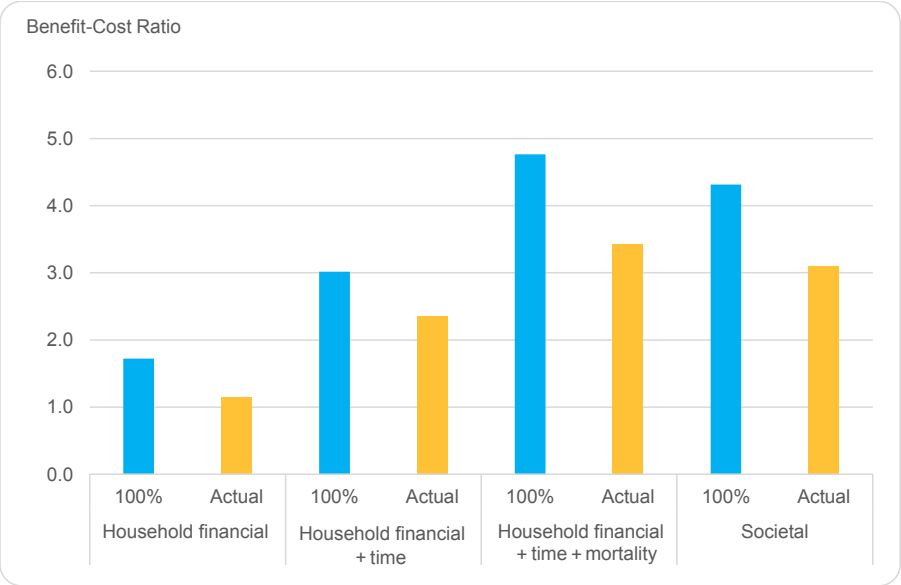
Variable	Units	Rural	Urban
National damage cost at 2015 sanitation use (34% rural, 65% urban)	Billion INR	9,643	2,536
As % of GDP	%	7.9%	
National damage cost at 70% toilet usage rate in rural and urban	Billion INR	5,761	1,515
As % of GDP	%	4.7%	
National damage cost at 100% toilet usage rate in rural and urban	Billion INR	3,257	856
As % of GDP	%	2.7%	

[a] Conversion to US $ should be made at the mid-2017 rate of 64.5 Indian Rupees (INR) to 1 US Dollar.

6 Cost-benefit analysis

Costs and benefits are compared over a 10-year time period, including both investment, operations and maintenance costs. Figure 30 shows the overall results, comparing 100 per cent and actual toilet usage rates, while Table 15 shows the breakdown by wealth quintile. When 100 per cent of households in a community use a toilet, the financial savings exceed the financial costs to the household by 1.7 times, on average. For the poorest households, the BCR is higher at 2.4 times. When household time savings (from closer toilet access and less sickness) and the time for cleaning and maintaining the toilet are valued, the benefits exceed costs by 3.0 times. When benefits of lives saved are included, the benefits exceed costs by 4.7 times. If the government contribution to the toilet cost is included, reflecting a broader societal perspective, the benefits exceed costs by 4.3 times. Under all scenarios, the benefit-cost ratios are higher for poorer households than for richer ones (see Table 15).

Figure 30. Benefit-cost ratios under different perspectives and usage rates



Other economic measures shed further light on the performance of the intervention. The annual internal rate of return (IRR) on the financial investment is 32 per cent for all population groups, which is well above what households would earn from putting their money into a bank savings account. For the poorest households, the financial IRR is higher at 69 per cent. Taking into account the full cost of the toilet – i.e. adding the government financial contributions – the average financial IRR is 18 per cent for all households and 24 per cent for poorer households. The net financial return on the household expenditure on the toilet and handwashing station averages INR 21,390 (US $332) over 10 years. The average financial payback period is two years for all households, and only one year for the poorer households.

When calculating benefit-cost ratios under conditions of actual toilet use (of 85 per cent on average from the entire sample), the benefits are adjusted downwards using the amounts shown in Table 13 in section 5.6, and the costs remain the same. The amount by which the benefits exceed costs reduces accordingly to 1.1 times (from the household financial perspective) and 3.4 times (from the societal perspective). For the poorest quintile, the household financial savings exceed costs by 1.6 times.

Table 15. Benefit-cost ratios under different perspectives and scenarios, and by wealth quintile

Group	100% Use of sanitation and hygiene facilities				Actual use of sanitation and hygiene facilities			
	1. Household financial perspective	2. Household financial perspective + time impacts	3. Household financial perspective + time impact + lives saved	4. Societal perspective (includes government incentive)	5. Household financial perspective	6. Household financial perspective + time impacts	7. Overall household perspective + time impact + lives saved	8. Societal perspective (includes government incentive)
All	1.7	3.0	4.7	4.3	1.1	2.3	3.4	3.1
Poorest	2.4	4.0	7.0	5.8	1.6	3.1	5.0	4.2
Q2	1.4	3.3	5.4	4.7	0.9	2.6	3.9	3.4
Q3	1.6	2.9	4.5	4.0	1.0	2.2	3.3	2.9
Q4	1.7	2.9	4.3	3.9	1.1	2.3	3.1	2.9
Richest	2.1	2.8	4.0	3.7	1.4	2.1	2.8	2.7

The results are relatively robust to changes in assumptions. When the social discount rate is changed, the impact is relatively minor, shown in Figure 31. With larger family sizes and more children, the BCR increases significantly to at least nine from the broader economic perspectives. When health externalities are assumed the household financial BCR reduces from 1.7 to close to 1.1, but when no externalities are assumed it decreases less, to 1.5. When treatment seeking is reduced to only 50 per cent of cases, the financial BCR reduces to 1.3. However, when the baseline rate of diarrheal disease cases per person per year are halved, the BCR reduces below 1.0 (from the household financial perspective). If the toilet lasts for 20 years before being replaced, the BCR increases to 2.3 (from the financial perspective) and 5.0 (from the societal perspective).

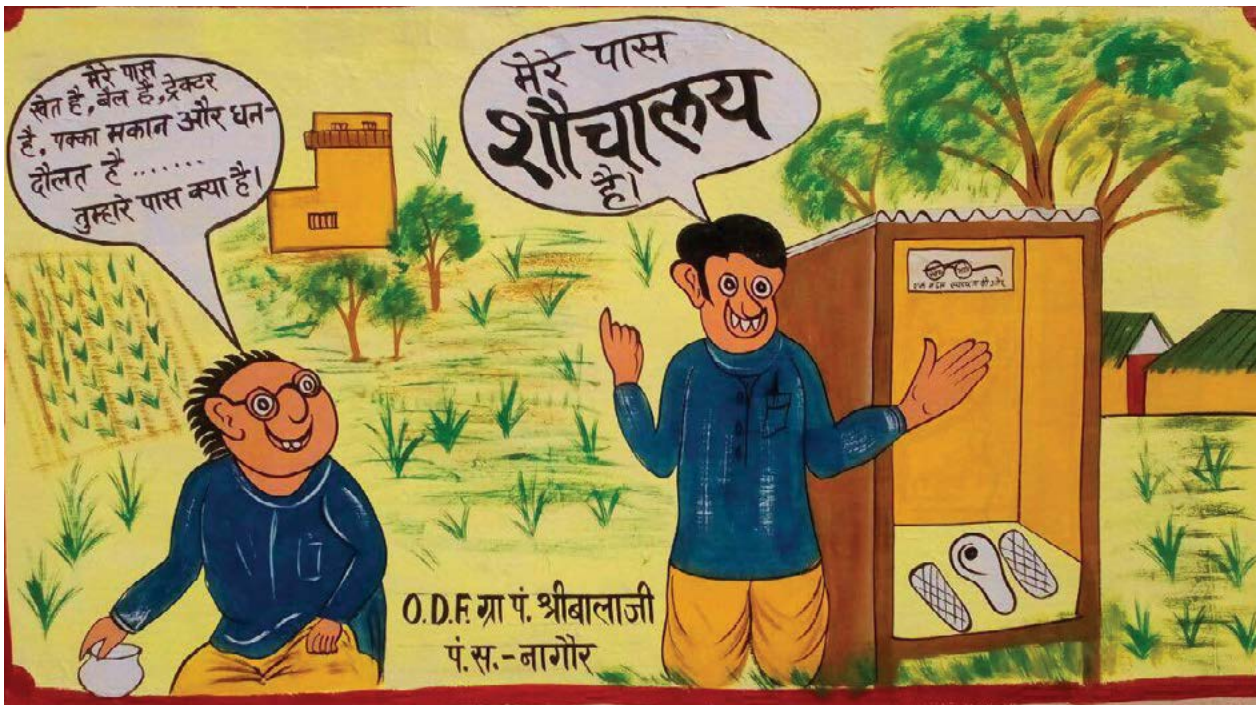
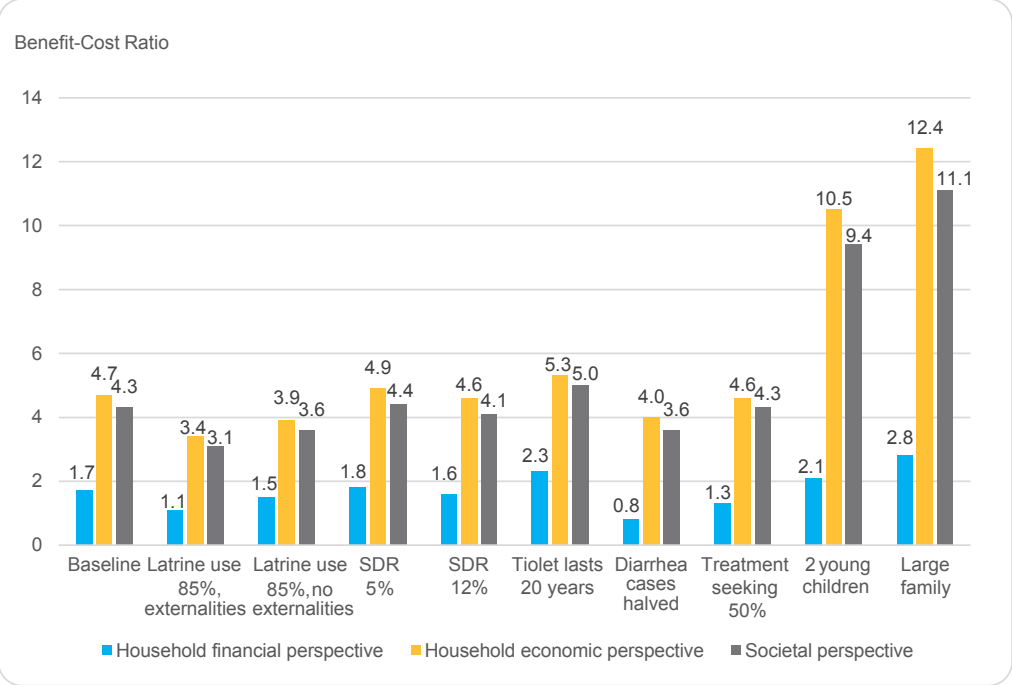


Figure 31. Benefit-cost results under alternative data inputs and scenarios



SDR – social discount rate. '2 young children' family includes 3 adults. Large family is 2 young children, 2 school age children and 3 adults.

7 Conclusions

In conclusion, this study has shown that the Swachh Bharat Mission (Gramin) is highly cost-beneficial from both a financial and an economic perspective. Even households that invest INR 16,000 (US $248) of their own money in a toilet and handwashing station will see those funds repaid in 2 years from the medical costs saved. The financial payback period could be sooner given that some sanitation-related diseases were not included in the study, such as Hepatitis A and E, soil-transmitted helminths and enteropathy. Childhood stunting and its consequences on long-term health and educational outcomes were also not included in this study, but would add considerably to the benefits of owning and using a toilet. However, when household members do not use their toilet and they defecate in the open, the benefits can be reduced considerably, thus emphasizing the importance of strengthening behaviour change components of the SBM(G).

It should also be noted that some other benefits of improved sanitation have not been quantified and valued in this study, such as reuse value, tourism value and the impact of improved management of faecal matter on water quality. Selected social benefits were assessed qualitatively through asking the respondents to indicate strength of agreement with statements about the toilet, and these aspects were all shown to be very important to households. Hence the financial and economic benefits expressed in monetary terms are likely to be greater than those presented in this study.

The results presented also confirm previous studies conducted in India. In preparing for a recent sanitation loan to support the SBM, the World Bank estimated a benefit-cost ratio (including both financial and non-financial benefits) of around 4.0 – for a toilet that was assumed to cost INR 15,000 (US $232). This present study showed very similar rates of economic return, based on the fuller economic benefits (an average BCR of 4.3 from the societal perspective). Indeed, in this current study it was found that households – even poor households – make their own investments on top of the government incentive to the tune of several thousand rupees. Hence as well as identifying the full investment costs to households of implementing SBM, this survey has documented an increased benefit level compared with those previously identified – in particular for the medical costs saved.

8 Annex

Annex 1. Sample frame after exclusions applied

State	Initial sampling frame		After dropping villages with no data on household numbers at baseline	After dropping duplicates	After dropping Naxal/Flood areas		After dropping villages with <35 new toilets or <20% increase in toilets		After dropping blocks with <5 eligible villages Final sampling frame	
	Blocks	Villages	Villages	Villages	Blocks	Villages	Blocks	Villages	Blocks	Villages
Andhra Pradesh	662	18,942	18,426	18,426	657	18,426	384	7,045	355	6,699
Assam	241	27,267	21,403	21,359	192	19,075	107	9,051	104	9,030
Bihar	534	38,715	31,716	31,686	487	29,342	93	3,408	67	2,915
Jharkhand	239	29,688	26,172	26,116	231	25,682	107	7,658	104	7,616
Karnataka	176	27,532	26,590	26,576	176	26,576	125	14,045	125	14,033
Madhya Pradesh	313	51,344	49,741	49,739	312	49,739	244	29,136	244	29,136
Maharashtra	351	40,522	40,375	40,359	318	36,517	225	20,228	225	20,225
Odisha	314	47,271	42,912	42,902	279	39,147	171	16,241	171	16,241
Rajasthan	295	41,506	39,469	39,459	290	39,459	250	25,081	250	25,080
Tamil Nadu	385	12,542	12,529	12,525	384	12,525	272	7,773	269	7,736
Telangana	438	11,037	10,647	10,647	434	10,647	200	3,921	174	3,605
Uttar Pradesh	821	99,085	83,918	83,900	804	83,900	204	15,661	200	15,537
Total	4,769	4,45,451	4,03,898	4,03,694	4,564	3,91,035	2,382	1,59,248	2,288	1,57,853

The United Nations Children's Fund
73, Lodi Estate
New Delhi – 110003
India

Email: newdelhi@unicef.org
Website: www.unicef.in

All photos provided by UNICEF