

# Understanding Willingness to Pay for Sanitary Latrines in Rural Cambodia:

## **Findings from Four Field Experiments of iDE Cambodia's Sanitation Marketing Program**

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**iDE**, formerly International Development Enterprises, is an international nonprofit organization that creates income and livelihood opportunities for poor rural households. The studies reported here are of iDE Cambodia's Sanitation Marketing Scale-Up project. The findings would not have been possible without iDE Cambodia's sincere commitment to informing their operations through both thoughtful qualitative learning approaches and rigorous quantitative impact evaluations. We are especially thankful to Stu Taylor, Mike Roberts, Cordell Jacks, Tamara Baker, Yi Wei and Matt Seitz for their insights and active engagement.

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**PATH** is an international nonprofit organization that transforms global health through innovation. PATH's approach blends the entrepreneurial spirit of business, the scientific expertise of a research institution, and the passion and on-the-ground experience of an international NGO. This study builds on previous work that PATH has done on water and sanitation financing in rural Cambodia.

**IDinsight** is a non-profit development consulting organization that helps policymakers and managers make socially impactful decisions using rigorous, timely and client-centered evidence. IDinsight's core service tailors experimental evaluation methodologies - including, but not limited to, randomized controlled trials - to the priorities and constraints of policymakers and managers working in international development. IDinsight led all aspects of the studies reported here.

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## Executive summary

Improving sanitation is essential for decreasing illness and death caused by diarrheal diseases, which account for more child deaths than HIV/AIDS, tuberculosis and malaria combined.<sup>1</sup> 2.5 billion people worldwide still lack improved sanitation.<sup>2,3</sup> This problem is particularly pronounced in rural Cambodia, where 80% of households go without hygienic sanitation.<sup>4</sup>

iDE Cambodia's Sanitation Marketing program facilitates the market for rural sanitation by training small-scale concrete producers in the production and sale of sanitary latrines. As iDE seeks to increase penetration of latrines in its Sanitation Marketing Scale-Up program,<sup>5</sup> it was faced with several key questions:

Question 1: What is the uptake of latrines at different price points (i.e., what is the full *demand curve* for latrines)?

Question 2: Do *subsidies* reduce eventual installation and usage of latrines?

Question 3: Does willingness to pay for latrines increase *after the rice harvest*?

Question 4: Does offering *financing* for latrines increase willingness to pay for latrines?

iDE Cambodia partnered with IDinsight to rigorously answer these four questions using field experiments. The key findings from this research agenda were:

1. Demand Curve:
  - a. A minority of non-latrine owners (between 3% and 20% depending on the context) is willing to pay cash for a sanitary latrine at its current market price.
2. Subsidies:
  - a. This study finds directional, but not statistically significant evidence that subsidies reduce latrine installation and usage – more research is needed.
3. Post-harvest:
  - a. Willingness to pay for latrines does not vary significantly by season.
4. Financing
  - a. Offering microfinance loans for latrines increases uptake of latrines fourfold at market price, from 12% to 50%.
  - b. Offering microfinance loans for latrines decreases operational cost per latrine by up to 70% due to significantly higher volume of sales.

Given the low willingness to pay for latrines with cash, efforts to sell latrines at market price without any financing mechanism will lead to continued low penetration. The major implication of this study is that offering microfinance loans for latrines will dramatically increase uptake of latrines, while also making distribution significantly cheaper per latrine sold. Large-scale efforts to offer financing packages for latrines should be aggressively pursued in rural Cambodia, and have the potential to increase latrine coverage from the current national rural level of 20%<sup>6</sup> to 60%.

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<sup>1</sup> Progress on Drinking Water and Sanitation, WHO and UNICEF, 2012 Update.

<sup>2</sup> Ibid.

<sup>3</sup> "Improved sanitation" is defined by the WHO/ UNICEF Joint Monitoring Programme as a facility that hygienically separates human excreta from human contact.

<sup>4</sup> Progress on Drinking Water and Sanitation, WHO and UNICEF, 2012 Update.

<sup>5</sup> iDE's Sanitation Marketing Scale-Up project is funded by the Bill & Melinda Gates Foundation and the Stone Family Foundation, with technical support from the Water and Sanitation Program of the World Bank.

<sup>6</sup> Ibid.

## Motivation & background for study

Increasing access to improved sanitation<sup>7</sup> is essential for decreasing the massive health burden caused by diarrheal diseases, which account for more child deaths than HIV/AIDS, tuberculosis and malaria combined.<sup>8</sup> According to the WHO and UNICEF, 2.5 billion people worldwide still lack access to improved sanitation. This problem is particularly pronounced in rural Cambodia, where 80% of households lack access to hygienic sanitation.<sup>9</sup>

iDE Cambodia is improving sanitation by facilitating a market for the production, distribution, and sale of low-cost latrines in rural areas through its sanitation marketing initiative. From 2009 to 2011, iDE implemented the Sanitation Marketing Pilot Project, funded by USAID Cambodia MSMU Project and the Water and Sanitation Project of the World Bank (WSP), in which 17,424 unsubsidized pour-flush sanitary latrines were purchased in 11 districts of Cambodia. At the conclusion of this pilot project, iDE initiated the Sanitation Marketing Scale-Up (SMSU) program to expand access to latrines through its sanitation marketing approach. SMSU is funded by the Bill & Melinda Gates Foundation and the Stone Family Foundation, with technical support from the Water and Sanitation Program of the World Bank (WSP).

In order to better understand and address barriers to uptake of low-cost sanitary latrines in its scale-up, iDE engaged IDinsight to lead a research effort. Research was prioritized according to the following criteria: (1) immediate relevance to informing SMSU operations; (2) feasibility of conducting rigorous, prospective study without undue disruption to SMSU operations; and (3) ability to inform broader questions concerning sanitation. After an initial scoping period, iDE and IDinsight agreed upon the following research questions:

1. What is the uptake of latrines at different price points (i.e., what is the full demand curve for latrines)?
2. Do subsidies reduce eventual installation and usage of latrines?
3. Does willingness to pay for latrines increase after the rice harvest?

Findings from the first research question shed light on the possible role of cash constraints in determining a customer's WTP and thus had important implications for iDE's operational strategy. These findings informed the decision to add a fourth research question:

4. Would offering financing for latrines increase uptake and willingness to pay for latrines?

IDinsight used field experiments to answer each of the four core questions outlined above. This report discusses the methodology, sampling strategy, results and implications for each of the four questions, in turn. The report concludes with recommendations to guide iDE's scale-up of sanitation financing and potential areas of future research.

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<sup>7</sup> "improved sanitation" is defined by the WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation as a facility that hygienically separates human excreta from human contact.

<sup>8</sup> Progress on Drinking Water and Sanitation, WHO and UNICEF, 2012 Update.

<sup>9</sup> Progress on Drinking Water and Sanitation, WHO and UNICEF, 2012 Update.

# Question 1

## Willingness to Pay for Sanitary Latrines

This section presents two separate but related studies to measure willingness to pay (WTP). WTP study A takes place in Kandal and Svay Rieng Provinces, in villages previously exposed during the Sanitation Marketing pilot. WTP study B answers the same question, but in four SMSU scale-up provinces – Oddar Meanchey, Banteay Meanchey, Siem Reap, and Kampong Thom – that had minimal previous exposure to sanitation marketing.

### WTP study A: Kandal and Svay Rieng Provinces

#### Motivation and Background

During the Sanitation Marketing Pilot Program, iDE's efforts were most intensive in Kandal and Svay Rieng Provinces. One of the objectives in SMSU is to deepen penetration in these provinces in the SMSU, better understanding the demand drivers and "willingness to pay" (WTP) for latrines within key household segments is critical. Mapping the entire demand curve – what percent of households are willing to buy latrines at different price – can shed light on whether and how effectively targeted subsidies of different sizes can increase penetration of latrines.

#### Methodology to estimate WTP

There are a number of methodologies to estimate an individual's WTP for a particular product, and these methods can be broadly grouped into two types – stated preference methods and revealed preference methods.<sup>10</sup> Stated preference methods rely on a respondent's response to a hypothetical question, and have been shown to overestimate how much an individual is actually willing to pay.<sup>11</sup> Revealed preference methods estimate WTP based on a binding transaction in which the respondent may ultimately have to pay for the product.

We use one such revealed preference method to estimate WTP, the Becker-deGroot-Marschak (BDM) mechanism. The BDM mechanism is a pricing game which incentivizes the respondent to state their true maximum WTP. BDM has been shown to accurately estimate WTP in developing country contexts.<sup>12</sup> Appendix 1 describes in detail the rules of the game and how it accurately estimates WTP.

The BDM method was chosen for four primary reasons:

1. Provides an exact estimate of an individual's WTP (therefore maps the full demand curve at every price point). This is an advantage over other revealed preference methods such as "take-it or leave-it" methodology that merely provides an upper or lower bound estimate of an individual's WTP for a product.

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<sup>10</sup> Berry, J, Fisher, G, and Guiteras, R. "Eliciting and Using Willingness to Pay: Evidence from Field Trials in Northern Ghana". Working paper, 2011.

<sup>11</sup> Murphy, J, Allen, G, Stevens, T, and Weatherhead, D, "A Meta-analysis of Hypothetical Bias in Stated Preference Valuation", *Environmental and Resource Economics*, March 2005 pp 313-325.

<sup>12</sup> Berry, J, Fisher, G, and Guiteras, R. "Eliciting and Using Willingness to Pay: Evidence from Field Trials in Northern Ghana". Working paper, 2011.

2. Provides greater statistical power for a given sample size than other revealed preference methods such as take-it or leave-it.
3. Can be used to estimate sunk cost and screening effects<sup>13</sup> (with a specific interest in whether subsidies would have any impact on latrine usage).
4. Easily implemented in context of rural Cambodia<sup>14</sup>

The BDM pricing game was integrated into the standard village sales process developed by Whitten & Roy Partnership (WRP), a sales management consulting firm, and iDE and the sales pitch developed by WRP and 17 Triggers, a behavior change consulting firm, with iDE. The sales process starts with an interactive village group presentation that illuminates the personal, economic, convenience, and dignity enhancing benefits of owning a pour-flush sanitary latrine. The sales process closes by generating group excitement to purchase a latrine. Individuals are then signed up to purchase a latrine, the price being determined by playing the BDM game (see Appendix 1 for more details on the BDM game).

## Sampling Strategy and External Validity

The sample frame for this study included 566 villages in which the Sanitation Marketing Pilot took place, given the goal of understanding how to increase latrine penetration in its scale-up within Kandal and Svay Rieng. A stratified random sampling procedure was followed to select 17 villages (8 villages in Kandal and 9 in Svay Rieng) as the study sample. Within each study village, a stratified random sampling procedure was used to select 50-60 non-latrine owning households (70% non-ID Poor and 30% ID Poor<sup>15</sup> households), for a total sample of 940 observations.<sup>16</sup> The goal of this sampling strategy was to maximize external validity of the findings to all villages in Kandal and Svay Rieng that had been exposed to iDE’s sanitation marketing. As table 1 below shows, the study sample is not statistically significantly different from sample frame villages on key variables.

**Table 1:** Village Characteristics in Kandal and Svay Rieng Provinces

Parameter (mean value)	All Pilot Villages	Study Villages
% baseline latrine coverage*	22.0%	21.5%
% of households that are ID Poor*	31.1%	26.1%

\*differences are not statistically significant at alpha = .1

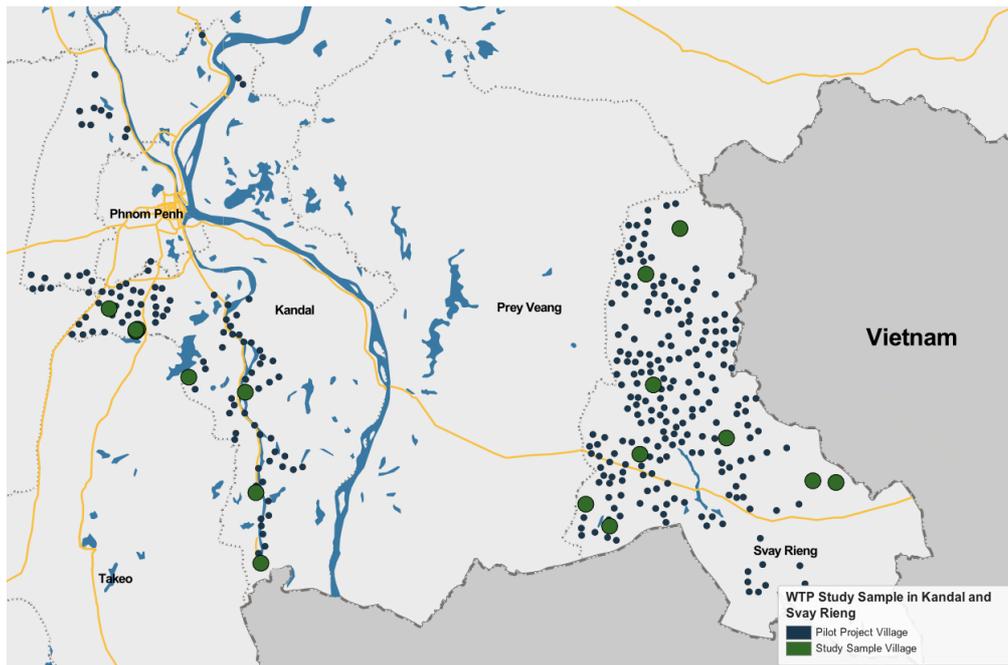
<sup>13</sup> Sunk cost effect is the effect of price paid on product usage, controlling for willingness to pay. This is an important question given the debate on whether subsidies cause customers to value a product less and therefore use it less. The screening effect is the effect of willingness to pay on product usage, controlling for price paid.

<sup>14</sup> Initially, there was some skepticism about the ability of rural Cambodians to understand the BDM pricing game and give an accurate estimate of their own WTP for latrines. We conducted extensive piloting of the BDM mechanism in the field, and found no issues with using the BDM methodology. Customers viewed it as a fair process, often comparing it to a lottery and calling it the “lucky draw” game in Khmer. Based on this field piloting, we decided to go forward with the BDM mechanism as our primary measure of WTP for latrines.

<sup>15</sup> “ID Poor” is the Government of Cambodia’s official designation for households below the poverty line. ID Poor households receive a government issued ID Poor card.

<sup>16</sup> 3 observations from the total 940 were ultimately dropped due to misunderstanding of the rules of the BDM game by the respondents. The remaining 937 observations form the basis for analysis.

**Map 1:** Study villages in Kandal and Svay Rieng



## Operational details

Within each of the 17 sample villages, the evaluation had the same operating procedure:

1. Do a short census of the entire village to determine latrine ownership and ID Poor status.
2. From the population of all non-latrine owners in the village, draw a stratified random sample of 50-60 households, with 70% non-ID Poor and 30% ID Poor.<sup>17</sup>
3. Conduct a quick baseline survey with all sampled households and invite the households to a group sales meeting.
4. At the group sales meeting, give the sales pitch for the latrine, and then play the BDM game with each household present to get an estimate for that household's WTP, and to complete the sale.
5. After the group sales meeting, follow up with each household not at the group sales meeting, give a direct sales pitch, and then play the BDM game.
6. Coordinate with latrine producers for the delivery of latrines to all customers.

## Results

The main outcomes to the WTP BDM experiment in Kandal and Svay Rieng were:

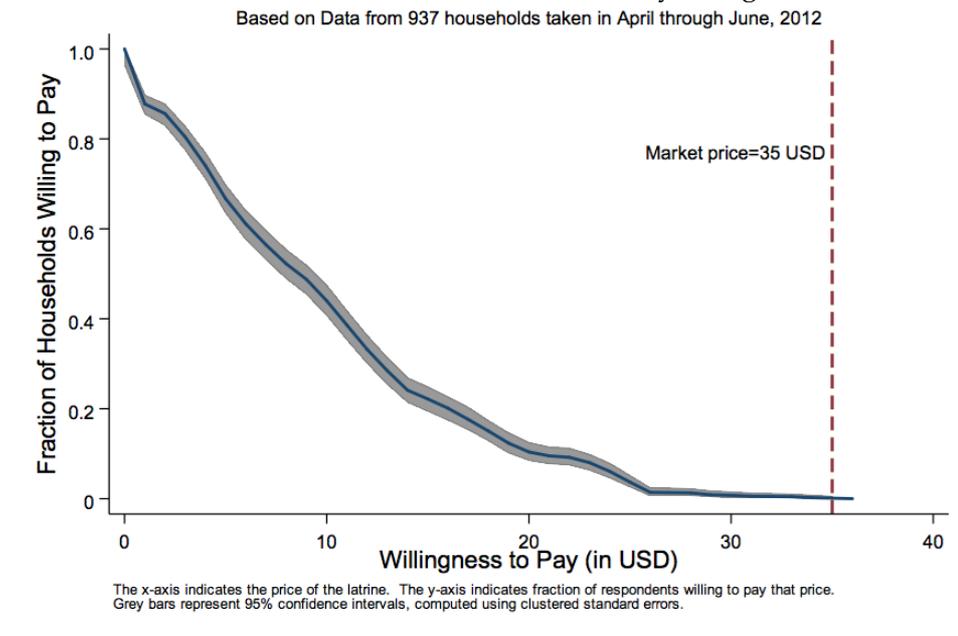
1. Median WTP is only \$10 per latrine – far lower than the average market price of \$35.00 in Kandal and Svay Rieng.
2. Only 3% of respondents are willing to pay the current market price of \$30.00.
3. ID Poor households have an average WTP that is \$2.50 lower than that of non-ID Poor households.

The full demand curve and the demand curve divided by ID Poor status are presented in the two figures below:

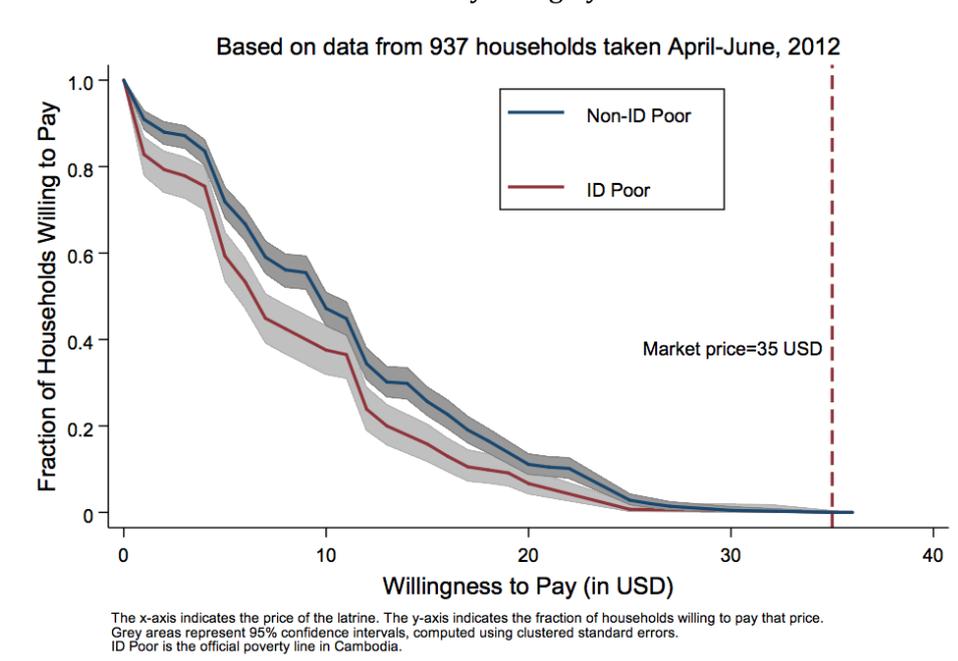
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<sup>17</sup> 50 households per village in the 8 Kandal villages, and 60 households per village in the 9 Svay Rieng villages.

**Graph 1: Demand curve for Latrines in Kandal and Svay Rieng Provinces**



**Graph 2: Demand curve in Kandal and Svay Rieng by ID Poor status**



Why is WTP among households without latrines so far below the current market price?  
There are several possible explanations:

- **Previous Sanitation Marketing Exposure:** All villages in the sample had previously been exposed to sanitation marketing. It is possible that this first round or two of sanitation marketing exposure captured the majority of households willing to pay for a latrine with cash at market price.
- **Payment Options:** In Kandal and Svay Rieng, respondents were instructed that they would need to pay for the latrines the same day that they played and won the BDM game. **This is a shortcoming in the study, as it deviates from the standard village sales process of allowing cash on delivery, and may have led to an underestimate**

**of WTP.** Demanding payment at the time of sale may have decreased measured WTP, given customer wariness about paying up front then not receiving the product. Payment was switched to cash on delivery for the WTP studies in the northern provinces (see WTP Study B below) to more closely mimic the standard village sales process.

## Implications

In order to significantly increase uptake by subsidizing the price would require a deep subsidy given how low WTP is. Targeting the subsidy only to official ID Poor households would not make the subsidy significantly more efficient, given that average WTP for ID Poor households is only \$2.50 less than for non-ID Poor households – few households in either group are willing to purchase without a large subsidy. Thus, in areas with high latrine coverage or previous sanitation marketing exposure, different ways to drive market penetration should be considered, such as further demand-creation interventions or financing packages (unless a project is willing to consider very large subsidies). Lastly, any conclusions or implications from this study should take into consideration the fact that WTP estimates from this study may be underestimated due to the payment issue mentioned above.

## WTP Study B: Northern Provinces

### Motivation

Following the Kandal and Svay Rieng WTP study, we measured WTP in the four northern SMSU scale-up provinces of Kampong Thom, Siem Reap, Oddar Meanchey, and Banteay Meanchey. Given that these provinces had less previous exposure to sanitation marketing than Kandal and Svay Rieng, iDE wanted to measure WTP in these provinces and to examine whether WTP varied by season.

### Methodology to estimate WTP

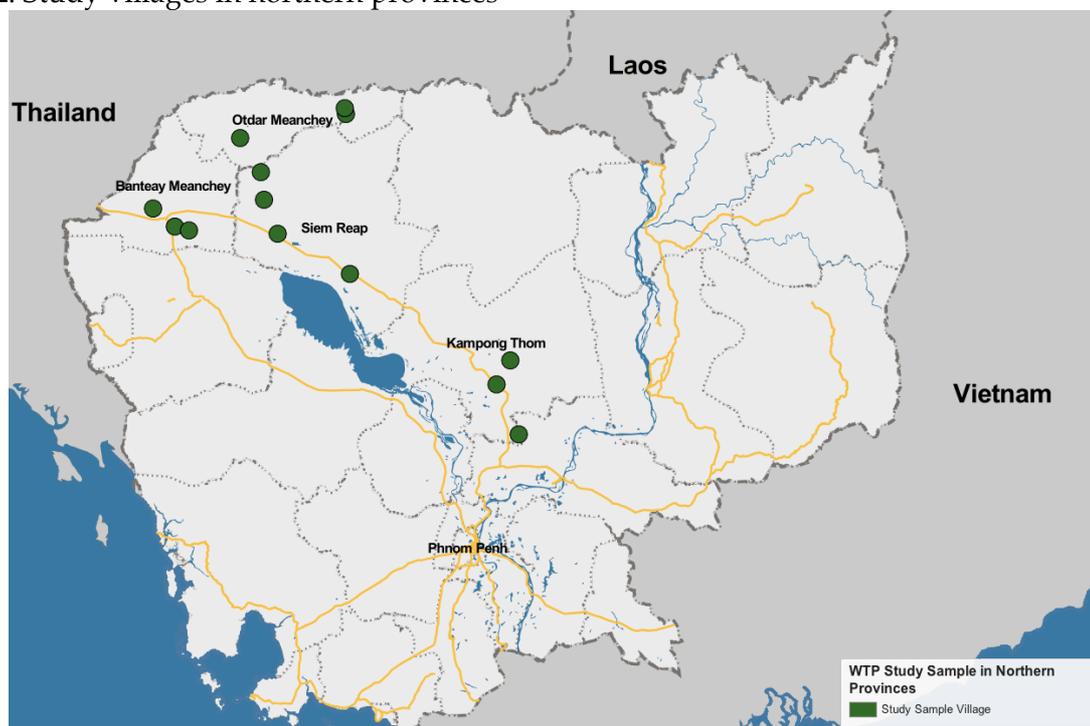
The same BDM methodology to estimate WTP described above was used in the northern provinces. The only operational difference was that respondents were allowed to pay on delivery rather at time of sale, which conforms more closely to the standard village sales process.

### Sampling Strategy and External Validity

The sample frame for this study included all villages in the 4 northern provinces. Since SMSU was scaling-up to the northern provinces, this study was intended to map the demand curve for latrines for the entire scale-up geography (rather than simply within pilot project villages, as in Kandal and Svay Rieng). Given this, the sample frame included all villages in the 4 northern scale-up provinces. A stratified random sample of 12 villages was

drawn from this frame, and within each village a stratified random sample of 50 non-latrine owning households (35 non-ID Poor and 15 ID Poor households) was drawn.<sup>18</sup>

**Map 2:** Study villages in northern provinces



## Results

As graphs 3 and 4 below indicate, approximately 20% of households are willing to pay the market price of approximately 50 USD.<sup>19</sup> Median WTP is approximately 27.50 USD. ID Poor households also have slightly lower WTP than non-ID Poor households, as in Kandal and Svay Rieng provinces. Lastly, WTP was not statistically significantly different between the four provinces, as shown in graph 5.<sup>20</sup> Demand as measured in these 4 provinces is higher than in the pilot provinces of Kandal and Svay Rieng, though due to the previously mentioned change in when customers make payments, the results should not be compared directly.

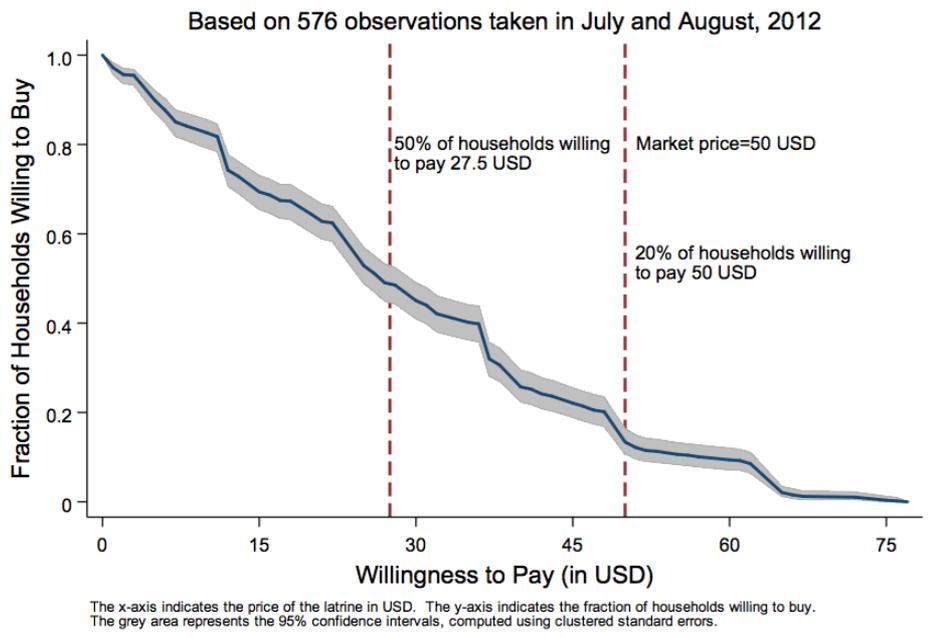
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<sup>18</sup> One additional village was chosen in addition to the initial 12 at the time of random sampling in case enough certain selected villages did not contain 50 non-latrine owning households. Ultimately, the study sample eventually included an additional 13<sup>th</sup> village and 576 total observations were recorded, compared to the 600 observations planned. The deficit of 24 observations was due to inability to locate or replace all selected households.

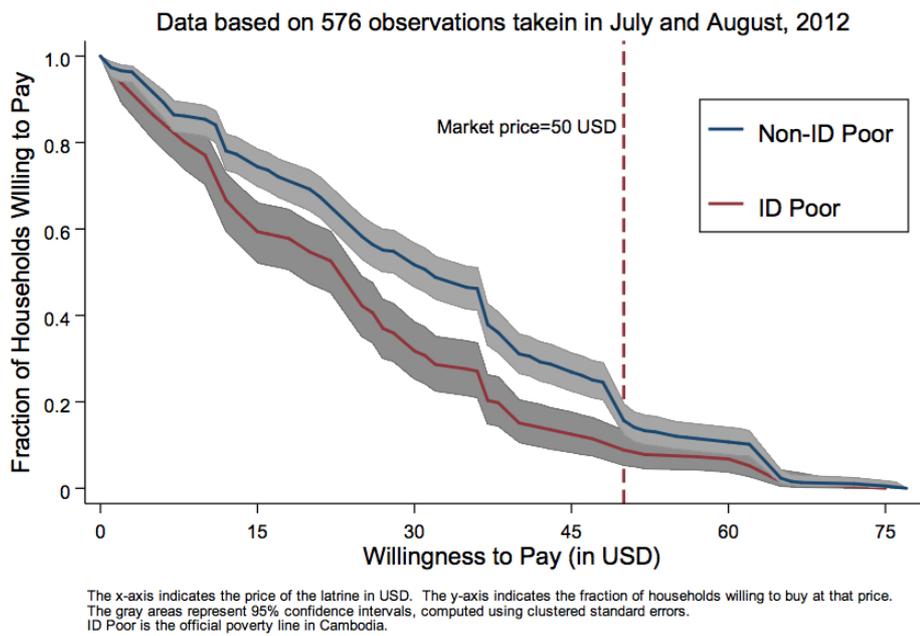
<sup>19</sup> Note that the market price in the northern provinces is higher than in Kandal and Svay Rieng, in part because of the higher transportation costs of supplies from Phnom Penh and because of a more nascent market.

<sup>20</sup> 95% confidence interval bands have been omitted from the graph for ease of visualization, but differences between the demand curves are not statistically significant at the  $\alpha = .05$  level.

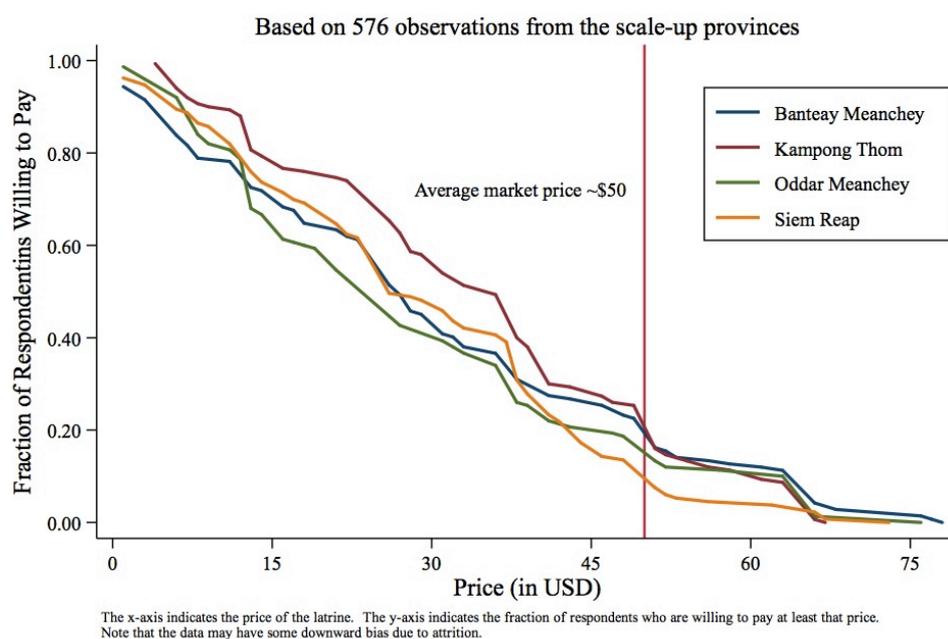
**Graph 3:** Demand curve for latrines in northern provinces



**Graph 4:** Demand curve for latrines in northern provinces by ID Poor status



**Graph 5: Demand curve for latrines by province\***



\*Differences in WTP between the curves are not statistically significant at  $\alpha = .05$

Additionally, as Table 2 below shows, there is a correlation between presence of a previous subsidy in a village and average WTP for that village. The interpretation of this correlation is unclear, as there are several possible explanations:

1. Subsidies decrease demand for purchasing latrines in the future as non-latrine owners are waiting for another round of subsidies.
2. Villages that previously received a subsidy are on average poorer and it is the low income levels rather than previous subsidy that accounts for the lower average WTP.
3. The previous subsidy allowed a majority of households to obtain a latrine and only the “laggard” households that have very little demand for latrines remain.

Given that this is only a correlation and there are several possible explanations, strong conclusions that offering a subsidy decrease subsequent demand should not be drawn.

**Table 2: WTP among non-latrine owners in villages with and without previous subsidy**

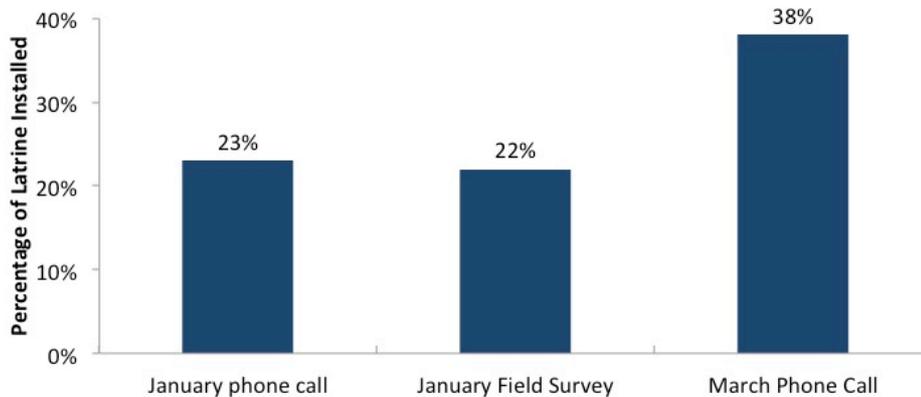
	Northern villages with previous subsidy	Northern villages with no previous subsidy
Mean Willingness to Pay	\$22	\$32
% Latrine Coverage at Baseline	74%	22%

### Latrine Installation Rates

IDinsight first conducted a phone survey of all 256 households that purchased a latrine in the July – August 2012 WTP study B. This was followed by a field survey of all 256 households, in which surveyors directly verified latrine installation. The phone survey yielded nearly the same installation rates as the direct verification field survey, as evidenced by the first two bars in Graph 6 below. A second phone-based study was done in March and showed statistically significantly higher installation rates – roughly 38%. Given the

congruence in results between the January phone survey and January in person survey, it is likely that the March phone survey accurately captures an actual increase in installation rates.

**Graph 6:** Latrine Installation Rates Over Time



This gradual increase in installation rates over time mirrors iDE's previous experience and monitoring data from the pilot project which shows that 50% of latrines are installed within 100 days of delivery and 95% are installed within 15 months of delivery.<sup>21</sup> There are a number of factors that account for the slow, gradual increase in installation rates after purchase. Chief among these is that the vast majority of households wish to purchase a concrete or brick shelter for their latrine before installing it (as opposed to installing it right away and erecting a more temporary thatch or wood shelter, while saving the money for a more expensive shelter). Only 6% of respondents surveyed installed their latrine before buying and erecting a brick or concrete shelter, the cost of which is on the order of 150 USD to 200 USD. 69% of individuals surveyed who had not installed their latrines cited "not enough money" as the main reason why they had not installed their latrine. Since the average respondent also stated that it costs 0 USD to install their latrine (i.e., they install it themselves with the help of relatives or friends), we infer that the majority of these respondents mean "not enough money" for a shelter - an inference that is supported by narratives from more in-depth qualitative interviews with a sub-selection of respondents.

While the majority of households will likely install their latrines over the coming months (given the historical data from iDE), providing a ready-made, low-cost, attractive shelter or providing shelter financing packages could accelerate the rate at which households install and use their latrines.

### *Sunk Cost and Screening Effects*

Optimal pricing for health goods such as latrines requires an understanding of (a) whether households with higher WTP are more likely to use the product ("screening effect of pricing") and (b) whether the price paid itself has an effect on use ("sunk cost effect" or "causal effect of price paid")<sup>22</sup>. Informing a policy decision of whether to subsidize latrines depends critically on whether subsidies affect subsequent usage. One methodological

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<sup>21</sup> iDE Sanitation Marketing Pilot Project End of Project Report, 2011.

<sup>22</sup> Ashraf, Nava, James Berry, and Jesse M. Shapiro. 2010. "Can Higher Prices Stimulate Product Use? Evidence from a Field Experiment in Zambia." *American Economic Review*, 100(5): 2383-2413.

advantage of BDM is that it allows identification of both channels: WTP is revealed in the bidding process; the transaction price is random, conditional on winning and WTP<sup>23</sup>.

Measuring actual use of the latrine is operationally difficult and expensive, and self-reports of health behaviors frequently suffer from serious social desirability bias<sup>24</sup>. As a result, we use latrine installation as an objective proxy for use, since installation is a necessary condition for latrine use.

Table 3 below demonstrates the percentage of households who had installed their latrine by January 2013, divided by WTP quintile and subsidy level. The bottom left cell (1<sup>st</sup> WTP quintile and shallow subsidy) is blank because we do not observe installation for those who lost in BDM, i.e. with  $WTP < Price\ drawn$ . Each “WTP quintile” corresponds to twenty percentile increments – the 1<sup>st</sup> WTP quintile refers installation rates of winning respondents who fell within the lowest 20% of WTP, 2<sup>nd</sup> WTP quintile refers to winning respondents who fell between the 20-40<sup>th</sup> percentile of WTP, etc.

Screening effects (the effect of WTP on installation) can be seen by reading along rows – reading from left to right along a row tracks how installation rate changes as WTP increases for a given subsidy level. For the “deep subsidy” in which winning respondents paid 5 USD for a latrine, we do not see a clear pattern between installation rate and WTP quintile. None of the differences between installation rates are statistically significant. For the “shallow subsidy” in which respondents paid more than 25 USD for a latrine, we actually see decreasing installation as WTP rises (suggesting a counterintuitive negative screening effect). However, none of these differences are statistically significant, so no conclusions about such an effect can be drawn.

Sunk cost effects (the causal effect of price paid on installation) can be seen by reading down columns for a given WTP quintile. With the exception of the 5<sup>th</sup> quintile, there seems to be directional evidence of a sunk cost effect – respondents are less likely to install their latrine if they receive a subsidy, for any given WTP quintile. For example, among winning respondents who had a WTP within the 2<sup>nd</sup> quintile, only 17% installed their latrine if they randomly received a deep subsidy while 33% installed their latrine if they randomly received a shallow subsidy. However, it is important to note that none of these differences are statistically significant. Further studies with larger sample sizes are needed to answer more definitively whether subsidies do in fact decrease the percent of households who install their latrine.

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<sup>23</sup> Berry, J, Fisher, G, and Guiteras, R. “Eliciting and Using Willingness to Pay: Evidence from Field Trials in Northern Ghana”. Working paper, 2011.

<sup>24</sup> Gupta, S. K., Islam, M. S., Johnston, R., Ram, P. K., & Luby, S. P. (2008). The chulli water purifier: acceptability and effectiveness of an innovative strategy for household water treatment in Bangladesh. *The American Journal of Tropical Medicine and Hygiene*, 78, 979-984.

**Table 3:** % of BDM winners with installed latrines by Jan 2013, by WTP and subsidy level

Subsidy Level	WTP Quintile				
	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
Deep Subsidy (Price Paid = 5 USD)	22% n=18	17% n=6	9% n=11	13% n=15	29% n=7
Shallow Subsidy (Price Paid > 25 USD)		33% n=9	31% n=13	25% n=73	22% n=55
Multiple regression analysis indicates that none of the above fixed effects are statistically significant at the 5% level. Data reflects 205 observations from household surveys taken in August 2012 and January 2013.					

## Implications

As graph 3 shows, a moderate decrease in price would significantly increase latrine uptake. If the latrine price decreased from the average market price in the north of \$50 to closer to the \$35 market price in the Kandal and Svay Rieng, uptake would double from 20% to 40% of non-latrine owners. Moderate subsidies, a more efficient production and supply chain, or decreased delivery costs (by increasing the number of latrine producers) are potential strategies to decrease price and therefore significantly increase uptake of latrines.

## Question 2

### Seasonality and WTP

#### Motivation and Background

Anecdotal evidence suggests that willingness to pay for latrines may be higher after the rice harvest (January - March), given that households generally have more cash on hand during this time. While sales data collected by iDE shows a slight bump in sales after the harvest (in January), the interpretation of this slight increase in sales is unclear. It may represent a period of higher willingness to pay due to increased cash on hand, in which case a strategy of more intensive sales efforts post harvest could drive increases in latrine coverage. Alternatively, this sales bump could simply be due to greater availability of rural customers or greater activity of sales agents after the harvest (since they are not occupied on their farms), in which case a more intensive sales push post harvest would not yield significant increases in latrine coverage.

A randomized evaluation of latrine sales with a financing option (treatment group) vs. latrine sales with the regular cash on delivery payment (control group) was already planned for January-February 2013 (see Question 4 below for more details). This provided an opportunity to compare the WTP figures from the July - August 2012 study in the northern provinces with WTP figures from the control (cash on delivery) group in the January - February 2013 randomized evaluation.

#### Sampling Strategy

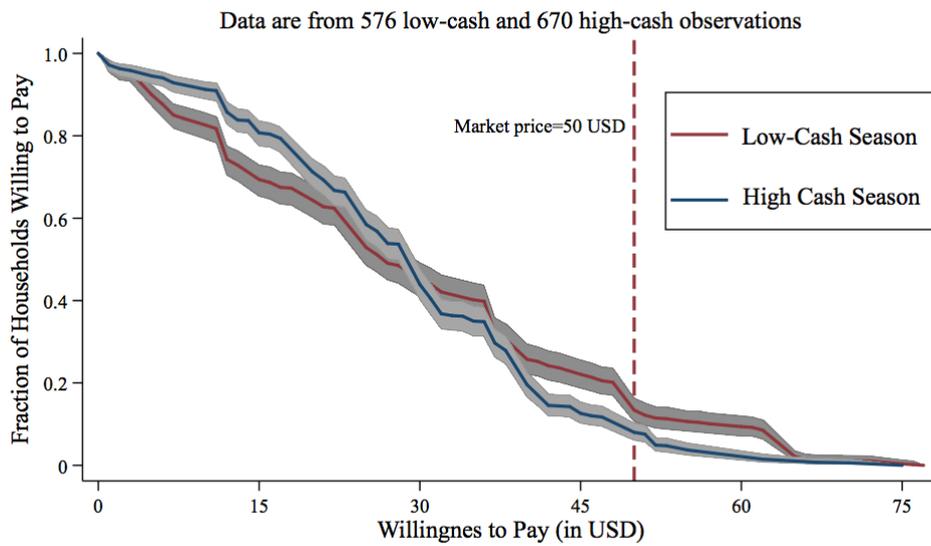
This study design used WTP data from Kampong Thom province gathered in July - August 2012 and compared it with WTP data from 15 randomly selected villages in Kampong Thom province in January - February 2013. The sales and payment process for both the 2012 and 2013 studies were the same, took place in the same geography and hence can be compared to give an indication of whether there are seasonal variations in WTP.

#### Results

As graph 7 below shows, there is little variation in WTP due to seasonality. Note that one cannot interpret this comparison as a causal, rigorously identified test of whether seasonality affects WTP. Since there could have been differences between the two study periods other than the harvest (e.g., sanitation education programs), we can only say that WTP in low-cash and high-cash seasons appear to be similar.

It is possible that rural Cambodians already have planned their consumption and this seasonal increase in liquidity after the harvest does not translate into a higher willingness to pay for a latrine. Savings or other planned durable goods purchases such as bicycles, clothing, radios or TVs may be higher priorities than latrines.

**Graph 7: Demand curve for latrines by season**



The x-axis indicates the price of the latrine in USD. The y-axis indicates the fraction of households willing to buy.  
The gray areas indicate 95% confidence intervals, computed using clustered standard errors.  
Low-cash observations were collected in Kampong Thom, Siem Reap, Odar Meanchey, and Banteay Meanchey provinces in July and August, 2012.  
High-cash observations were collected in Kampong Thom province in January and February, 2013

## Question 3

# Randomized evaluation of providing microfinance loans for sanitary latrines

### Motivation

As the WTP studies demonstrated, most households in rural Cambodia are not willing to pay for latrines at the current market price. However, it was unclear from the WTP studies whether this is because there is truly low demand for latrines in rural Cambodia or because rural Cambodians face cash constraints and cannot afford the \$50 lump sum payment for the latrine. Customer responses to our survey questions did not clarify this question. In order to test this hypothesis more rigorously and shed light on the potential for financing to increase latrine penetration in a cost-effective way, we ran a randomized evaluation that compared WTP for latrines when customers are offered a microfinance loan for the latrine compared to WTP when they must purchase the latrine with cash on delivery. The financing model and loan terms utilized in the study were based on the Sanitation Financing (SanFin) operational structure developed by PATH and adapted in partnership with iDE for use in the SMSU project. **This randomized evaluation answers the question, “what is the effect of offering financing for latrines on willingness to pay for latrines”?**

### Sampling Strategy

The sample frame for this randomized evaluation included all villages of Kampong Thom province, Cambodia. We randomly selected 30 villages to serve as our study sample to ensure they were representative of the province. Average values for the key variables – baseline latrine coverage, households per village, and percent of population below the poverty line – were not statistically significantly different between the 30 villages randomly selected for the study and the overall the sample frame. Within each village, a quick census was performed to determine all non-latrine owning households and the ID Poor status of each of these households. 15 ID Poor households were randomly selected from this, and 35 non-ID Poor households were randomly selected, for a total of 50 households per village.

### Methodology

Villages in the study were randomly assigned to one of two groups: cash on delivery or financing. These groups were not statistically different across the key variables, as demonstrated in Table 3 below.

**Table 3:** Baseline characteristics in control (non-financing) and treatment (financing) groups

	Non-Financing Villages	Financing Villages
% ID Poor*	25.5%	23.1%
Mean baseline latrine coverage*	30.0%	22.4%
Average market price*	48 USD	47.25 USD
Market price range*	42.50 USD to 57.50 USD	40.00 USD to 53.75 USD
# of villages	15	15

\* Differences are *not* statistically significantly different at alpha = .1

## Intervention Description

The “non-financing” group received the standard village latrine sales pitch, using BDM to determine the price they were willing to pay, with full cash payment required on delivery of the latrine. The “financing” group received the same standard village sales pitch, but was also offered loans specifically to finance the purchase of a latrine. The BDM game was used to determine their maximum willingness to pay in terms of *monthly installment*. The schematic below highlights the terms of the loan and how it was integrated into the BDM pricing game:

### *BDM Structure with financing – mimics standard village sales process closely*

1. Client receives standard village group and individual sales pitch
2. Client educated on financing package during group and individual sales pitch
3. Client plays BDM game - states desired maximum monthly installment payment to make over 12 months (as per terms below)
4. Client randomly draws a monthly payment from envelope. If drawn price is lower than bid price, must buy; if drawn price higher than bid, cannot buy

### *Financing Terms*

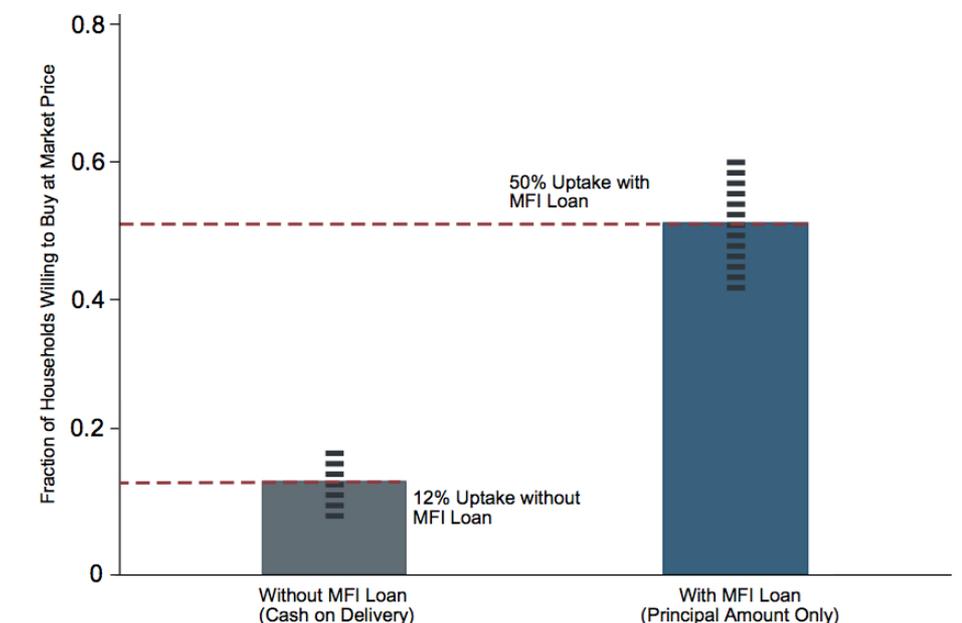
1. VisionFund loan package – 2.8% interest per month
2. Declining balance with monthly payments over a 12 month period
3. Group liability

Utilizing the PATH/iDE SanFin model, VisionFund Cambodia served as the microfinance partner for the financing villages and worked in close concert with the latrine sales team to ensure seamless coordination between sales and the approval and processing of latrine loans. A team of 8 sales agents was paired with one dedicated loan officer with the authority to make on-site loan approvals and coordinate the formation of joint liability groups at the time of sale. The sales agents were full-time staff visiting villages 5 days per work and were managed by a team leader. They received no commission for sales.

## Results

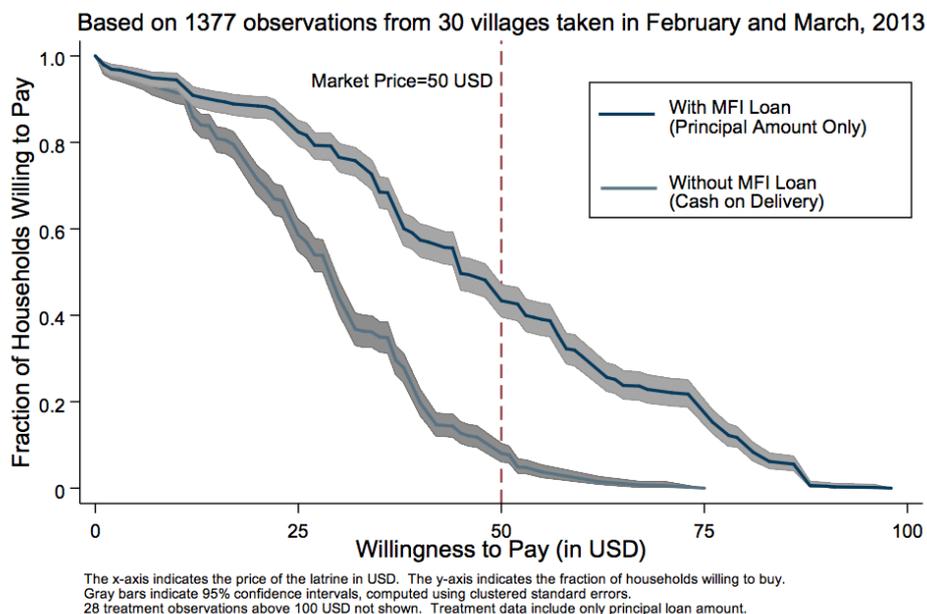
Offering a microfinance loan for a latrine dramatically increases customers’ willingness to pay. As graph 8 below shows, only 12% of non-latrine owners are willing to buy a latrine for the market price of 50 USD with cash on delivery, but 50% of non-latrine owners are willing to purchase a latrine at market price when offered a loan to finance the purchase. As the 95% confidence interval bars suggest, these results are highly statistically significant, with a p-value of 0.00 (clustering standard errors at the village level).

**Graph 8: Uptake of Latrines at Market Price with and without an MFI Loan**



As graph 9 below demonstrates, the percentage of non-latrine owners willing to buy a latrine at any given price point above \$10 is dramatically higher when they are offered a loan to finance their latrine. Note that the demand curve for the MFI Loan villages refers only to the principal amount. If the demand curve were to reflect the full principal plus interest the customers pay over the life of the loan, the distance between the two demand curves would be even greater.

**Graph 9: Demand Curve for Latrines with and without Financing**



### *Loan Approval and Repayment Rates*

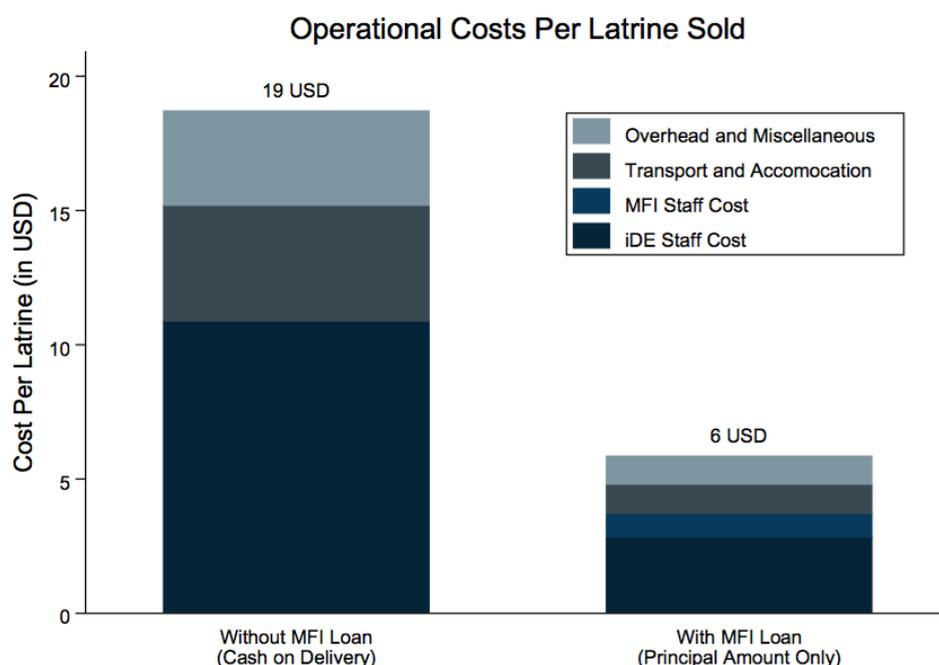
The loan approval rate for individuals who wished to purchase a latrine with financing was over 87% - a promising indication that the majority of those who wish to purchase a latrine with financing are credit worthy for 50 USD. Ultimately, however, the key test for the viability of financing as an effective sanitation intervention is if repayment rates are high. As of July 2013 (4 - 5 months after monthly payments began) repayment rates were 100%. Ongoing monitoring of repayment rates over the next 12 months is necessary to judge the ultimate viability of this approach, but initial indication and VisionFund experience with loans for other consumer products shows that repayment rates are likely to be high in rural Cambodia.

### *Cost-Effectiveness*

The dramatic increase in latrine sales in villages that were offered financing has important implications for the cost-effectiveness of the financing intervention. One of the largest costs of the program is the time of sales agents and their transportation costs to remote villages. Since sales agents made over four times as many sales per village meeting when loans were offered, the fixed cost of their time and transportation was spread out over many latrines. This more than compensates for the additional cost of the time and transportation of the VisionFund loan officers.

If we assume a direct-sales model approach (like that used in this evaluation), in which a team of 8 full-time sales agents and 1 loan officer travel from village to village making sales and processing loans, the projected sales and marketing cost ("operational cost") per latrine sold decreases from 19 USD per latrine without financing to 6 USD per latrine with financing. This represents a dramatic 70% decrease in operational cost per latrine sold. The "operational cost per latrine sold" refers to the cost of marketing and sales, and excludes the 50 USD cost of the latrine (which captures the latrine producers' construction costs, latrine delivery costs, and profit). This sales and marketing cost also excludes the initial costs that iDE invested in developing the low-cost sanitary latrine and in training concrete producers in how to create the latrines. Graph 10 below compares the breakdown of component operational costs of a direct sales model using a full-time sales force (similar to the model used in the study), with financing and without financing.

**Graph 10:** Operational cost per latrine sold, no financing vs. financing



## Implications and Recommendations

The results from this randomized evaluation show that providing financing for sanitary latrines has tremendous potential to cost-effectively increase sanitation in rural Cambodia. A four-fold increase in latrine sales with up to 70% decrease in operational cost per latrine sold provides strong evidence that latrine financing should be scaled up in rural Cambodia. Assuming 20% latrine coverage in rural areas as per the 2012 WHO/UNICEF Joint Monitoring Programme report,<sup>25</sup> this study indicates that an at-scale latrine financing program has the potential to increase latrine coverage to around 60%,<sup>26</sup> without having to provide any subsidies.

When considering scale-up of this model, however, it is critical to be attentive to several key factors to ensure that results at scale mirror those found in the study.

### *Key Operational Details of the Model*

Three key features of the SanFin operational model should be maintained in any future latrine financing program:

1. **Dedicated loan officers** – VisionFund assigned dedicated loan officers whose main responsibility was to travel with the latrine sales team so that they could immediately form liability groups among customers who wished to purchase a latrine. This minimized any errors or confusion that might arise from poor communication between sales agents and loan officers. 1 loan officer generally accompanied 8 sales agents to each village sales meeting.

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<sup>25</sup> Progress on Drinking Water and Sanitation, WHO and UNICEF, 2012 Update.

<sup>26</sup> 50% of non-latrine owners in the study were willing to buy a latrine at market price with a loan. Given that 80% of households in rural Cambodia do not own a latrine, offering latrine financing can reach half of this 80%, which when added to the current 20% coverage, yields a total latrine coverage rate of 60%.

2. **On-site loan approval** – The dedicated loan officers were given authority to approve customers for loans at the time of sale. This allowed for a seamless sales process and prevented any uncertainty among customers as to whether they would be approved for a loan. Over 90% of those who wished to purchase a latrine were deemed credit-worthy and received a group liability loan.
3. **Well-managed, full-time, salaried sales force** – Having a dedicated team of full-time, salaried sales agents will make it easier to coordinate with loan officers than a decentralized model of sales agents who only earn a commission per sale. Furthermore, our experience is that a full-time sales team that is well-managed will cover more villages than a decentralized team of “sanitation teachers” that only receive compensation based on commission. A full-time sales team that travels in small groups (with 1 loan officer per group) can cover an entire village in one day, whereas a lower ratio of sales agents to loan officer does not effectively utilize the time of the loan officer, thereby increasing cost per latrine sold.

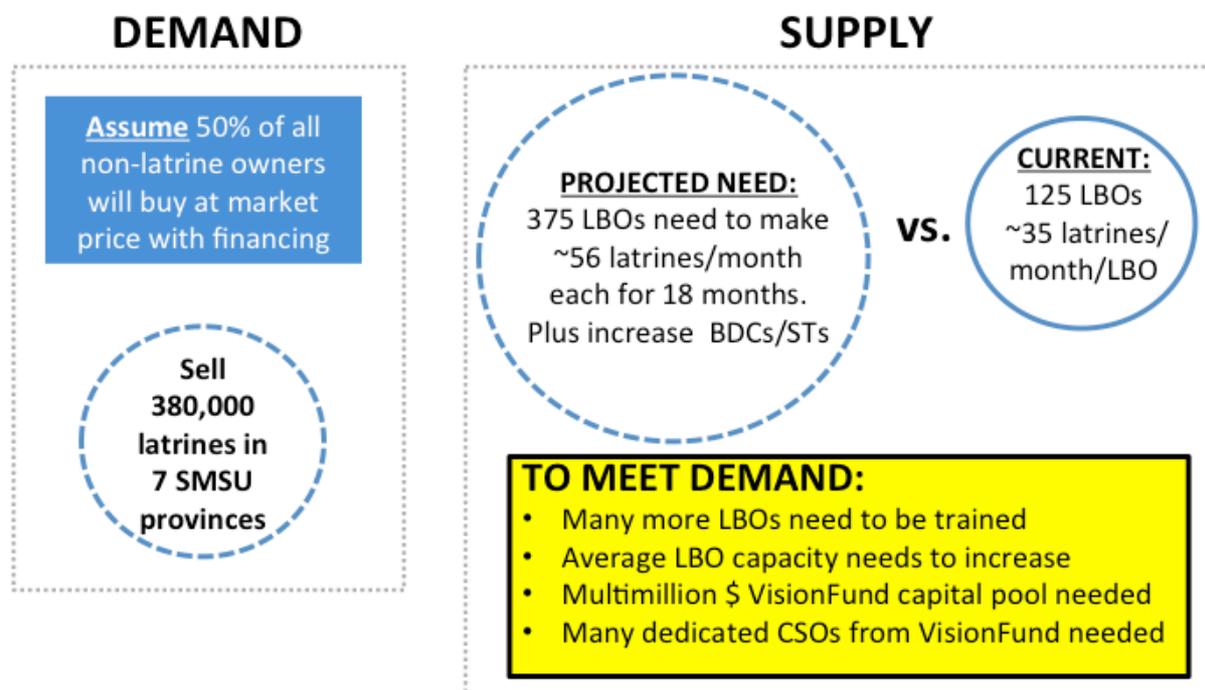
#### *Implication of findings beyond Kampong Thom province*

This study took place in a representative subsample of villages in Kampong Thom province, and thus is generalizable at the very least to rural Kampong Thom. However, as graph 5 above shows, willingness to pay for latrines is roughly the same in the four northern provinces of Kampong Thom, Oddar Meanchey, Banteay Meanchey, and Siem Reap. These provinces also have roughly the same levels of latrine coverage and ID Poor households. Thus, the findings are likely generalizable to these provinces as well. While the exact increase in sales with financing might vary from village to village in rural Cambodia, the sheer size of impact and relatively low levels of latrine coverage and access to credit for consumer products indicate that the results are likely generalizable to most of rural Cambodia. As iDE expands into different regions of Cambodia, it should critically assess whether the findings in this study will generalize to its new areas of operations. Key characteristics to be considered when assessing external validity of the findings include low baseline latrine coverage and minimal access to consumer financing for latrines comparable to that in the study province.

#### *Managing Scale-Up*

Latrine financing has the potential to increase demand for latrines more than four-fold in rural Cambodia. As Figure 1 below demonstrates, this means that scaling-up latrine financing will require a massive increase in the production capacity of iDE-associated latrine producers and a concomitant increase in the number of sales agents. Furthermore, scale-up will require a microfinance organization that can raise a large capital pool and handle a dramatic increase in loans to be processed.

**Figure 1:** Increase in supply of latrines and financing needed to meet increased demand that would arise from scale-up of latrine financing



In order to manage such a large increase in production without sacrificing quality of implementation, we recommend the following approach:

1. **Identify a highly competent manager to manage the scale up** – The latrine financing program requires a high degree of coordination between the MFI, latrine producers and in-house sales agents. iDE should hire one manager who oversees all aspects – both hiring and managing a team of in-house sales agents and coordinating with the latrine producers and MFI loan officers.
2. **Sign MoU with a flexible, high-quality MFI** – Scaling up latrine financing will require an MFI (such as VisionFund Cambodia) that is able to manage a large team of dedicated loan officers with authority to grant on-site loan approval. Furthermore, scale-up will require the MFI to raise a substantial capital pool of several million USD. iDE should sign an MoU early on with the right MFI(s) in order to give the MFI sufficient time to hire extra loan officers and managers and raise the required capital pool for scale-up. The gradual, stepwise approach to scale-up outlined below will make it easier for the MFI to manage the increased work that will accompany scale-up.
3. **Start in one commune** – Start in one commune to refine all details of implementation and coordination between the different actors involved. Aim to target every village in the first commune. Restricting operations to a narrow geography will decrease management and coordination challenges and facilitate learning for the new manager.
4. **If successful in saturating one commune, expand to saturate one province** – If operations are running smoothly, expand to one province. This again allows for easier management than coordinating between multiple provinces. If there is

indication during phase 2 (saturating one commune), then the team should begin to train new latrine producers in the rest of the province, as needed.

5. Increase training of latrine producers in other provinces and raising of capital pool while saturating first province.
6. Scale up across all 7 of the Sanitation Marketing Scale-Up provinces.

While these six steps outline a high-level approach to scaling-up latrine financing in rural Cambodia, a detailed operational plan highlighting hiring, training, coordination, fundraising and implementation rollout will be necessary before commencing scale-up and should be led by the manager in charge of scale-up.

## Conclusion and Areas for Future Research

This set of field experiments has five main findings:

1. A minority of non-latrine owners (between 3% and 20% depending on the context) is willing to pay cash on delivery for a sanitary latrine at its current market price in rural Cambodia.
2. Willingness to pay for latrines does not vary significantly by season.
3. Large subsidies are needed to dramatically increase latrine uptake.
4. Offering microfinance loans for latrines increases uptake of latrines fourfold at market price, from 12% to 50% of non-latrine owners.
5. Microfinance loans for latrines decreases operational cost per latrine by up to 70% due to significantly higher volume of sales.

These findings lead to one clear directive for iDE Cambodia – it should scale-up financing for latrines in order to cost-effectively increase access to improved sanitation across rural Cambodia. In addition to this main implication, the research findings suggest several areas of further research.

First, as the section on latrine usage demonstrates, there is a time lag between purchase of the latrine and its installation and usage. Our research suggests that one of the leading drivers of this time lag to installation is that rural Cambodians prefer to wait until they have the money to purchase a concrete or brick shelter before installing and using their latrine. Given that cash constraints are an impediment to purchasing a \$50 latrine, the same is also likely true of the more expensive latrine shelter. Further research should be pursued into designing a less expensive shelter and exploring whether financing can increase purchase of latrines and decrease time to installation.

Second, iDE should explore whether financing can be applied to increase uptake of similar durable purchases for which there is minimal financing and low uptake. The findings of this study should certainly not be interpreted to suggest that financing will increase uptake of any such products, but it would be worth exploring whether there are similar health or productivity enhancing products for which consumer financing may be necessary.

Lastly, even if latrine financing is scaled-up, there is still a substantial portion of the population in rural Cambodia that will continue with unhygienic sanitation practices. As iDE scales up latrine financing, it should simultaneously gather evidence and develop hypotheses on potential ways to provide improved sanitation to these remaining portions of the population. These potential solutions should be piloted in the field and then subjected to rigorous impact evaluation in order to scale up the most cost-effective intervention, as was done with latrine financing.

Most immediately and importantly, however, iDE has rigorous evidence that sanitation financing an extremely cost-effective way to dramatically increase uptake of sanitary latrines in rural Cambodia. It should focus its present energies on judiciously scaling up latrine financing. If iDE is successful in its scale-up efforts, it will have made a significant dent in the challenge of increasing access and use of improved sanitation for millions of Cambodians.

# Appendix 1: Becker-deGroot-Marschak Mechanism

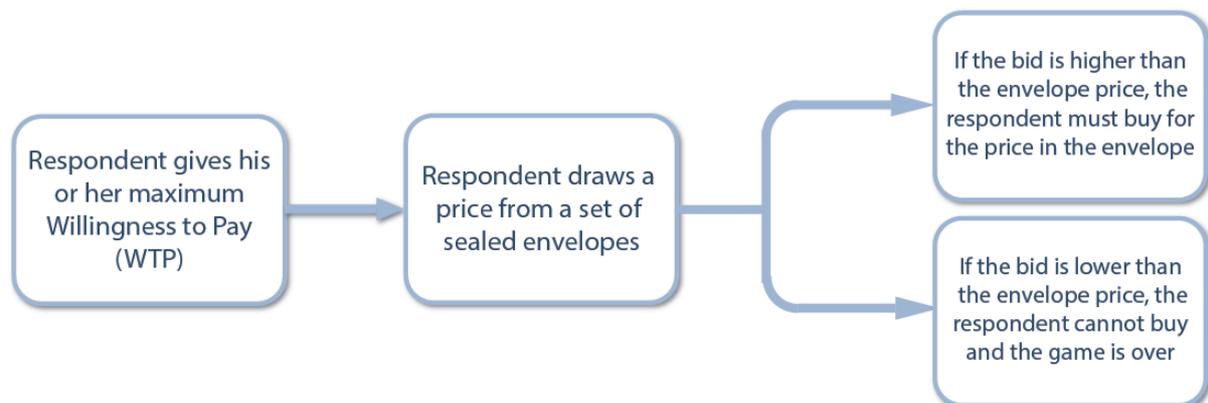
## Background on BDM

Developed in the 1960's by three economists, the Becker-de Groot-Marschak mechanism is a pricing game used to determine the value a particular individual places on a product. The rules of the BDM are as follows:

- The respondent gives his or her maximum willingness to pay for a product.
- The respondent chooses a draw price at random.
- One of two things then happen:
  - If the draw price is *higher* than the bid price, the respondent loses and the game is over.
  - If the draw price is *less than or equal to* the bid price, the respondent wins the game and *must buy* the product for the draw price.

In practice,<sup>27</sup> the respondent is allowed to revise their bid several times before settling on a final bid to ensure they understand the rules. Figure 2 below is a diagrammatic representation of the BDM game.

**Figure 2: Flowchart of BDM game rules**



The BDM game is not the only way to measure a respondent's WTP for a product. IDinsight considered a range of possible pricing games before deciding to use the BDM game. Below is a discussion of different aspects of the game IDinsight considered in its decision.

## Incentive Compatibility

The key challenge in measuring WTP is ensuring an accurate answer. In order to do this, a methodology must be *incentive compatible*, that is, it must be in the respondent's interest to give his or her actual WTP. The top box in the last step of the BDM game diagram (Figure 2)

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<sup>27</sup> In practice, every interaction with a respondent would have three phases after the sales pitch for the latrine: 1) explanation of the rules of the BDM game; 2) trial of BDM with a low price product, usually a pack of Oreo cookies with a retail value of \$0.50; 3) BDM game for the latrine

holds to the key to the BDM game's incentive compatibility. If the respondent wins, he or she pays *the price drawn*, and not his or her bid price. To see that it is in the respondent's best interest to give his or her exact willingness to pay, suppose the respondent bids some amount  $x$  less the exact willingness to pay  $y$ . If the respondent draws a price  $p$ , and  $p$  is between  $x$  and  $y$ , then the respondent forgoes a  $y-p$  discount on the latrine. That is, if a respondent bids 15 USD when her actual WTP is 25 USD, and draws a price of 20 USD, then she is unable to buy the latrine and has to forgo the 5 USD discount she would have received if she bid her actual WTP. Since this is true for all prices less than the respondent's willingness to pay, it is optimal for the respondent to give his or her exact maximum willingness to pay.

### **Amount of Information**

Mapping the demand curve means measuring what fraction of households will buy a product across a range of prices. Among the pricing games used to map a demand curve, there are two types of outcomes: binary outcomes, where the respondent either buys an item or does not and continuous outcomes, which measures the exact amount the respondent will pay for an item. A binary outcome gives a response to only one offer price, while an exact measure of a respondent's willingness to pay allows us to extrapolate whether he or she would have bought at other offer prices. More concretely, if a respondent buys a latrine for 30 USD, then we know her willingness to pay is some amount greater than or equal to 30 USD. On the other hand, if we know a respondent's WTP is 38 USD, then we know that she will buy a latrine if it is 38 USD or less but will not buy it above 38 USD. Hence, measuring the exact willingness to pay gives us more information and allows us to have a smaller sample size to map the demand curve relative to other techniques.

### **Accuracy of Responses**

While BDM is theoretically incentive compatible, this does not necessarily mean it gives accurate WTP estimates in practice. There have been a number of studies comparing BDM and other pricing games in the economics literature.<sup>28,29,30</sup> These are often carried out for relatively cheap products in developed economies. In these cases, BDM appears to perform well. It is less clear, however, how well BDM performs in a low-income context for a relatively expensive product, such as a latrine.

Berry *et al*, 2011, used a randomized experiment to compare the estimates of BDM and TIOLI in measuring WTP for chlorine dispensers for clean water in Ghana. They find that BDM may slightly underestimate WTP for a product relative to take-it-or-leave-it methodology.<sup>31</sup> BDM does not, however, seem to vastly underestimate the magnitude of WTP relative to take-it-or-leave-it. Based on this paper, we decided that the richness of information BDM provides was worth a small downward bias in our results.

### **Numeracy and Understanding in Rural Cambodia**

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<sup>28</sup> Noussair, Charles, Robin, Stephane & Ruffieux, Bernard, 2004. "Revealing consumers' willingness-to-pay: A comparison of the BDM mechanism and the Vickrey auction," *Journal of Economic Psychology*, Elsevier, vol. 25(6), pages 725-741, December.

<sup>29</sup> Kaas, K.P., Ruprecht, H. (January 2006). "Are the Vickrey Auction and the BDM Mechanism Really Incentive Compatible? Empirical Results and Optimal Bidding Strategies in Cases of Uncertain Willingness-to-pay". *Schmalenbach Business Review* 58: 37-55.

<sup>30</sup> Shavit, Tal, Shahrabani, Shosh, and Benzion, Uri, 2006. "WTP-WTA disparity among competitive and non-competitive subjects - an experimental study". *Applied Financial Economics Letters*; 2(5):333-336.

<sup>31</sup> Berry, J, Fisher, G, and Guiteras, R. "Eliciting and Using Willingness to Pay: Evidence from Field Trials in Northern Ghana". Working paper, 2011.

Before deciding to use the BDM game, IDinsight piloted the BDM game against the Take It Or Leave It game. Starting with well-educated professionals in Phnom Penh and working slowly towards remote villages in isolated areas of Cambodia, IDinsight found at each stage that respondents understood and even liked the game. The BDM game evidently meshed well with the Cambodian idea of a “lucky draw”, which is how many respondents described the game. Based on this piloting, IDinsight decided that the game would be relatively straightforward to carry out in rural Cambodia.

### **Sunk Costs and Screening Effects**

BDM has the further advantage of being able to tease out the “sunk cost” and “screening effects”.<sup>32</sup> The BDM game tells us the respondent’s maximum WTP but also presents that respondent with a randomly chosen price. With these two pieces of information (WTP and price paid), we can determine the effect of price paid on latrine usage, conditional on WTP, and what is the effect of WTP on latrine usage, conditional on price paid. The sunk cost and screening effects will be estimated and reported in a follow-on study to this report.

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<sup>32</sup> A sunk cost effect is the (possibly irrational) effect of previous payment or investment in a particular product on the use of that product. A screening effect occurs when a respondent’s internal valuation of a product causes a different change in use of that product.