# ESTIMATING THE ECONOMIC BENEFITS OF MARKET-BASED SANITATION PROGRAMS

## Model Design and Application

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## Abbreviations and Acronyms

ADB – Asian Development Bank
CTP – Cost to Participant
DNE – Does Not Exist
DRWS – Department of Rural Water Supply
EI – Economic Impact
GDP – Gross Domestic Product
JMP – Joint Monitoring Program
KHR – Cambodian Riel
MOI – Market of Interest
NGO – Non-governmental Organization
Non-SP – Sanitation Provider (not directly support by WaterSHED)
RCSAS – Rural Consumer Sanitation Adoption Survey
SB - Sanitation Benefit
SDG – Sustainable Development Goals
SP – Sanitation Provider (directly supported by WaterSHED)
TMV – Total Market Value
TSB – Total Sanitation Benefit
TSRWSSSP – Tonle Sap Rural Water Supply and Sanitation Sector Project
TSV – Total Subsidy Value
USD – United States Dollars
UNICEF – United Nations International Children's Emergency Fund
VA – Value Added
WASH – Water, Sanitation and Hygiene
WHO – World Health Organization

# Introduction

Over the past decade, the market-based approach to sanitation has become an increasingly popular modality for improving sanitation outcomes in emerging economies. Proponents have declared this approach as a sustainable way to grow the market for key sanitation products in underserved areas and reach bottom of pyramid consumers. The approach appears to not only improve the state of sanitation within these areas, but also to have positive knock-on effects for the local economy. Although a substantial and growing body of evidence supports these claims, a model to estimate the economic benefits of market-based sanitation has yet to be developed. This leaves donors and developing country governments with incomplete information to go on when deciding whether to invest in such programs or to continue funding sanitation programs, which provide households with the same products for free or at a subsidized cost.

To this end, this paper suggests a model to estimate the economic benefits of market-based sanitation programs. The model should not be understood as a definitive yardstick, which can be applied to all market-based programs or as a comprehensive 'whole economy model' which accounts for all market interactions resulting from a given program's activities. Rather, the model should be viewed as a conceptual framework for how to think about the economic benefits resulting from market-based programs. This includes both the *downstream* economic benefits to households that purchase sanitation products and services as well as the *upstream* economic benefits to the market actors that produce them. The application of the model will vary according to the specific nature of the program being assessed, and the accuracy and robustness of findings is highly dependent on the availability of data for a given program and the area in which it operates. It is hoped that the model will provide those working in the WASH sector with a new tool for assessing market-based sanitation programs, which can be tailored to different contexts and improved over time.

This paper provides a Conceptual Framework for the model and then applies it to WaterSHED's *Hands-Off* sanitation marketing program in rural Cambodia. The paper also applies the model's concepts to a subsidy-based sanitation program. This yields comparable metrics between the two approaches, which can help donors and policy makers make more informed sanitation investments.

## Bridging the Conceptual Gap in Existing Research

Within the past two decades, numerous studies have been conducted on the cost-effectiveness of subsidy-based sanitation programs. These are programs in which targeted poor households are provided with a latrine or other sanitary products or services for free or at a subsidized cost. For the most part, these studies calculate the economic benefit of improved sanitation experienced by households in the program.[1] Improved sanitation within the household leads to an increase in healthy, productive working days for household members, lower household expenditure on healthcare and fewer incidences of premature death. This, in turn, increases the household's economic output and the growth of the wider economy. Relatedly, households that do not own a latrine must spend a significant amount of time waiting to use shared public toilet facilities or travelling to a place to practice open defecation. Households that own a latrine have relatively more time to spend on economically productive activities, resulting in greater economic output. These economic benefits from owning a latrine, hereafter referred to as 'sanitation benefits' (SB), are then compared to the cost of the subsidy program to determine its cost-effectiveness. These studies have been instrumental in making the business case for subsidy programs to donors and developing country governments.

[1] For further details on the nature of these studies, see Hutton (2001). This seminal text discusses the various methodologies used to determine cost-effectiveness of water and sanitation interventions.

While these studies provide useful insights into the 'downstream' impact of these programs to consumers, they do not capture the 'upstream' impact on producers. These cost-effectiveness studies operate under the assumption that the sanitary products are produced outside of the local economy and the benefit or determinant of the program on local producers is seldom considered. Within the WASH sector there has been considerable debate regarding the potential displacement effect that subsidy-based programs can have on the local economy, whereby local producers cannot compete with the program's subsidized products. Some subsidy programs do source a proportion of their sanitation products from local producers, which can serve to support the local economy. However, it is often the case that local markets cannot produce sanitation products at the scale necessary for large subsidy programs. Similarly, the administrative burden and costs of interacting with a multitude of small, local producers can also be prohibitive. An in-depth analysis of the upstream economic impacts of subsidy-based programs on local producers is beyond the scope of this report. Suffice it to say that this is not deeply explored by existing cost-effectiveness studies and is an important area for further research.

Unlike the subsidy-based approach, the market-based approach places significant focus on 'upstream' economic benefits, with the objective of growing the local market for sanitation products. Consequently, applying the same cost-effectiveness methodology from the subsidy-based approach to the market-based approach would fail to capture much of its benefit. Such models do not account for the increase in revenues and profits to local producers that come as a result of these programs, nor the increase in jobs or impact on local wages. Although market-based sanitation programs are relatively new, they are beginning to capture some of these metrics, with promising results. However, these are stand-alone metrics and do not take into account the 'downstream' costs to consumers. Unlike the subsidy-based approach, there is no exogenous injection of capital into the local economy. No external organization is paying the full or partial cost of the sanitation product. Rather, the market-based approach generally requires that consumers bear the full cost.

***Table 1: Current Methodologies for Measuring Impact***

| Sanitation Approach | Methodology for Measuring Impact | Inside the Scope of Analysis | Outside the Scope of Analysis |
|---|---|---|---|
| Market-based | Stand-alone indicators | • Total products sold<br>• Revenues and profits to local producers<br>• Employment and wages | • Economic impact due to labor productivity gains and time savings (relative to cost to consumer) |
| Subsidy-based | Cost-effectiveness studies | • Total products distributed/sold<br>• Economic impact due to labor productivity gains and time savings | • Revenues and profits to local producers<br>• Employment and wages |

In short, the metrics for success for these two approaches are different, making direct comparisons difficult. Furthermore, taken in isolation, none of these existing measurements of impact are capable of capturing the total economic benefits and costs of either approach. This model ambitiously attempts to pick up where other studies have left off. It measures the change in the costs and benefits to both consumers and producers due to the market-based approach. In doing so, it attempts to bridge the conceptual gap between the analysis used for both types of approaches and provide a fuller picture of sanitation programming's effects on the local economy.

## Conceptual Framework

A bewildering variety of programs are considered 'market-based', making a single, comprehensive definition problematic. However, the following two objectives apply to the wide majority of market-based programs.

1. Increase the number of people owning product(s) or receiving service(s) that in some way improves the social or economic wellbeing of the owner or society in general.
2. Build and strengthen local market systems to operate as a sustainable medium for supplying these product(s) or service(s).

These objectives imply that the model should: 1) measure the extent to which a program 'builds' a market for a given product and 2) measure the impact of market output (i.e. the product or service) on consumers' wellbeing and the wider economy. To do so, the model first defines a market of interest (MOI), then compares the total number of products sold and the product's average market price between two different scenarios: one in which the program exists (*Program Scenario*) and one in which it does not exist (*DNE Scenario*). This comparison gives an indication of how the market of interest transforms as a result of the program, both in terms of its efficiency and total output. The change in efficiency and total output can then be used to calculate the change in upstream costs and benefits to producers and downstream costs and benefits to consumers as a result of the program. These metrics can then be used to calculate the program's impact on the wider economy. The following section provides a detailed explanation of these concepts and also lists the model's assumptions and limitations.

### The Market of Interest

A market of interest (MOI) must be defined as a parameter for the model. The MOI is defined by three dimensions; product, target market and time.

1. Product: The product(s) or service(s) sold in the market of interest.
2. Target market: The total population to which the product(s) or service(s) is/are promoted/made available.
3. Time: The period over which the product(s) or service(s) is/are promoted/made available to the target market.

At a minimum, the target market should be defined by a geographic area. It should include the program's existing or intended operational area and preferably be delineated according to government administrative boundaries. This allows for more accurate estimates of the size and demographic characteristics of the target market. Depending on the objectives of the program and available data, the target market can also be stratified or limited to one particular subgroup. For example, a program may be only interested in its impact on households living under the poverty line.

The timeframe should include the entire period over which the program is attempting to build the market and to increase transactions of the product(s) or service(s) in the target market. However, this period can be difficult to define for market-based programs. A proportion of market actors will continue to offer the product(s) or service(s) after the program has ended. As such, the model may understate the effect. The date at which this model is applied is one possible endpoint. This measures only the program's impact to-date. It is also possible to forecast the future impact of the program, though with an admitted tradeoff in accuracy. Doing so may be desirable for assessing a program's contribution to national or international policy targets such as government five-year plans or the Sustainable Development Goals (SDG).

## Demand, Efficiency and Total Market Value

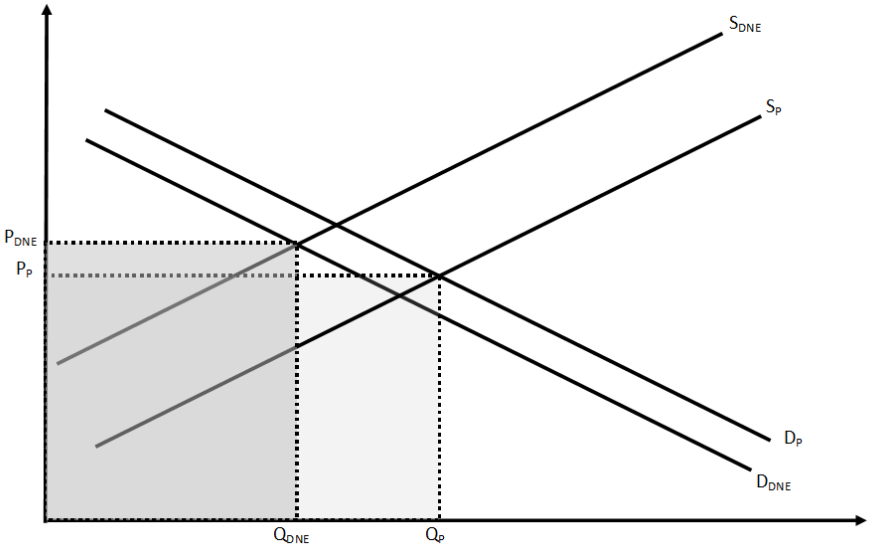
After a market of interest has been identified, it is necessary to determine how the program activities interact with and transform the market. For the sake of simplicity, the model assumes only two categories of program activities, based on their effects on the market of interest.

1. Demand fulfillment: Market-based programs support market actors through various activities so they can provide their products or services to consumers at a lower price. Examples include: product design support, technical and professional skills training, and removing barriers to or supporting bulk purchases of product inputs.
2. Demand activation: Market-based programs conduct various activities to increase consumers' perceived value of a given product or service, thereby helping to convert their intent to purchase into a decision to purchase. Examples include: social marketing campaigns and the use of sales agents.

These two types of activities change the relationship between supply and demand in the market of interest. Activities that increase market efficiency, decrease the product's market price.[2] In the context of this model, this is not the price of a product or service, but rather the total cost to a consumer to make use of the product or service. Depending on the nature of the product or service, the market price may include retail mark-up, sales commission, shipping, and installation. An increase in market efficiency shifts the market's supply curve to the right. This is illustrated below in the difference between the supply curve of the of the DNE Scenario ($S_{DNE}$) and the supply curve for the Program Scenario ($S_P$). At any given quantity, the market price will be lower under Program Scenario than the DNE Scenario. At the same time, activities that generate demand cause the market's demand curve to shift to the right. This is illustrated as the difference between the demand curves of the DNE Scenario ($D_{DNE}$) and the Program Scenario ($D_P$). At any given market price, consumers are willing to buy a greater quantity of products or services under the Program Scenario than the DNE Scenario.[3]

[2] This holds true when prices are not perfectly inelastic.
[3] The supply and demand curves pictured here are for illustrative purposes only and not used for model estimates. The model uses a variety of data sources to estimate the total number of products sold and the market price for both Program and DNE Scenarios.

*Figure 1: Example of Supply and Demand Curve Shifts*




The point at which the supply and demand curves meet is known as market equilibrium. This point predicts the total quantity of products or services sold at a given market price. These figures can be multiplied to provide the Total Market Value (TMV). The shift of both supply and demand curves under the Program Scenario, means that the market equilibrium changes as does the TMV. In other words, the program leads to a change in the total number of products or services sold and the market price per product, resulting in a change in the market's total value. The graph above illustrates a scenario in which the improvement in market efficiency (demand fulfillment) has outpaced the increase in demand (demand activation). This shifts the market equilibrium down and to the right. This indicates a larger quantity of products sold at a lower price due to the program.

TMV is a useful metric, because it gives a sense of the size of the market. It can also be disaggregated to find the value of all the inputs required to offer the product or service. These inputs represent the upstream economic benefits to the producers. For example, if the proportion of business profit or employee wages is known on a unit basis, this proportion can be applied to the TMV to estimate the total business profits and employee wages generated by the market as a whole. The TMV is also equal to the total downstream cost to consumers. Therefore, a large TMV is not necessarily a good project outcome. By itself, TMV does not yield a significant amount of useful information and should always be discussed in its relation to the number of transactions. For example, a market-based program could theoretically decrease the TMV if the Program's impact on market efficiency was substantially greater than its impact on demand generation. This is still considered a successful program, but one would not see this just by looking at the TMV. Conversely, a market that becomes less efficient while maintaining the same number of transactions would experience an increase in TMV. In this situation, consumers are actually worse off. Market-based programs should only attempt to 'grow' markets in terms of their total output (i.e. number of transactions) while maintaining or improving market efficiency. This 'lean' market growth results in both upstream benefits for producers and downstream benefits for consumers.

It is also important to note that TMV is not a reliable measure of economic impact. Market value, as it is defined here, is a result of consumer spending. This spending is endogenous to the local economy, resulting in a substitution effect. If a household decides to purchase a latrine, the money spent

increases the TMV of the latrine market. However, if the household decided not to purchase a latrine, at least some of that money would have been saved, spent or invested elsewhere in the local economy.[4] TMV growth can be understood as the reallocation of resources within an economy from one sector to another, which may or may not result in overall economic growth.

## Economic Growth

Rather than trying to account for this substitution effect, it is much easier to measure the impact of a MOI on the wider economy by comparing the MOI's inputs and outputs. Actors operating within a market can been seen as part of the production function, because they take in multiple inputs and convert them into a product or service with a given economic value.

### *Inputs*

This model defines inputs as everything required for the production and delivery of a ready-to-use product or service to the end consumer. These inputs and their associated costs represent not only the businesses that offer the product or service but all actors within the market of interest that contribute. Depending on the nature of the market, this may include: retailers, sales agents and businesses that transport and install the product. The aggregate cost of all inputs represents the market price as defined by this model. Therefore, the value of all inputs into the market is equal to the TMV.

### *Outputs*

Calculating the value of all market outputs relates back to the original assumption that market-based programs promote products or services that create some social or economic benefit to households or society in general. In the case of household latrines, customers experience a sanitation benefit (SB). Improved sanitation within the household leads to a decrease in the prevalence of disease. This results in lower healthcare costs for the household, improved labor productivity and a deduction in the premature deaths. In addition, households that own a latrine do not have to wait to use public toilet facilities or travel to a place to practice open defecation. This frees up time for economically productive activities. The time savings and improved health outcomes due to latrine ownership results in increased economic output for the household, thereby contributing to wider economic growth. As previously discussed, many studies estimate this 'sanitation benefit' (SB) for subsidy-based programs. The same type of methods can be used here to calculate the SB for market-based programs. Multiplying the SB per unit by the total quantity yields the Total Sanitation Benefit (TSB) generated by the Market of Interest. In short, the TMV is equal to the total cost to the economy to produce the products and services, while the TSB is the total benefit generated by the products and services. The ratio of TMV:TSB can be thought of as the market of interest's efficiency ratio. This is a measure of how efficiently it converts inputs into outputs. For example, if a latrine market has an efficiency ratio of 1:4, then every dollar spent on latrines by rural consumers generates four dollars of value to the economy. The market's value added (VA) to the economy can be calculated by subtracting the TMV from the TSB, expressed as:

TSB – TMV = VA

[4] The total increase in one market is not necessarily equal to the total decrease in other markets in the local economy. The substitution effect is determined by a variety of factors and estimating the extent to which it occurs in a given economy entails complex calculations based on data that is not always readily available. Inter alia, the substitution effect is dependent upon factors such as: the definition of local economy, the bundle of products households typically buy and the extent to which products in the bundle are produced within the local economy, the velocity of money through the economy, and how the household financed their purchase. For example, they could reduce spending on other products or increase their productive output (e.g. working more hours) to earn more money.

The model can then determine the Program's economic impact (EI) by finding the difference between the VA in the Program Scenario and the DNE Scenario, expressed as:

$VA_P - VA_{DNE} = EI$

Just like an exogenous injection of capital, the increase in economic wealth due to the program will cause a ripple effect through the wider economy as it is spent, re-spent and reinvested, changing hands from one market actor to another. If available, it is possible to apply a regional multiplier to determine the full economic impact of the program.

## Assumptions

The model is based on two assumptions about the nature of the market as well as consumer behavior. These are listed below.

1. **Households in the target market in both the Program Scenario and DNE Scenario would not spend their income on other items that improve their productive capacity.** For example, households that purchase a latrine are not reallocating money that they would have otherwise been used to pay for children's school fees or purchase productive assets like a sewing machine or rice tiller. Doing so would result in a substitution effect, resulting in lower than estimated economic growth in the local economy. While a proportion of household spending inevitably goes toward other productive assets, it is beyond the scope of this model to determine the economic returns of those assets. Therefore, the sanitation benefit in the model is likely overstated to some degree.
2. **Latrine producers and their employees live in the same areas as their customers and also spend their income on the same 'bundle of goods'.** The market-based approach claims to support local economic growth. Although the 'local economy' is difficult to define, it is important that the latrine market is locally based and does not pull capital out of the local economy. For example, if latrines are produced by a large business located far from its consumer base, then the money consumers spend on latrines will not remain in the local economy. If latrine producers are located in the same area as their customers, then their income from latrine sales will mostly remain in the local economy. Of course, the producers may spend their income on products that are imported from other areas such as motor vehicles or mobile phones, but there is no reason to assume that their spending patterns will be significantly different from those of their customers, who also consume some imported products.

## Limitations

The stylized nature of the model implies several limitations (listed below), which prevent it from fully capturing the complexity of market-based programs. Where possible, this model should be used in conjunction with other tools to provide a more comprehensive picture of the economic benefits of the market-based approach.

- **Positive externalities outside the market of interest:**
    - **Improved market efficiency in other product markets:** Market-based programs typically provide training to professionalize small businesses, covering such topics as

booking keeping, inventory management and customer engagement. This can reduce a businesses' operational costs, which in turn, can reduce the price to consumers of all the products and services the business produces; not just the product or service the program is trying to promote. In essence, the market-based approach can improve the efficiency of multiple product markets. This positive externality is not accounted for in the current model, which only assesses the program's impact on the market of interest.

- **Product sales outside geographic or demographic boundaries of the target market:** Businesses engaged by the program may sell their products or services to individuals not included in the target market. This is especially true for businesses located close to administrative boundaries, like the boarder of a state or province. Similarly, demand generation activities, such as social marketing campaigns, may generate demand for the products and services in geographic areas outside the target market. This is especially the case when using mass media and when marketing tools are adopted by businesses operating outside the target market.

- **Consumer convenience and time savings:** Individuals in underserved markets often have to invest substantial time and effort to acquire certain products or services. For example, building a latrine in rural Cambodia often required hiring a mason, agreeing on design details, materials and cost. Customers are also typically responsible for sourcing latrine construction materials, which means travelling to several shops to attain all the necessary hardware.[5,6] Market-based programs strengthen local systems to provide consumers with finished products and services where they live, thereby freeing the customers' time for economically productive activities.
- **Higher utilization of productive assets:** Small businesses, which experience an increase in product sales may gain more value out of productive assets due to a higher rate of utilization. For example, a small business owns a delivery truck that is seldom used due to low demand for its products. If sales increase, then the truck will be used more often.
- **Accounting for the impact of other sanitation programs in the market of interest:**
  - **Attribution is difficult:** It is often the case that multiple sanitation programs occur within the same market of interest. Therefore, the difference between the Program and DNE Scenarios is the result of combined actions; not just the program being assessed by the model. Demand generation is particularly difficult to attribute to a single program. If a household is exposed to the social marketing campaigns of two different sanitation programs and buys a latrine, it is difficult to determine the extent to which each campaign contributed to the purchase.
  - **Positive and negative synergies:** The combination of programs in a given market of interest can lead to positive or negative synergies. For instance, a subsidy-based program may operate in the same market of interest as a market-based program. If the market-based program helped to establish local latrine suppliers and also reduced the price of latrines, then the subsidy program could subsidize a higher number of latrines. Conversely, subsidy-based programs might erode the perceived value of

[5] WaterSHED (2009). Water and Sanitation in Kampong Speu, Cambodia: Supply Chain Analysis and Strategy Development. Lien Aid and World Toilet Organization. Phnom Penh, Cambodia.
[6] Pedi, D. et al. (2014). Rural Consumer Sanitation Adoption Study: An Analysis of Rural Consumers in the Emerging Sanitation Market in Cambodia. WaterSHED. Phnom Penh, Cambodia.

latrines in the minds of consumers, undercut local businesses with free or lower-priced products and services and encourage households to delay purchase in the hopes of receiving a subsidy. In order to mitigate this limitation, it is important that development organizations and governments openly share information on sanitation program activities so that impact can be properly assigned. From a methodological standpoint, organizations operating in the same market of interest should use the model to measure their combined impact rather than trying to disaggregate it amongst several programs. However, joint assessments are not always the most politically feasible.

## Model Application: The WaterSHED *Hands-Off* Program

Following two years of research and design (2009-2010), WaterSHED implemented the *Hands-Off* sanitation marketing program between 2011 and 2017 in rural provinces in Cambodia. Inter alia, the program engages and supports a network of small businesses, referred to as "SPs" to produce low cost, improved latrines. The Program provides SPs with technical skills training related to latrine production as well as business professionalization training on topics such as book keeping and inventory management. The program also links SPs to local sales agents, who actively market latrines in rural communities. WaterSHED also conducts social marketing campaigns about improved sanitation and latrine usage to generate consumer demand.

In the following section, the model is broken down into several steps and applied to the *Hands-Off* program. The model's application is based on available data sources such as the Program's M&E system as well as a several socio-economic surveys and studies pertaining to the WASH sector in rural Cambodia. However, it should be understood that while data sources and the details of the model's application may change depending on the country in which it is applied, the concept behind the model and the steps listed below will generally remain the same.

### 1. Define the Market of Interest

In the case of the *Hands-Off program*, the market of interest is defined as improved latrines (product) sold by market actors in the program area (target market). The target market consists of an estimated 1,145,149 households in eight, predominantly rural provinces in Cambodia.[7] The program started in 2011 in four provinces and expanded to an additional four over the following two years.[8] The timeframe for the market of interest will be the seven-year period between January 1, 2011 and December 31, 2017 as SP sales data is available for this time period.

### 2. Calculate Metrics for the 'Does Not Exist' Scenario

Before estimating program impact, it is first necessary to establish a hypothetical scenario in which the program does not exist. This provides a baseline to which the Program Scenario can be compared.

[7] According to the Sanitation Coverage Survey (2015), WaterSHED's program area covered 1,052,203 households over eight provinces as of early 2014. Comparing data from the 2011 survey baseline (for six provinces) to the 2014 survey (for the same six provinces) revealed an annual population growth 2.86%. This growth rate was compounded over 3 years and applied to the 2014 household figure for all eight provinces for an estimated 1,145,149 households by the end of 2017.
[8] Tboung Khmum was originally part of Kampong Cham Province when the program started.

## 2.1 Market price of a latrine

In the absence of the *Hands-Off* program, most under-served rural consumers in Cambodia rely on local masons to build their latrines. In general, these latrines are larger and more expensive than latrines produced by SPs. They have a wider platform and the vast majority have a superstructure, which consists of brick walls and a metal roof. To estimate the market price of a latrine in the absence of the program, we rely on data from a 2009 supply chain analysis[9] of latrine production in Kampong Speu Province. This is a largely rural province in which the *Hands-Off* program now operates. The supply chain analysis was conducted in the province prior to the existence of the program; therefore, findings are indicative of the market price for latrines in its absence. The analysis included focus group discussions with masons to estimate the cost of labor and material inputs required to build a household latrine. Findings from four focus groups yield an average estimated materials cost of 1,470,850 KHR and labor cost of 601,750 KHR.[10] Combining these inputs results in a latrine market price of 2,072,600 KHR. [11] To include these estimates in the model, they must first be adjust for inflation and converted to USD. The timeframe for the market of interest is the seven-year period from 2011-2017, so the figures should be adjusted to 2014, which falls in the center of the MOI timeframe. Doing so yields a materials cost of $437.82, labor cost of $179.12 and total market price of $616.94.[12]

It is important to note that the cost of labor includes that of both the masons and the assistant laborers they hire. Masons did not define profit. Rather, their 'profit' is the cost of the labor that they contributed to construction. To allow for comparable calculations later in the analysis, this model assumes that the same profit:labor cost ratio applies to both SPs and non-SPs. This is 0.63.[13] As such, the $179.12 of labor per unit can be disaggregated into $69.86 in business profits per unit and $109.26 in wages per unit.

## 2.2 Total latrine sales volume

Since latrine sales in all of rural Cambodia are not tracked, changes in latrine coverage can be used as a proxy indicator for latrine sales under the DNE Scenario. Pedi et al. (2012) estimates that in the absence of a sanitation program, latrine coverage in rural Cambodia increases at a rate of 1.3% per year.[14] This was estimated by comparing findings from two sanitation surveys that were three years apart in areas where no sanitation programs were being implemented. The survey covered six villages in Kandal Province and six villages in Svay Rieng Province. These two locations had annual increases in latrine coverage of 1.9% and 0.6% respectively, leading to an estimated increase in latrine coverage of 1.3% for rural Cambodia in general. The model will refer to this as the background sanitation coverage rate.

To fit the dimensions of the market of interest, the background sanitation coverage rate is compounded annually over a seven-year period (timeframe) and multiplied over an estimated population of 1,145,149 households (target market). This yields a 9.46% increase in sanitation coverage over a seven-year period, representing an additional 108,331 households with a latrine.[15]

[9] WaterSHED (2009). Water and Sanitation in Kampong Speu, Cambodia: Supply Chain Analysis and Strategy Development. Lien Aid and World Toilet Organization. Phnom Penh, Cambodia.
[10] A breakdown of the cost of inputs estimated by each focus group discussion can be found in Appendix A.
[11] The latrine market price is the total cost to consumers for a ready-to-use latrine. Labor cost for masons include the installation of the latrine, though customers are often required to source and transport many of the material inputs themselves. The additional costs to consumers for the self-transport of materials is not included here.
[12] The following conversion rate is used throughout the report. 1USD:4100KHR
[13] Each latrine core sold by an SP results in $9.77 in business profits and $15.28 in wages for a profit: labor ratio of 0.63.
[14] Pedi, D., Kov, P., and Smets, S. (2012). Sanitation Marketing Lessons from Cambodia: A market-based approach to delivering sanitation. WSP-EAP Field Note.
[15] This estimate assumes that no households installed more than one latrine.

The change in sanitation coverage is not synonymous with latrine sales. Households that already have a latrine may need to repair or replace an existing one. These would represent latrine sales that were not captured by the background rate. According to a WaterSHED survey, 90% of households that purchased a latrine from an SP did not previously own a toilet; the other 10% did.[16] The model assumes this proportion of toilet replacement sales (10% of total sales) to be the same in both Program and DNE Scenarios. The estimate of change in sanitation coverage can be multiplied by 1.11 to incorporate this information. After this adjustment, the model estimates that in the absence of the program 120,248 latrines would be sold over a seven-year period in the would-be program area.

***Table 2: DNE Scenario Total Latrine Sales***

| | |
|---|---|
| Households in market of interest (as of 2017) | 1,145,149 |
| Background sanitation rate over (6-year period of program implementation) | 9.46% |
| Number of households with new latrines | 108,331 |
| Replacement Latrines Multiplier | 1.11 |
| **Total Latrines Sold** | **120,248** |

## *2.3 Total Market Value, Profits and Wages*

Under the DNE Scenario, a total of 120,248 latrines were sold at an estimated market price of $609.53 per unit. This yields a total market value (TMV) of approximately $73.3 million. In other words, if the program did not exist, the market for latrines in the eight rural provinces would total $73.3 million in value and yield $8.3 million in business profits for local producers (i.e. masons) and 13 million in wages for their assistant laborers.

***Table 3: DNE Scenario Total Market Value, Business Profits and Wages***

| | |
|---|---|
| Total Latrines sold | 120,248 |
| Market price per unit | $609.53 |
| Business profits per unit | $69.02 |
| Wages per unit | $107.95 |
| **Total Market Value** | **$73,294,865** |
| **Total business profits** | **$8,299,248** |
| **Total wages** | **$12,980,876** |

[16] Pedi, D. et al. (2014). Rural Consumer Sanitation Adoption Study: An Analysis of Rural Consumers in the Emerging Sanitation Market in Cambodia. WaterSHED. Phnom Penh, Cambodia.

## 2.4 Total Sanitation Benefit

Total sanitation benefit (TSB) is defined as the economic value of the MOI's output, in this case improved household latrines. Although the definition of 'improved' latrine varies, the UNICEF/WHO Joint Monitoring Program (JMP), define this as a toilet system that separates human waste from human contact that is used only by household members and not shared with others.[17] The substructure of SP latrines follow a standard design and fit this definition. Data from the 2009 supply chain analysis, cited earlier, indicates that the majority of latrines produced by non-SPs also fit this definition, despite variation in their substructure design. Therefore, in this application of the model, it is assumed that both SP and non-SP latrines both provide the same sanitation benefit.

In order to calculate the total sanitation benefit, it is first necessary to determine the per unit sanitation benefit. This is the economic gain brought about by one additional household owning an improved latrine. No existing estimations for this metric could be found; however, Hutton et al. (2008)[18], calculates both the economic costs from poor sanitation and hygiene in Cambodia as well as the potential economic gains from addressing them. While the estimates from the Hutton et al. model do not align perfectly with the parameters of this model, they can be used to provide a crude estimate of the sanitation benefit brought about by improved latrines.

Hutton et al. (2008) estimates that poor sanitation in Cambodia leads to economic losses of $187.1 million per year due to negative health outcomes. Open defecation or the use of unsanitary toilet facilities, paired with poor hygiene practices results in a higher disease burden for households. This, in turn, increases household expenditure on healthcare, reduces labor productivity and in severe cases leads to premature death. While a proportion of these health outcomes are due to poor hygiene practices, the Hutton et al. model estimates that access to 'improved toilet systems' would result in improved health outcomes and reduce economic losses by $59.9 million.[19] This reduction in economic loss can also be thought of as economic gain. If the entire population had access to improved sanitation facilities, such as a latrine produced by SPs or Non-SPs, then Cambodia's GDP would increase by $59.9 million.

The Hutton et al. model also estimates the time that individuals spend walking to a place to practice open defecation or waiting to use shared public toilet facilities. These activities constitute a significant amount of time lost from economically productive activities and result in an estimated annual economic loss of $38.2 million. As with health-related outcomes, this economic loss can be flipped to economic benefit when it is properly addressed. If each household in Cambodia had access to its own improved latrine, more time could be devoted to economically productive activities, thereby increasing the country's GDP by $38.2 million.

[17] According to Hutton et. al 2008:
"Types of systems that are likely to achieve this consist of flush or pour flush to piped sewer/septic tank/pit latrine, ventilated improved pit (VIP) latrine, pit latrine with slab and composting toilet."

[18] Hutton, G. et al. (2008). Hutton Economic Impacts of Sanitation in Cambodia: A five-country study conducted in Cambodia, Indonesia, Lao PDR, the Philippines and Vietnam under the Economics of Sanitation Initiative (ESI). World Bank: Water and Sanitation Program. Jakarta, Indonesia.

[19] The remainder of economic loss due to poor health outcomes can be attributed to poor hygiene practices. This has been excluded from the calculation, because households that purchase a latrine in the MOI do not necessarily improve their hygiene practices. The Hands-Off Program, does conduct extensive social marketing campaigns with the objective of improving hygiene practices, but no quantifiable data exists regarding the efficacy of these campaigns. Similarly, the 'product' of hygiene messaging exists outside the MOI. It is not something that MOI pay nor something that SPs produce. Including it in the sanitation benefit of latrines would not be appropriate.

*Table 4: Predicted Economic Gains from Improved Sanitation*

| Impact Category (Million USD) | Improved toilet system | Latrine access |
|---|---|---|
| **Health** | **59.9** | |
| Healthcare | 4.3 | |
| Productivity | 1.6 | |
| Premature Death | 54 | |
| **Other Welfare** | | **38.2** |
| Time Use | | 38.2 |

Adding 'Improved toilet system' and 'Latrine access' equals a combined $98.1 million worth of economic benefit for the economy of Cambodia. In order to achieve this full benefit, each household in the country would require access to an improved toilet system. In other words, sanitation coverage would have to reach a theoretical 100%. In 2005, when the Hutton et al. model was calculated, sanitation coverage in Cambodia was 21.6%[20] over a population of 2.8 million households.[21] The 2.2 million households without access to an improved toilet system represent the shortfall to achieving the economic benefit. Therefore, in 2005 the economy of Cambodia would experience a gain of $45.31 for every additional household that gained access to an improved toilet system.[22]

*Table 5: Sanitation Benefit Calculation (2005 value)*

| | |
|---|---|
| Economic Benefit from 100% Sanitation Coverage (Health + Time Use) | $98,100,000 |
| Population of Cambodia (2005) | 13,806,974 |
| Average Household size (people) | 5 |
| Sanitation Coverage | 21.6% |
| Number of households without a latrine | 2,164,934 |
| Annual Sanitation Benefit (per latrine) | $45.31 |

Conceptually, it is best to view this value as the average economic benefit from the improved health outcomes and time savings that a household experiences when it has access to an improved latrine. As such, it can also be applied to households that buy a replacement latrine. This is based on the assumption that households buy a replacement latrine if their current latrine is not functioning properly and therefore not providing them with the full sanitation benefit. Although the purchase of a replacement latrine will not result in $45.31 of economic growth, it will prevent the equivalent

[20] National Institute of Public Health and National Institute of Statistics (2006). Cambodia Demographic and Health Survey 2005. National Institute of Public Health and National Institute of Statistics. Phnom Penh.
Note, the CDHS calculates sanitation coverage based on the JMP definition of improved latrine cited earlier.
[21] According to population projections from the National Institute of Statistics, the population of Cambodia was 13,806,974 in 2005. This is the same projection used by the Hutton et al. model. According to the CDHS(2005), the average household size in Cambodia in 2005 was 5. Dividing the total population by average household size yields 2,164,934 households.
[22] This is not net gain, as costs for gaining access to an improved toilet system is not included in this estimation and will be addressed later in the analysis.

amount of economic loss. After being adjusted for inflation and changes in household size, the value can also be applied to different points in time.

The timeframe for the market of interest is the seven-year period from 2011-2017, so the 2005 economic benefit should be adjusted for 2014, which falls in the center of that timeframe. Doing so yields an economic benefit of $71.41 per latrine in 2014.[23] This figure is equivalent to the annual sanitation benefit per latrine. Based on discussions with WASH sector experts, the model assumes a 25-year lifespan for a latrine in rural Cambodia.[24] This results in a sanitation benefit of $1,785.30 spread out over a 25-year period. Factoring in future inflation, the present value of the per unit sanitation benefit is 1,008.39.[25]

***Table 6: DNE Scenario Sanitation Benefit Calculation (2014 value)***

| | |
|---|---|
| Average HH size | 4.6 |
| Inflation in Cambodia (2005-2014) | 71.3% |
| Annual Sanitation Benefit(per latrine) | $71.41 |
| Latrine Lifespan | 25 |
| Future Sanitation Benefit (per latrine) | $1,785.30 |
| Present Value Sanitation Benefit (per latrine) | $1,008.39 |

Now that the per unit sanitation benefit has been calculated it can be multiplied by the total number of latrines sold in the market. As previously stated, 120,248 latrines were sold in the market of interest in the DNE Scenario.[26] At a per unit sanitation benefit of $1,008.39, the total sanitation benefit of the market of interest is $121.3 million.

***Table 7: DNE Scenario Total Sanitation Benefit Calculation***

| | |
|---|---|
| Latrines sold | 120,248 |
| Present Value Sanitation Benefit (per latrine) | $1,008.39 |
| **Total Sanitation Benefit** | **$121,256,399** |

[23] According to CDHS 2015, the average household size in Cambodia was 4.6. Between 2005 and 2015 the Cambodian economy experienced 73.4% inflation (as measured by change in CPI with base year 2010 = 100). World Bank. World Development Indicators Database. Accessed 16 December 2018. https://data.worldbank.org/

[24] The latrine's physical structure can last significantly longer than 25 years; however, it is likely that a household's living situation will change significantly within that timeframe. For example, the household may relocate to a different home or choose to renovate or upgrade their latrine into a full bathroom.

[25] The discount inflation rate was determined by finding the average inflation rate in Cambodia for the last 20 years (1997 – 2017). This provides a discount rate of 4.98%

[26] According to a WaterSHED Sanitation Coverage Survey (2014), 4.3% of households in the program area that own a latrine share it with neighboring households. As these latrines are shared by multiple households, they do not fit the definition of an improved toilet system. Sharing latrines also results in additional wait time, which detracts from time spent on economically productive activities. Still, access to these latrines results in greatly improved sanitation for all households that use them. Therefore, the model will still count all SP and non-SP latrines as 'improved'. Though the sanitation benefit is spread out over slightly more households, the total sanitation benefit remains approximately the same.

### 2.5 Market Efficiency Ratio and Value Added

The total market value is equivalent to the total cost of inputs for producing latrines within the market of interest. Conversely, the total sanitation benefit is equivalent to the total economic benefit of the latrines produced in the market of interest. The market efficiency ratio under the DNE Scenario is 1.63 and calculated as follows.

total sanitation benefit / total market value = market efficiency ratio

$121.3 million / $74.2 million = 1.63

A market efficiency ratio of 1.65 means that for each $1 households invest in latrine purchases; the economy will experience a net increase of $1.65. This means that in the absence of the program, latrine sales in the market of interest would result in a net contribution of $48.6 million to Cambodia's GDP. This is calculated as:

total sanitation benefit – total market value = value added to the economy

$121.3 million - $74.2 million = $47.1 million

## 3. Calculate Metrics for the Program Scenario

### 3.1 Market price of a latrine produced by SPs

The first step in establishing the Program Scenario is to determine the market price that consumers pay for a ready-to-use latrine produced by SPs participating in the program. The Rural Consumer Sanitation Adoption Survey (RCSAS) (2014) provides useful cost estimates in this regard. The survey asked respondents who had purchased latrines from SPs to estimate the total material and labor costs for their latrine's substructure and the superstructure. They were also asked to describe the latrine's material composition.

**Latrine substructure**

Latrine substructure is fairly standardized across all SPs, as it is based on the WaterSHED 'latrine core' design. This consists of a pit with three concrete rings, a pit lid, a connector pipe, chamber box, ceramic pan, and a platform made of brick and cement. Analysis of the RCSAS data yields an average cost of $45.22 for substructure materials and $24.58 for labor.[27] It is also important to note that the vast majority of latrine cores produced by SPs are sold through a local sales agent. Commission fees vary based on the total price of the latrine core, but tend to be around $2.50.[28] This results in a total market price of $72.30 for a latrine core (substructure) produced by an SP. This finding is strikingly consistent with a materials costing survey conducted by WaterSHED in 2016, which estimated a latrine core market price of $72.00.[29]

[27] Due to several outliers within the survey dataset, a 5% trimmed mean was used to calculate the average. A 5% trimmed mean excludes the lowest 5% and highest 5% of the data. An average is taken of the middle 90%. This removes outliers from the dataset, thereby serving as a more robust measure of central tendency. It is important to note that the labor costs calculated here include latrine delivery and installation so that the latrine is 'ready-to-use'.
[28] This figure is taken from the SP Latrine Materials Costing Survey (2016).
[29] The SP Latrine Materials Cost Survey (2016) provides a detailed breakdown of the inputs and related costs to the latrine core. These can be found in Appendix B.

**Latrine Superstructure**

Unlike the substructure, latrine superstructures vary greatly in terms of design, size and material composition. This results in significant variation in the total cost consumers pay for them.[30] To account for this variation, the model broadly categorizes superstructures by wall material; cement/brick, metal, and wood/thatch/other. Below is the average labor and material costs for each superstructure based on RCSAS data.[31]

***Table 8: SP Superstructure Input Costs***

| Superstructure | Materials | Labor | Market Price |
|---|---|---|---|
| Concrete/brick | $202.44 | $48.89 | $251.33 |
| Galvanized steel | $88.24 | $25.61 | $113.85 |
| Wood/Thatch/Other | $14.36 | $26.83 | $41.19 |

[32]

Adding material and labor costs results in estimated market prices of $251.33, $113.86, and $41.19 for concrete/brick, galvanized steel and wood/thatch/other superstructures respectively. The average material and labor costs for the substructure (the latrine core) can then be added to those of the superstructure and the commission fee to determine the market price for each of the three types of latrines.

***Table 9: SP Latrine Input Costs***

| Latrine | Materials | Labor | Commission Fee | Market Price |
|---|---|---|---|---|
| Concrete/brick | $247.66 | $73.47 | $2.50 | $323.63 |
| Galvanized steel | $133.46 | $50.19 | $2.50 | $186.15 |
| Wood/Thatch/Other | $59.58 | $51.41 | $2.50 | $113.49 |

It is clear from this analysis that latrines with concrete/brick-walled superstructures are significantly more expensive than the other two types. Latrines with concrete or brick walls are typically considered by rural households as 'ideal latrines'. At the same time the relatively high cost of these latrines puts them out of the financial means of many poor households. The RCSAS noted a higher rate of superstructures built of wood/thatch/other materials in poorer provinces. Prior to the advent of the *Hands-Off* program, concrete/brick superstructures were practically the only kind of superstructure available to customers. It is the only kind of superstructure that masons would build. The fact that some consumers opted for these lower cost options, indicates that the *Hands-Off* program increased

[30] SPs were not always responsible for the production of the latrine superstructure. In some cases, customers hired local masons to produce the superstructure while others invested their own time and labor to build the superstructure themselves. Since the objective of this calculation is to determine the value of the entire market of interest, these superstructures will be considered 'part of' SP latrines whether or not the SPs produced the superstructure or they were made by other market actors.

[31] This average is also a 5% trimmed mean.

[32] A majority respondents that opted for superstructures of galvanized steel or wood/thatch/other built the superstructure themselves. These respondents did not provide cost estimates for their own labor, so the estimates above are based on a very small number of data points. Additional research would be needed to revise or add validity to these estimates.

the diversity of the market's product offering, thereby supporting the market to more accurately reflect and serve the needs of consumers.

Establishing three market prices based on latrine superstructure type is useful for illustrating the significant cost differential between these models, but it can also make subsequent calculations in this model somewhat cumbersome. To circumvent this issue, the weighted mean of these three figures can be used as a single market price. According to the RCSAS, 81% of respondents owned a latrine with concrete/brick walls, while 8% owned one with galvanized steel walls and 11% owned one with walls make of other materials.[33] Applying these weights to the market price for each latrine type yields a weighted average market price of $289.52.

***Table 10: SP Latrine Weighted Market Price Calculation***

| Latrine | Market Price | Weight |
|---|---|---|
| Concrete/brick | $323.63 | 81% |
| Galvanized steel | $186.15 | 8% |
| Wood/Thatch/Other | $113.49 | 11% |
| Market Price Weighted Avg. | $289.52 | |

## 3.2 Latrine Sales by SPs

According to sales data collected from WaterSHED's M&E system, SPs sold a total of 164,329 latrines in the seven-year period between January 1, 2011 and December 31, 2017 in the eight program provinces. Approximately 10% of these latrines (16,936) were sold to NGOs, while the remaining 90% (147,393) were sold to customers, either directly or via a sales agent. Although latrine sales to NGOs represent an increase in sanitation benefit within the market of interest, this impact cannot be fully attributed to the *Hands-Off* Program. The spending on these latrines by NGOs is also not representative of endogenous demand within the market of interest. Consequently, latrine sales to NGOs are excluded from this analysis, and the model will only consider the 147,393 latrines sold to consumers.

## 3.3 Market price of a latrine produced by non-SPs

Comparing the Program Scenario to the DNE Scenario is essentially comparing an entire market of interest to itself with the addition of program activities. This means that the latrine sales of non-SP producers must also be considered in the Program Scenario. Unfortunately, there is no data available on the market price of latrines produced by non-SPs during the same time period as the market of interest. It is reasonable to assume that increased competition from SPs would lead non-SPs to reduce the market price of their product. If their products remained the same price it is unlikely that anyone would by them. However, non-SPs did not receive any type of training from the program, meaning that they may still be using inefficient production techniques and designs. This may limit their ability to reduce the price of their products. In the absence of data, this application of the model will assume that non-SPs were able to reduce the price differential between their product's old market price and SP latrine market price by two-thirds. This results in a market price of $398.87 for non-SP latrines. Under the DNE scenario, business profits and wages accounted for 11.3% and 17.7% of the total

[33] This sample consisted of 240 households that had purchased a 'core latrine' and a superstructure of some kind.

market price respectively. In the absence of data, these same proportions can be applied to yield an estimated $45.17 in business profit and $70.65 in wages for each latrine produced by non-SPs.

### 3.4 Latrine Sales by non-SPs

To calculate latrine sales by non-SPs it is necessary to first estimate the total number of latrines sold in the market of interest, then subtract the number of SP latrines. Total latrine sales in the market of interest can be estimated using data from a WaterSHED Sanitation Survey, which tracked the change in the number of households with a latrine over a three-year period.[34] The survey found an 11.7% increase in the proportion of households in the market of interest(geographic area) that own a latrine from 30% in 2011 to 41.7% in 2014.[35] This yields an average annual increase of 3.9%; approximately 3 times the background sanitation coverage rate in non-program areas. This figure can be extrapolated in the following equation to estimate the total number of additional households with a latrine in the market of interest for the whole seven-year time period.

HH in MOI x annual increase in number of HH with a latrine x years = increase in households with latrines in MOI

1,145,149 x 3.9% x 7 = 312,626

The model estimates that within the seven-year time period an additional 312,626 households in the market of interest now own a latrine. In order not to overstate the impact of the *Hands-Off Program* any latrine sale in the market of interest associated with the sanitation programming of another organization should not be considered in this analysis. As previously stated, SPs sold 16,936 latrines to NGOs, and it is reasonable to assume that these NGOs distributed or subsidized the sale of these latrines to individuals in the market of interest. As such, these latrine sales to NGOs should be excluded from the analysis. It is also necessary to account for all other NGO activities which may have led to the increase in latrines in the market of interest over the seven-year period. Numerous NGOs have conducted WASH programing in this geographic area in the past seven years and have likely distributed or subsidized the cost of many latrines; however, no data is publically available to quantify the extent of these activities. In the absence of data, the model will assume 1/4 of the increase in the number of latrines (73,937) was brought about by NGO programming and should be excluded from analysis.[36]

***Table 11: Latrine Sales by Non-SPs***

| | |
|---|---|
| HH in Market of Interest(2017) | 1,145,149 |
| Annual increase in number of HH with a latrine | 3.9% |
| Program Timeframe (years) | 7 |
| Increase in households with a latrine | 312,626 |
| SP sales to NGOs | 16,876 |

[34] WaterSHED (2015). Survey on Basic Water and Sanitation Facilities in Eight Target Provinces of WaterSHED in Cambodia. Note that this is the actual number of households with a latrine, not the number of households which have access to a latrine.
[35] These figures are for the six provinces that had both baseline and end line survey data. Two other program provinces did not have baseline data so their change could not be estimated. The average annual increase from these six provinces (3.9%) will be applied to all eight provinces.
[36] Further research and information sharing between WaterSHED and WASH NGOs in the market of interest should be conducted to provide a more accurate estimate the total number of latrines subsidized or distributed for free in the program area.

| | |
|---|---|
| NGO subsidized or free latrines | 73,937 |
| Remaining increase households with latrine | 221,812 |
| Replacement Latrines Multiplier | 1.11 |
| **Total latrine sales to consumers** | **246,212** |
| **SP sales to consumers** | **147,393** |
| **Non-SP sales** | **98,819** |

The remaining figure (221,812) should then be multiplied by 1.11 to account for the 10% of customers that bought replacement latrines. According to these calculations, the total latrine sales to customers in the market of interest is 246,212. SPs were responsible for 60% of these sales (147,393 latrines), while non-SPs accounted for the remaining 40% (98,819 latrines). It is important to point out that although Non-SP sales are lower in the Program Scenario than the DNE Scenario, it is not possible to tell if Non-SPs have lost business. On the contrary, many of the non-SPs in the DNE Scenario are the small producers that WaterSHED turned into SPs in its *Hands-Off* program. Therefore, these small producers have not necessarily started producing fewer latrines. They simply fall under a different category under the Program Scenario.

### 3.5 Total Market Value

Over a seven-year period, SPs sold a total of 147,393 latrines at a per unit market price of $289.52. This yields a market value of approximately $42.7 million. Data from the SP Materials Costing Survey (2016) revealed that 13.5% of the total market price of an SP latrine core goes toward SP profit while 21.1% goes towards wages for labor. An additional 3.4% goes towards local sales agents in the villages as a commission fee. In the absence of data, this application of the model assumes that the proportional costs of these inputs remain the same for the market price of the whole latrine, superstructure included. Therefore, the market value of $42.7 million can be disaggregated by the same proportions, into $5.8 million in profits for SPs, $9 million in wages for SP employees, and $1.5 million in commission fees to local sales agents.[37]

Over the same time period non-SPs sold a total of 98,819 latrines at a per unit market price of $398.87. This yields a market value of approximately $39.4 million. Applying input cost estimates cited earlier, this yields $4.5 million in profits for non-SPs and $7 million in wages for the labor they hire. Adding together the latrine sales of both SPs and non-SPs yields a total market value of $82.1 million under the Program Scenario.

***Table 12: Program Scenario Total Market Value***

| | | |
|---|---|---|
| **SPs** | Latrines Sold to Consumers | 147,393 |
| | Market Price (per unit) | $289.52 |
| | **Market Value** | **$42,672,661** |

[37] The fourth input is material inputs (not pictured below) which represents the remainder of the market value.

| | | |
|---|---|---|
| | -Profits | $5,760,809 |
| | -Wages | $9,003,932 |
| | -Commission Fees | $1,450,870 |
| **Non-SPs** | Latrines Sold | 98,819 |
| | Market Price (per unit) | $398.87 |
| | **Market Value** | **$39,416,231** |
| | -Profits | $4,463,297 |
| | -Wages | $6,981,055 |
| | -Commission Fees | N/A |
| **TOTAL MARKET VALUE** | | **$82,088,892** |

### 3.6 Total Sanitation Benefit

Over the seven-year period, the market of interest sold a total of 246,212 latrines to rural consumers. At a per unit sanitation benefit of $1,008.39, total sanitation benefit is $248.3 million under the Program Scenario.

***Table 13: Program Scenario Total Sanitation Benefit***

| | |
|---|---|
| Latrines sold to rural consumers (SPs + Non-SPs) | 246,212 |
| Annual sanitation benefit (per Latrine) (USD) | $1,008.39 |
| **Total Sanitation Benefit** | **$248,277,334** |

### 3.7 Market Efficiency Ratio and Value Added

The market efficiency ratio for the Program Scenario is calculated as follows:

total sanitation benefit / total market value = market efficiency ratio

$248.3 million / $82.1 million = 3.02
Therefore, under the Program Scenario, each $1 households invest into latrine purchases results in $3 worth of economic growth. This means that latrine sales in the market of interest resulted in $166.2 million worth of economic growth. This is calculated as:

total sanitation benefit – total market value = value added to the economy

$248.3 million - $82.1 million = $166.2 million

## 4. Compare DNE and Program Scenarios

The previous steps in the model provide a complete picture of what the market of interest looks like both with and without the *Hands-Off* program. By comparing these two scenarios the model is able to measure the ways in which the program has transformed the market of interest and how this impacts the wider economy. The table below provides a summary comparison between the two scenarios.

***Table 14: Comparison of DNE and Program Scenario***

| Metric | DNE Scenario (USD) | | Program Scenario (USD) | Difference (USD) | Difference % |
|---|---|---|---|---|---|
| Latrine Market Price | $ 609.53 | SP | $289.52 | $(320) | -53% |
| | | Non-SP | $396.40 | $(213) | -35% |
| Latrines Sold | 120,248 | SP | 147,393 | | |
| | | Non-SP | 98,819 | | |
| | | TOTAL | 246,212 | 125,964 | 105% |
| Market Value | $ 73,294,865 | SP | $42,672,661 | | |
| | | Non-SP | $39,171,884 | | |
| | | TOTAL | $81,844,545 | 8,549,681 | 12% |
| Profits | $ 8,299,248 | SPs | $5,760,809 | | |
| | | Non-SPs | $4,435,629 | | |
| | | TOTAL | $10,196,438 | 1,897,190 | 23% |
| Wages | $ 12,980,876 | SPs | $9,003,932 | | |
| | | Non-SPs | $6,937,779 | | |
| | | TOTAL | $15,941,710 | 2,960,834 | 23% |
| Commission Fees | N/A | Non-SPs | $1,450,870 | | |
| | | TOTAL | N/A | N/A | N/A |
| Total Sanitation Benefit | $ 121,256,399 | SP | $148,629,635 | | |
| | | Non-SP | $99,647,699 | | |
| | | TOTAL | $248,277,334 | 127,020,935 | 105% |
| Market Efficiency Ratio | 1.65 | | 3.03 | 1.4 | 83% |
| Economic Value Added | $ 47,961,534 | SP | $105,956,973 | | |
| | | Non-SP | $60,475,815 | | |
| | | TOTAL | $166,432,788 | $118,471,255 | 247% |

The findings from this model indicate that the WaterSHED *Hands-Off* program achieved the two main objectives of market-based programs. It not only led to a significant increase in latrines sales but it did so through building an efficient, sustainable market for latrines in underserved, rural areas. Due to the Program, latrine sales in the market of interest more than doubled from approximately 120,000 to 246,000 and the total market value increased by $8.6 million. The program also resulted in an

additional $1.9 million in profits to latrine producers (both SPs and non-SPs) and $2.9 million in wages to the labor they hire; a 23% increase from the DNE scenario. These metrics indicate that the program has indeed built and strengthened local market systems for the supply of latrines in program areas, representing not only a more sustainable way to provide latrines to rural consumers but also an increase in small business profits and employment opportunities within the market of interest.

At the same time, the program also made the market vastly more efficient. Under the Program Scenario, consumers pay a market price of $290 for a latrine produced by an SPs and $396 for a latrine produced by a non-SP. These prices are 53% and 35% less than the market price in the DNE Scenario. In this sense the program led to 'lean' market growth, whereby the increase in total market value was driven by the increase in total sales, while the market price per unit decreased. In other words, consumers were able to receive the same sanitation benefit at either a 53% or 35% discount. Had consumers wanted to purchase the same number of latrines in the absence of the program, it would have cost them an additional $68.2 million (not pictured). This sanitation discount is also reflected in an 83% increase in the market efficiency ratio from 1.65 to 3.03. In the absence of the program, every dollar a household invests in a latrine would contribute $1.65 to the economy due to improved health outcomes and time savings. Due to the program, every dollar a household invests in a latrine now contributes $3.03 to the economy.

In summation, the program both grew the market and made it more efficient. This means that it not only increased total latrine sales but also reduced the price consumers pay for a given amount of sanitation benefit. In doing so, it led to net increases in both upstream benefits for producers and downstream benefits for consumers. These two effects can essentially be combined into one metric; the program's impact on economic growth. In the absence of the program, the market of interest would have yielded a net contribution of $50 million to Cambodia's economy over a seven-year period. Under the WaterSHED *Hands-Off* program, the market of interest contributed a total of $166.4 million to the economy over the same time period. This results in a net increase in the market of interest's contribution to the economy by $118.5 million.[38]

[38] Unfortunately, a regional multiplier has not been calculated for the program area. However, in future applications of this model a regional multiplier should be applied to account for the program's total economic impact.

## Market-based vs Subsidy-based

Traditionally, governments and development organizations that wish to increase sanitation coverage have implemented subsidy-based programs that either distribute latrines free of charge or offer partial subsidies. The market-based approach has emerged as an increasingly popular alternative; though policy makers and practitioners within the WASH sector often lack comparable metrics between the two. The following section applies the concepts of this model to a latrine subsidy program to yield comparable results to the market-based approach. The results of this analysis should not be understood as definitive evidence that one approach is necessarily better or worse than the other. Rather, it should only serve as an example for understanding how to interpret the results of both approaches in somewhat comparable terms.

This section compares the Asian Development Bank's (ADB): Tonle Sap Rural Water Supply and Sanitation Sector Project (TSRWSSSP)[39] to the WaterSHED *Hands-Off program*. The TSRWSSSP was a four-year project with the goal of improving access to safe water and sanitation and promoting better hygiene within Cambodia's Tonle Sap Basin. The project was implemented by the Department of Rural Water Supply (DRWS) under the Ministry of Rural Development and was financed through an $18 million grant from the Asian Development Bank and government contributions. The project consisted of four components, covering a wide array of sanitation related activities and capacity building support to the DRWS. The 'Sanitation Improvement' component provided latrines to rural households at a subsidized price. In total, the project spent $4.7 million on latrine subsidies. This resulted in a total of 45,056 installed latrines[40] with a cost to the program of $103.87 per latrine.[41] In comparison, the *Hands-Off* program resulted in the installation of 246,212 latrines over a seven-year period.[42] The *Hands-Off* program expenditure was $2.5 million, costing the program $10.77 per latrine[43]; slightly more than one-tenth the per latrine cost of the TSRWSSSP.

The conceptual framework of the model can be loosely applied to these figures in order to calculate comparable metrics between the TSRWSSSP Project and the *Hands-Off program*. In a sense, both programs reduce the market price of latrines to consumers. In the case of the *Hands-Off* program, this is the result of increased market efficiency. In the case of the TSRWSSSP, this is the result of a direct subsidy. Therefore, the total cost savings to consumers can be calculated for both. For the TSRWSSSP, this is the total value of program subsidies, $4.7 million. For the *Hands-Off* program, this is the cost savings due to the reduced price consumers pay for SP and Non-SP latrines under the Program Scenario. This was calculated in the previous section as $68.2 million. However, some interpretation is required. The cost savings to consumers under the *Hands-Off program* is derived from a hypothetical situation. It is based off how much consumers would have to pay for purchasing the same quantity of latrines as the Program Scenario but at the per unit cost of the DNE Scenario. In reality, they did not 'save' this money, because they would not have bought the same quantity of latrines if the *Hands-Off* program did not exist. The same is likely true in the case of the TSRWSSSP.

[39] Data regarding the TSRWSSSP was gathered from: ADB (2011) Cambodia: Tonle Sap Rural Water Supply and Sanitation Sector Project. Completion Report. Project No 34382. Asian Development Bank.
[40] One could posit that some of the households receiving the subsidy might have bought a latrine over the four-year project period even without the subsidy. This would be the project's DNE Scenario. While this is likely the case, it is not possible to accurately calculate this figure. Unlike the market-based approach that 'self-selects' latrine purchasers, the subsidy approach targets the poor households, which are therefore not representative of the wider population. The better the targeting, the smaller the likely substitution effect. As such, the model assumes no substitution effect for the subsidy-based approach although it is likely significant. Consequently, the model likely overstates the sanitation benefit of the subsidy-based approach by a fair margin.
[41] This figure only accounts for the cost of the subsidy and is also the average size of the subsidy received by project participants. Expenditure data was not available for the administrative costs associated with providing these subsidies.
[42] This figure is calculated by subtracting the total number of latrines in the DNE Scenario from the Program Scenario.
[43] This figure includes all expenditures on the *Hands-Off* program by WaterSHED between 2011 and 2017.

Economic impact provides a more straightforward comparison and can be calculated for the subsidy approach as follows:

Total Sanitation Benefit (TSB) + Total Subsidy Value (TSV) - Cost to Participant (CTP) = Econ Impact (IE)

The TSRWSSSP resulted in the installation of 45,056 latrines for a TSB of $45.4 million.[44] The project's Total Subsidy Value (TSV) of $4.7 million should then be added as part of the project's economic impact, because it represents an injection of exogenous capital from the project into the economy.[45] The Cost to Participant (CTP) is the total financial contribution that project participants paid towards the full price of the latrines. This is equivalent to the TMV in the market-based approach. It should be subtracted from the project's economic impact because it represents the price participants are paying for the sanitation benefit. In the absence of readily available data, it is assumed that the average household contribution was half the amount of the subsidy, covering one-third of the latrine price.[46] This is yields a cost of $51.94 per latrine for a total CTP of $2.3 million.

Adding the total sanitation benefit to the total subsidy value and subtracting the total cost to participants yields an economic impact of 47.8 million for the TSRWSSSP. In comparison, the *Hands-Off* program had an economic impact of $166.4 million (calculated in the previous section). In order to better inform sanitation investments, the economic impact of a project can be divided by total program expenditure. Every dollar the TSRWSSSP invested in latrine subsidies resulted in $10.2 of economic growth, while the *Hands-Off* program yielded a return of $62.8 in economic growth for every dollar invested. Even if Non-SP latrine sales are excluded from the equation, the *Hands-Off* program still yields a net positive economic impact of $106 million, contributing $40 to the economy for every $1 invested.

***Table 15: Comparison of Subsidy and Market-Based Approaches***

| | TSRWSSSP | *Hands-Off* Program | | |
|---|---|---|---|---|
| | | SPs | Non-SPs | Program Total |
| **Program Expenditure** | $4,680,000 | | | $2,652,066 |
| **Timeframe and Duration** | 4 yr 6 months | | | 7 yr |
| **Installed Household Latrines** | 45,056 | 147,393 | 98,819 | 246,212 |
| **Program cost per latrine** | $103.87 | | | $10.77 |
| **Cost savings to consumers** | $4,680,000 | | | $68,229,626 |

[44] Prior to 2010, the latrines installed under TSRWSSSP fit the JMP definition of an improved toilet system. Past that period, households were allowed to build any type of superstructure or substructure they wished. It is unclear whether the post 2010 latrines fit the definition of improved toilet system. For the sake of simplicity, the model assumes all TSRWSSSP latrines fit the definition of improved toilet system and therefore provide the same sanitation benefit as the toilets produced by Non-SPs and SPs in the *Hands-Off* Program.

[45] Publically available project documents do not provide any information on the location of the latrine suppliers; hence, it is not possible to determine the proportion of latrines produced by local producers nor the proportion of this injection of capital that was captured by the local economy. Therefore, the comparison below on economic impact does not refer to the rural areas in which the project took place but rather the economy of Cambodia as a whole.

[46] This is an approximation as available program data does not allow for an exact calculation of average household contribution. From the onset of the project, four latrine types were offered, with subsidies ranging from 60% for pour flush latrines to 90% for dry pit latrines. Of the participating households 77% selected wet latrines while the remaining 23% selected dry pit latrines. However, a major change of project scope in 2010 where households could select a latrine with any type of super structure or substructure they wished. It is therefore, not possible to calculate the actual average cost of latrines purchased through the subsidy program nor the average household contribution.

| | | | | |
|---|---|---|---|---|
| **Total Sanitation Benefit** | $45,434,022 | $148,629,635 | $99,647,699 | $248,277,334 |
| **Economic Impact** | $47,774,022 | $105,956,973 | $60,475,815 | $166,432,788 |
| **Economic Impact/ Program Expenditure** | 10.2 | | | 62.8 |

This comparison is meant as an example of how to interpret the impacts of both the market-based approach and the subsidy-based approach in somewhat comparable terms. However, figures must be appropriately interpreted and any comparison should consider the different objectives of the two approaches. For example, subsidy approaches often attempt to target the poorest households, while the market-based approach does not. Even if a subsidy-based approach results in a smaller economic impact, its impact may be more pro-poor.

Another fundamental difference is that the market-based approach builds and strengthens local market systems to provide sanitation products over the long-term. Subsidy approaches, at best, give local market systems a once-off injection of cash in the form of latrine subsidies. Moreover, these subsides do not necessarily go towards local latrine producers. It is often the case that latrines are purchased from large producers based in far-off urban centers. In such instances, the local market for rural latrines does not benefit from the program. Local latrine producers may even be negatively impacted due to a reduction in sales as they compete against an influx of cheaper, subsidized products.

Furthermore, this model assumes equal usage of latrines in each of the DNE, program, and subsidy scenarios and does not account for potential differences in the rate of abandonment. Proponents of market-based sanitation often argue that paying customers are more likely to consistently use their latrine. According to a WaterSHED study, 96% of adults in households that purchased a latrine from an SP used it consistently throughout the year.[47] However, without estimates of usage rates in DNE and subsidies scenarios, a direct comparison cannot be made.

Although this model can provide some insights into the economic impact of sanitation programs, it remains a crude instrument at best. It should be used in conjunction with other analytical tools, which take into account the multitude of ways in which sanitation programs affect the social and economic well-being of the individuals they serve. Only then can well-informed sanitation investments be made.

[47] Pedi, D. et al. (2014). Rural Consumer Sanitation Adoption Study: An Analysis of Rural Consumers in the Emerging Sanitation Market in Cambodia. WaterSHED. Phnom Penh, Cambodia.

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## Appendix A: Data from Mason Focus Group Discussions

Cost of material and Labor Inputs to Latrine Production (Adjusted to 2015)

| FGD | Platform m2 | Materials (USD) | Labor (USD) | Total Sale Price (USD) | Cost per m2 (USD) |
|---|---|---|---|---|---|
| 1 | 3 | $337.76 | $146.45 | $484.21 | $161.40 |
| 2 | 3 | $516.30 | $183.06 | $699.36 | $233.12 |
| 3 | 3.6 | $547.77 | $244.08 | $791.86 | $219.96 |
| 4 | 4.14 | $349.44 | $142.88 | $492.32 | $118.92 |
| **AVG** | **3.4** | **$437.82** | **$179.12** | **$616.94** | **$183.35** |

## Appendix B: Latrine Core and Substructure Inputs

| BASIC MODEL: Latrine Core and Substructure with 0.8m X 0.8m Platform | | | |
|---|---|---|---|
| **Input** | **Price per unit (USD)** | **Quantity** | **Total Cost (USD)** |
| Cement | $0.10 | 109.5 | 10.95 |
| Sand | $0.21 | 10 | 2.10 |
| Stone | $0.57 | 8 | 4.56 |
| Iron bar (rebar) | $0.19 | 22 | 4.18 |
| Engine Oil(black) | $0.13 | 4.5 | 0.59 |
| Ceramic Toilet pan/bowl | $9.00 | 1 | 9.00 |
| Tiles(1/2 pack) | $4.00 | 0.5 | 2.00 |
| PCV pipe (90mm) | $1.67 | 1 | 1.67 |
| PVC pipe (20mm) | $0.34 | 1 | 0.34 |
| Brick for construction (56 brick * 170 KHR) | $0.04 | 56 | 2.32 |
| Labor(latrine production pre-fab) | $0.88 | 6 | 5.28 |
| Delivery fee | $7.30 | 1 | 7.30 |
| Labor(installation) | $10.00 | 1 | 10.00 |
| Commission Fee | $2.44 | 1 | 2.44 |
| **TOTAL INPUT COSTS** | | | **63** |
| **TOTAL SALE PRICE** | | | **73** |
| **PROFIT** | | | **9.77** |
| **PROFIT MARGIN** | | | **13.5%** |

*All prices converted from KHR to USD at a rate of 4100:1

| Assumptions |
| --- |
| Delivery fee includes price of gas and driver labor. It does not include vehicle depreciation. |
| No cost data on depreciation of company assets(i.e. concrete molds, transport vehicle, hand tools) |
| Labor cost does not include cost to SP of providing workers with lunch and occasionally dinner |
| Tiles only cover area proximate to the basin. Does not cover whole slab. |

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