Women's Empowerment Water, Sanitation, and Hygiene (WE-WASH)

Social Return on Investment (SROI) Model

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Acronyms

APO	Adverse Pregnancy Outcome
CEA	Cost effectiveness analysis
GBV	Gender-based violence
GDP	Gross domestic product
GNI	Gross national income
GNP	Gross national product
PPP	Purchasing power parity
SDG	Sustainable Development Goal
SROI	Social return on investment
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
UTI	Urinary Tract Infection
VRWSP	Volta Rural Water Supply Project
WASH	Water, sanitation, and hygiene
WE	Women's empowerment
WHO	World Health Organization

Introduction

Aqua for All requires a valid method of demonstrating and valuing the social and economic impact specific to women's empowerment (WE) resulting from water, sanitation, and hygiene (WASH) investments and activities. To do this, Equilo, Inc. was contracted to develop a social return on investment (SROI) model that assigns a financial/monetary value of the social and economic impacts of WASH projects on WE due to benefits, including time-savings and reduction in gender-based violence (GBV) risk.

The detailed methodology is included in subsequent chapters of the report. The general approach taken to construct the WE-WASH SROI model includes the following:

- Review of existing SROI models and identification of appropriate indicators to include in the WE-WASH SROI model as financial proxy for social, economic and environmental impact.
- Review of existing social and economic indicators for outcome and impact measurement that may be included in the model, and other relevant literature, including indicators used in time use surveys and direct/ indirect GBV costs.
- Proposed indicators that may be used to collect data to measure social impact of specific WASH interventions to collect more robust investment-specific data to input into the SROI model to inform valuations, with a focus on identifying existing data gaps that need to be filled.
- Formulation of the SROI model that determines the social and economic impact, based on existing data and research demonstrating outcomes (time savings, productive, social benefits, other), of WASH investments/ activities, with clearly defined assumptions and inputs.
- Preliminary calculations to assign a global or regional value of a WASH investment or activity utilizing the WE-WASH SROI model.

Existing Models, Indicators, and Literature: Water

This section provides an overview of existing SROI models and indicators used to date, with a summary of the literature on the valuation of various variables, such as time and labor savings. Annexes I and II provide detailed tables with specific cost data related to time poverty and economic, health, and education cost-benefit analysis.

Background

Sustainable Development Goal 6[1] is to ensure availability and sustainable management of water and sanitation by 2030. Specific targets of SDG 6 include:

- ***6.1.*** By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- ***6.2.*** By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

Though there is enough fresh water storage on the planet, poor infrastructure limit people's access of clean water. The developing world face a series of challenges that are associated with WASH (Water, Sanitation, and Hygiene), including limited access to safe drinking water, the lack of sanitation, and water fetching. This model and literature review will specifically focus on water fetching and access to safe drinking water.

Access to drinking water is defined by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation as the source being less than one kilometer away from its place of use and it being possible to reliably obtain at least 20 liters per member of a household per day.[2]

When women have safe, affordable, and nearby access to clean drinking water it frees up their time and enables them to have healthier lives. Women may choose to use saved water collection time on leisure, childcare and supporting children with homework, and paid productive work through formal employment or entrepreneurial activities.

Improved water access for women in the community does not automatically indicate that the water is safe for drinking; measures still need to be taken to protect the water source from contamination or treat the water source after being accessed. This can be ensured through infrastructure at the water point itself, or we might assume that with women's additional time there may be increased time available to treat water at home through boiling or chlorination.

Access to water also means women are physically closer to the facilities and spends less time accessing water. Since the facilities are closer the chances women are exposed to violence is less likely because they spend less time waiting and traveling to water sources.

When girls can reduce time spent on water collection, their education may also improve, with more time to attend school. As well, when girls spent less time on physical drudgery of water collection and carrying, this may free up her time to study, play, and have increased physical and mental energy to focus when they attend school.

[1] United Nations. SDG 6- Water and Sanitation.
[2] WHO (2011). Interventions for Water Provision.

Numerous studies have been conducted, and models built, to quantify the costs of time and drudgery associated with water collection, benefits in reducing time spent and drudgery through WASH interventions, and social return on investment (SROI) of such interventions.

Time Poverty

Defining Time Poverty

"Working long hours and having no choice to do otherwise. An individual is time poor if he/she is working long hours and is also monetary poor, or would fall into monetary poverty if he/she were to reduce his/her working hours below a given time poverty line."

World Bank (2009). Working Long Hours and Having No Choice: Time Poverty in Guinea.

Time and labor spent on water collection is a serious challenge contributing to time poverty experienced in many developing countries globally. Estimates of time poverty experienced, disproportionately by women and girls, include:

- An estimated **3.36 million children and 13.54 million female adults** across 24 Sub-Saharan Africa are responsible for water collection with the collection times greater than 30 minutes.[3]
- In sub-Saharan Africa, on average, households spend **33 minutes in rural areas and 25 minutes in urban areas round trip** to collect water, and in Asia households spend 21 minutes and 19 minutes in rural and urban areas, respectively.
- **Women and girls are responsible for water collection in 80% of households** without access to water on premises.[4]
- An estimated **40 billion women-hours per year** are spent fetching water in sub-Sharan Africa.[5]

Poverty is typically measured by the minimum necessary level of income that must be secured by households to ensure basic basket of necessities. Based on income poverty measurement, gross domestic product (GDP) structure, purchasing power parity (PPP) have been developed to reflect the poverty of the region or country. However, the measurement based on income poverty thresholds alone has limitations. It assumes that households have a minimum quantity of time on production, including low-income households. The assumption is problematic. Indeed, low-income households may not have the requisite time for production because of the heavy burden of household work, caring, etc.

A basic model of time and income poverty, which states that the physically fixed number of total hours equals the sum of time spent on income-generation, household production, personal care, and everything else:

Xi (Time Poverty, or deficit/ surplus)*= Li(time spent on employment) + Ui (time spent on household production) +Ci (time spent on personal care) + Vi (time available for everything else)*

$$Xj = \sum_{i=1}^{n} \quad min\ (0, Xij)$$

[3] Graham, JP et al (2016). An Analysis of Water Collection Labor among Women and Children in 24 Sub-Saharan African Countries.
[4] United Nations SDG Joint Monitoring Programme (2017). Progress on Drinking Water, Sanitation, and Hygiene.
[5] Ray. Women, Water, and Development. Annual Review of Environment and Resources. Volume 32, 2007, pp 421-449.

Fetching water and collecting firewood are traditionally seen as unpaid housework, so this would be included in this model within the category of household production.[6] This model is useful as a basis to understand and calculate time poverty, but it has limitations as it does not allow the household to be compensated by the time surplus of another individual of the same household.

Different approaches that have been used to calculate the cost of time poverty specific to water collection include:

- Total time spent collecting water at individual or household levels, such hours/week, hours/month
- Time spent per return trip to collect water
- Gender division of time allocation, identifying time spent on various household (e.g. reproductive work) tasks by men vs. women

Value of Women's Productive, Reproductive, and Leisure Time

Some reports have estimated the number of total cost or potential economic benefit of WASH, such as a World Bank study that estimates that the economic loss of poor WASH in Indonesia and the Philippines is $3.3 bn and $ 1bn, respectively.[7] Improved WASH access enables individuals to potentially increase their productivity and income-generating activities and opportunities. Given the assumption that time saving could be used for income-generating activities, some models use gross domestic product (GDP) or gross national income (GNI) to calculate the value of saved time.

For women, the opportunity costs of time spent on water collection are high as it deprives them of choosing to spend their time for production, caring for their children or household, or leisure. Improved water services through WASH projects/technologies have beneficial effects for women. It is unclear how women will use the saved time once WASH projects/technologies enable them to have easier access to clean water.

- In a case study done in Ghana,[8] the survey found that women used the saved time from the Volta Rural Water Supply Project (VRWSP) on various activities that they perceived would promote their well-being. It is possible that women use the time for different activities, such as a combination of housework and market activities.

- In India, there is evidence suggests that better public infrastructure may release women's time to more market-oriented work.[9]

However, reduced time spent on water collection does not necessarily translate directly into an increase in income-generating activities or that it leads to increased income. An ADB report concludes that, *"there is little hard evidence to show that time saved is reallocated to activities that might have a transformative effect on gender relations in the household, such as participation in market work."* Instead, survey results seem to indicate that women would devote the saved time to other household work in Asia.[10] In one study, female respondents said they would spend the extra 30

[6] UN Stats. Guide to Producing Statistics on Time Use: Measuring Paid and Unpaid Work.
[7] World Bank (2008). Economic Impacts of Sanitation in Indonesia: A five-country study conducted in Cambodia, Indonesia, Lao PDR, the Philippines, and Vietnam under the Economics of Sanitation Initiative (ESI) Assessment of Sanitation Interventions in Indonesia. Water and Sanitation Program East Asia and the Pacific (WSP-EAP) World Bank Office Jakarta.
[8] Arku (2010). Time savings from easy access to clean water: Implications for rural men's and women's well-being. Presbyterian University College, College Department of Rural and Community Development, July 2010.
[9] ADB (2015). Balancing the Burden? Desk review of women's time. Poverty and Infrastructure in Asia and the Pacific.
[10] ADB (2015). Balancing the Burden? Desk review of women's time. Poverty and Infrastructure in Asia and the Pacific.

minutes a day, if they have a private toilet, bathing and washing (most preferred), or resting and cooking (second and third most preferred).[11]

Various models exist for calculating the value of productive, or income-generating activities (See Annex II). For example, for each hour saved, one can calculate the average gross national income (GNI), which could be disaggregated by male/ female, urban/ rural, job type) and multiply the minutes/ hours by that saved, using World Bank GNI/ PPP data[12] globally or per country.

For non-income generating activities (care and household work), it is possible to use market price (paid labor work on care and household work). For example, the market value for cleaning or cooking for a domestic worker, or childcare for a nanny, could be used to calculate the value of reproductive work, which may include:

- "Saving" in public expenditures (e.g. women care for an elderly dependent family member) reported by the government
- Cost of replacing an unpaid household worker with a paid worker (opportunity cost, specialist cost and generalist cost) through government reports, market value of domestic work based on different activities (laundry, cooking, childcare, etc.) and then transform this into an hourly wage

Thus, calculating the value of unpaid reproductive or household work could be calculated by:

> *Time spent on housework valued at a "suitable" wage + consumption of fixed capital [household durable, means of transport, facilities etc.] + taxes less subsidies on production = gross value added of household production + intermediate consumption used in production [raw materials, energy etc.] = output [total value of household production]*

Local household surveys can help collect data on this potential by collecting primary data related to current time spent on productive, reproductive, and leisure activities, and the financial valuation of such activities:

- Range and nature of daily activities
- Sources of income, and which activities generate income
- Current and preferred time allocation (if there were more time made available, and if what they would choose to do with their time would change based on how much time is saved)
- Hourly wages from formal employment (from government stats or self-reported)

In addition, unpaid work contributes to wellbeing. human capital building, and long-term economic growth, which can represent over 50% of GDP.[13] This additional value of unpaid care work related to the development of capacities, the broadening of options, and human relationships can be included within the SROI model as well.

Research in developed countries reveals positive relationships between leisure activities and self-reported physical health condition[14]. One study explores the potential association between leisure and economic growth in China, including "advancing by leisure" and "learning by leisure." Leisure time can positively affect economic growth because leisure time affects human capital accumulation by improving individual's intelligence, creativity and learning capacity. A correlation was found between leisure time and labor efficiency, where active leisure participation was found to improve

[11] World Bank (2008). Economic Impacts of Sanitation in Indonesia: A five-country study conducted in Cambodia, Indonesia, Lao PDR, the Philippines, and Vietnam under the Economics of Sanitation Initiative (ESI) Assessment of Sanitation Interventions in Indonesia. Water and Sanitation Program East Asia and the Pacific (WSP-EAP) World Bank Office Jakarta.
[12] World Bank GNI Global data accessible at: https://data.worldbank.org/indicator/ny.gnp.pcap.pp.cd
[13] Pan American Health Organization (2010). The Invisible Economy and Gender Inequalities: The importance of measuring and valuing unpaid work.
[14] Susilo and Liu (2017). Examining the relationships between individual's time use and activity participations with their health indicators.

productivity.[15] Definition of leisure (entertainment, relaxing, socializing, etc.)[16] To estimate the value of leisure (quantify) and survey design[17] value of leisure equal to the reservation wage, using information collected through interviews about the willingness to reduce the weekly number of hours at work→self-reported data from survey

Cost of Water-Borne Diseases and Associated Healthcare

In 2012 a total of 842,000 diarrhea deaths were caused by inadequate WASH (502,000 from water, 280,000 from sanitation and 297,000 from hand hygiene). This represents over half of diarrhea diseases, or an estimated 1.5% of the total disease burden. Contaminated water can transmit diseases such as diarrhea, cholera, dysentery, typhoid, and polio, etc.[18] Research shows water-supply modes and quality of drinking-water were statistically associated with diarrhea, etc.[19]

The economic returns depend on region and WASH technology choice, and range between USD 3 and USD 34 for every USD 1 invested. Universal improved access to water and sanitation services, including additional improvements such as point-of-use disinfection, would lead to an economic benefit ranging from USD 5 to USD 60 per dollar invested.[20]

In Bangladesh, 41% of *improved* water is contaminated with E. coli. (World Bank 2017)

For those who have to make a long journey for water collection, health problems for them and their families are observed, including spinal damage from carrying heavy loads and incidence of waterborne diseases which increase with distance to supply.[21] In 2004, an estimate of 4% of the global burden of disease and 1.6 million deaths per year were attributed to unsafe water supply and sanitation.[22]

One global study found that a 15-min decrease in one-way walk time to a water source is associated with a 41% average relative reduction in diarrhea prevalence, improved anthropometric indicators of child nutritional status, and an 11% relative reduction in under-five child mortality.[23]

Other research calculates the direct economic costs that are associated with visit health facilities as a result of water-borne diseases. It is assumed that 50% (range 0% to 2,100%) of diarrheal cases seeking formal health care take some form of transport at US$0.50 per return journey, excluding other direct costs associated with the journey. Other costs associated with a visit to the health facility are also assumed such as food and drinks, and added to transport costs, giving US$0.50 per outpatient visit and US$2 per inpatient admission. Time costs avoided of treatment seeking are assumed to be included in the time gains related to health improvement.[24]

In addition to direct health costs, there are costs associated with missing work and school due to illness. The expected time ill per case of diarrhea for a young child is assumed to be 5 days, which reflects the average of breast-fed infants (3.8 days) and formula-fed infants (6.2 days) in Mexico. For the valuation of this illness time, it would not be wholly justifiable to give young child days a valuation of the full GNI per capita. However, in recognition of the opportunity cost of the child's carer, who

[15] Wei, Xiang, Qu, Hailin, Ma, Emily (2010). A Study of the Effects of Leisure Time on China's Economic Growth: A Neoclass Growth Model.
[16] Aguiar, Mark and Erik Hurst (2005). Measuring Trends in Leisure: Evidence from Five Decades of Time Use Surveys.
[17] Jara-Díaz, et al (2008). Estimating the Value of Leisure from a Time Allocation Model.
[18] WHO (2019). Drinking Water.
[19] Yongsi, H. Blaise Nguendo (2010). Suffering for Water, Suffering from Water: Access to Drinking-water and Associated Health Risks in Cameroon.
[20] WHO. Making Water a Part of Economic Development. Economic Cost-Benefit Analysis.
[21] Graham, et al (2016). An Analysis of Water Collection Labor among Women and Children in 24 Sub-Saharan African Countries.
[22] WHO. Mortality and burden of disease from water and sanitation.
[23] Pickering and Davis (2012). Freshwater Availability and Water Fetching Distance Affect Child Health in Sub-Saharan Africa. Environment, Science, and Technology. Epub 2012 Feb 9.
[24] Hutton, G., Haller, L., & Bartram, J. (2007). Global cost-benefit analysis of water supply and sanitation interventions. Journal of Water and Health, 5(4), 481–502.

would have been doing other productive activities with the time they cared for the sick child, a daily value is taken at 50% of the GNI per capita. Assumptions are also used that 2 work days are lost per case of adult diarrhea. [25]

Cost of Missed Schooling

School absenteeism negatively impacts learning outcomes and can reduce future earning potential of a learner. According to the UNICEF, water collection can take time away from girls' education and in some cases prevent them from attending school altogether. In numerous WASH projects there is found convincing evidence suggest that improved access to water leads to improved schooling for both girls and boys (e.g. attendance to high school).[26]

With the time savings, girls' time spent in school and learning may increase. For instance, after four years of the project, the Rural Water Supply and Sanitation Project, which is launched by the World Bank in Morocco, it is found that girls' school attendance increased by 20 percent in as girls spent less time fetching water.[27]

Cost of Gender-Based Violence

Worldwide, one in every three women has experienced gender-based violence (GBV) in her lifetime. Gender-based violence impacts health, emotional and psychological status, communities, and the economy. Sexual violence increases women's morbidity and mortality, unwanted pregnancy and unsafe abortion, sexually transmitted infections and HIV, psychological trauma, and social stigma and exclusion. Globally, women and girls face risk of physical violence, including sexual assault, when traveling distances to collect water or at or around unsafe water points.[28]

In 2016, the global cost of violence against women was estimated by the UN to be US$1.5 trillion, equivalent to approximately 2% of the global gross domestic product (GDP), or roughly the size of the entire Canadian economy.[29] Costs of violence against women can be both direct and indirect, and are incurred by women and their families, by perpetrators and their families (considered by two of the 13 studies in this brief), and by state and non-state institutions. Women who survive the violence bear the brunt of costs – as much as six times the cost to the state. These overall costs of violence against women are comparable to state budgets for essential services. In Bangladesh, the cost of domestic violence at US$2.3 billion (equivalent to 2.1% of GDP in 2010) was equal to the health and nutrition budget for the whole country in that year. In Zambia, the cost of gender-based violence at 2.27% of GDP or US$473 million was comparable to the entire health budget for the country in 2016.[30]

[25] Hutton, G., Haller, L., & Bartram, J. (2007). Global cost-benefit analysis of water supply and sanitation interventions. Journal of Water and Health, 5(4), 481–502.
[26] United Nations SDG Joint Monitoring Programme (2017). Progress on Drinking Water, Sanitation, and Hygiene.
[27] Global Policy Forum (2012). Women Spend 40 Billion Hours Collecting Water.
[28] Pommelis, et al (2018). Gender Violence as a Water, Sanitation, and Hygiene Risk: Uncovering Violence Against Women and Girls as It Pertains to Poor WaSH Access.
[29] UN Women (2016). The Economic Costs of Violence Against Women.
[30] CARE International (2018). Counting the Cost: The Price Society Pays for Violence Against Women.

WE-WASH SROI Model - Water

This section presents a Women's Empowerment water, sanitation, and hygiene (WE-WASH) social return on investment model, based on the existing literature and data available. The section begins with the model and summary description, and is followed by a detailed description of the model variables and assumptions.

Model Summary

This section provides a broad overview of the WE-WASH SROI model accompanied by assumptions built into the model. The goal of the model is to quantify the financial value of the social and economic impact of WASH investments on women's and girls' empowerment. This is based on existing data and research demonstrating outcomes (e.g., time savings, productive, social benefits, other) of WASH investments/ activities, with clearly defined assumptions and inputs.

There are numerous variables that represent the value of the empowerment benefits enjoyed by a woman or girl with improved access to WASH as explored in previous sections. For simplification purposes, the model presented here makes the following broad assumptions:

- The WASH intervention will reduce time poverty and drudgery of a woman according to commonly accepted definitions of time poverty and improved access to clean water access (see previous section).
- The value that is calculated is the financial value, based on direct and indirect opportunity costs and social/ economic benefits, equivalent to 15 additional minutes of time saved per day on water collection.
- The variables included in the model include:
    - Average value of productive time gained
    - Costs of water borne diseases and associated health care costs averted

WE-WASH SROI Model (Simple)

Value of 15 minutes saved per woman from a WASH investment (USD$)=

Value of Productive Time Gained + Averted Diseases and Healthcare Costs (Ch)

Time use surveys should be utilized at the beginning and end of each project to determine the average minutes spent per women, and the total number of women beneficiaries, on water collection. Then, the total minutes estimated to be saved at the project may be multiplied against the value of each 15 minutes saved the WE-WASH model to identify the total SROI of a specific investment. Or, in other words, once estimated the total 15 minute increments of time saved for all anticipated women beneficiaries, a total assigned WE-WASH credit may be assigned for investment.

This simple WE-WASH SROI model omits several variables due to complexity of estimating financial values and data availability, further discussed below. Variables that are currently omitted but may considered to be included in future iterations of the model once further research and data becomes available include the following:

- **Value of reproductive (household and childcare) time gained**, including value of children's wellbeing, safety, health, and emotional wellbeing
- **Value of leisure time gained**, including value of mental and emotional health, well-being, and ability to think about and plan for the future
- **Value of additional waterborne disease and health care costs**, including value of averted deaths in the near-term and long-term and value of missed work and school as a result of the death, and value of children's increased nutrition resulting in better educational outcomes, attainment, and long-term income-generation prospects, and value of time spent by women on caring for ill family members
- **Value of averted education loss**, including value of avoiding missed school due to time spent on water collection or due to waterborne illness
- **Value of averted gender-based violence (GBV) costs**, including costs for in-patient and out-patient physical and psychosocial treatment for the treatment, legal costs for the survivor and perpetrator, and loss of income for the survivor and perpetrator

These variables are included in the below complex model, and not in the above simple model. These excluded variables from the simple model result in a low valuation of a calculated WE-WASH SROI model. As more data and research becomes available to allow introduction of variables from the complex model, the overarching WE-WASH SROI value will increase substantially.

WE-WASH SROI Model (Complex)

Value of 15 minutes saved per woman from a WASH investment (USD$)=

Average of (Value of Productive Time Gained (Pi) +Value of Leisure time Gained (Li) + Value of Reproductive Time Gained (Ti)) + Averted Diseases and Healthcare Costs (Ch) + Averted Education Loss (Ce) + Averted GBV Costs (Cg)

Model Variables and Assumptions

The specific cost calculation equations for each of the variables in the model is defined below, which include the value of productive time gained as a result of reduced time spent on water collection, in addition to averted water-borne disease and associated health care costs (Ch).

Value of Productive (Pi) Gained

With each extra 15 minutes of time saved that was previously used to collect water, women may choose to use this time on a range of activities, including productive (e.g. income-generating), reproductive (e.g. household activities), or leisure. Each of these come with a respective value, irrespective of what she may choose to do with her newly freed time. For the purposes of this model, we will use the market rate for paid time as a proxy value for a woman's time, regardless of the way in which she chooses to use her time.

Local and country specific data may be used to populate this Pi value for a more accurate estimate. This valuation is based primarily on the average annual GNI, and could be further refined to identify urban/ rural and male/female average annual GNI values. The value of productive time gained (Pi) in

Value of productive time gained (Pi)

Value of 15 minutes saved per woman from a WASH investment (USD$)=

Average annual GNI per capita / Average hours worked per year / 4 (15 minute) increments per hour

the WE-WASH SROI model is calculated as follows:

VALUE OF AVERTED COSTS OF WATER-BORNE DISEASES AND ASSOCIATED HEALTHCARE

Improved access to clean water in closer proximity to households reduces the prevalence of water-borne diseases within adults and children, thereby averting deaths from water-borne diseases, direct and indirect healthcare costs, and economic costs of missed days of work and school. It may also be assumed that healthier women can work more and earn more income, and healthy family members reduces their time spent on caring for the ill.

For the WE-WASH model the value of averted costs of water-borne diseases and associated healthcare is based on the estimated direct and indirect costs of water-borne diseases. This value is likely to be an underestimate, as it does not take into account valuation of:

- Value of productivity lost due to sick days from work or school
- Value of time caring for ill family members
- Value of improved nutritional status of children on learning outcomes, brain development, and future earning capacity as a result of averted diarrhea cases
- Direct and indirect costs of deaths averted, including funeral costs, lost future wages of the deceased, and lost productivity of affected family members

In addition, this valuation is based primarily on diarrhea prevalence as an indicator of a water-borne disease. The value of averted water-borne diseases and associated health care costs (Ch) in the WE-WASH SROI model is calculated as follows:

Value of averted costs of water-borne diseases and associated health care (Ch)

Value of 15 minutes saved per woman from a WASH investment (USD$)=

(Average cost of clinic visit to treat diarrhea + Average cost of roundtrip transport to clinic) x Percentage reduction in diarrhea cases from each 15 minutes saved on water collection

WE-WASH Global Credit Value: Water

Assigning specific values to each of the variables to identify one true global cost or value should be taken very carefully as a very broad estimation. For this reason it is recommended that local or country-specific data be used at the beginning of each project to calculate the project-specific WE-WASH credit. However, in lieu of having this data available, the following data is extracted to calculate the estimated WE-WASH global credit. The breakdown of calculations of each variable, Pi and Ch, can be found below.

WE-WASH Global Credit Value: Water

Value of 15 minutes saved per woman from a WASH investment

USD$1.50

Value of Productive Time (Pi) Gained

Value of productive time (Pi) gained for every 15 minutes a woman saves collecting water

USD$0.27

Local and country specific data may be used to populate this Pi value. As a default proxy in lieu of country- and locality-specific day, previous research and cost estimates may be utilized for these variables: **US$1.40 (Pi)=**

- **The current average annual (2018) gross national income (GNI)** per capita for all low income countries is US$2,225
- **Average full-time hours worked per year is 2,080**: $2,225/ 2,080 = US$1.07/ hour
- Each 15 minute increment is equal to: $5.59/ 4 increments in an hour = $0.27
- We assume in the model that each 15 minutes saved is either spent on productive work, unpaid reproductive work, or leisure time, which is not currently valued, but will use productive work as a proxy, assuming equal value of reproductive work or leisure time.

Value of Averted Costs of Water-Borne Diseases and Associated Healthcare

Value of averted costs of water-borne diseases and associated health care (Ch) for every 15 minutes a woman saves collecting water

USD$1.23

Local and country specific data may be used to populate this Ch value. As a default proxy in lieu of country- and locality specific day, previous research and cost estimates may be utilized for these variables: **US$1.23 (Ch)=**

- **Average cost of clinic visit to treat diarrhea: US$2.50** (US$0.50 per outpatient visit and US$2 per inpatient admission, assuming time costs avoided of treatment seeking are included in the time gains related to health improvement).[31]

- **Average cost for transport: US$0.25** (assuming that 50% of diarrheal cases seeking formal health care take some form of transport at US$0.50 per return journey, excluding other direct costs associated with the journey).[32]

- **Percentage reduction in diarrhea cases from each minute saved from water collection: 41%** (One global study found that a 15-min decrease in one-way walk time to a water source is associated with a 41% average relative reduction in diarrhea prevalence).[33]

Limitations and Data Availability

There are limitations in the accuracy of using this model, mostly related to the availability of locally-specific data to ensure accuracy of the model. Many of the existing studies regarding time use, savings, and poverty are presented as case studies and are locality-specific or project-specific, making it challenging to apply the exact quantitative findings to other localities. Thus, it is suggested that the model be utilized to input locality- and project-specific data that is collected for the greatest accuracy possible.

Variables that are currently excluded from the model due to limited availability of data, and could significantly increase the value of 15 minutes of time saved on water collection, include:

- **Value of reproductive (household and childcare) time gained**, including value of children's wellbeing, safety, health, and emotional wellbeing
- **Value of leisure time gained**, including value of mental and emotional health, well-being, and ability to think about and plan for the future
- **Value of additional waterborne disease and health care costs**, including value of averted deaths in the near-term and long-term and value of missed work and school as a result of the death, and value of children's increased nutrition resulting in better educational outcomes, attainment, and long-term income-generation prospects, and value of time spent by women on caring for ill family members
- **Value of averted education loss**, including value of avoiding missed school due to time spent on water collection or due to waterborne illness
- **Value of averted gender-based violence (GBV) costs**, including costs for in-patient and out-patient physical and psychosocial treatment for the treatment, legal costs for the survivor and perpetrator, and loss of income for the survivor and perpetrator

Variables that could change the accuracy of the model, which could be corrected by collecting project-specific data, include:

- Value of a woman in her productive years vs. girl in schooling years may vary (current model includes value of woman in productive years only)

[31] Hutton, G., Haller, L., & Bartram, J. (2007). Global cost-benefit analysis of water supply and sanitation interventions. Journal of Water and Health, 5(4), 481–502.
[32] Hutton, G., Haller, L., & Bartram, J. (2007). Global cost-benefit analysis of water supply and sanitation interventions. Journal of Water and Health, 5(4), 481–502.
[33] Pickering and Davis (2012). Freshwater Availability and Water Fetching Distance Affect Child Health in Sub-Saharan Africa. Environment, Science, and Technology. Epub 2012 Feb 9.

- Average local wages and employment/ entrepreneurship opportunity varies by locality, in addition to country
- Average health care costs and disease mortality rates vary by locality and country
- GBV prevalence varies by locality and country
- There may be urban vs. rural variance in average time to collect water/ savings, as well as the value of time savings and other opportunity costs.
- People may need several trips to a water source in one day to get enough water for daily use
- There may be seasonal variation (e.g. rainy vs. dry season rainy season water collection needs)
- An intervention may impact a woman's empowerment differently (e.g. piped water directly to her home, vs. borehole and tap nearby, and treated vs. untreated water source)

For a more accurate country-specific, or even locality-specific SROI value, it will be advantageous to include, where available, country-specific data for the variables within the model. This may be done either by:

1) Implementing a project-specific baseline survey that collects the required data from the community members OR
2) Utilization of existing country-specific or locality-specific data.

A combination of these two options may also be used, using available data where recent and relevant, and collecting primary data where there may be missing data.

Useful databases where data may be available for a specific country or locality related to average time spent collecting water, women's experience of GBV, water-borne disease incidence, etc. include, but are not limited by:

- USAID MEASURE Demographic Health Survey (DHS)
- OECD. Data for GDP per hour worked
- UNICEF
- World Bank

Existing Models, Indicators, and Literature: Sanitation & Hygiene

This section provides an overview of existing SROI models and indicators, with a summary of the literature on the valuation of various variables, such as time and labor savings, as well as GBV. The literature is reviewed with an eye to quantifying the impact of sanitation and hygiene investments on the empowerment of women and girls, leading to the development of a quantitative model that can be applied to proposed investments in the context of low-income countries. This model seeks to rely only on commonly used M&Es so that it can be operationalized simply and in a variety of project and country contexts.

Background

More than 900 million people in the world defecate in the open due to a lack of access to basic sanitation.[34] The Sustainable Development Goals (SDGs) include specific goals for sanitation and hygiene, especially as they relate to women and girls. SDG 6.2 reads, "By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations." In addition, SDG 1.4 reads, "By 2030, ensure that all men and women, in particular the poor and vulnerable, have equal rights to economic resources, as well as access to basic services."

WE-WASH & Covid-19

Two of the most important preventative measures against Covid-19 are **social distancing** and **handwashing**. This gives additional urgency to WASH investments.

- Women and girls may wait in long lines at the pump to retrieve water where it may not be possible to practice social distancing
- In urban areas, women and girls may have to walk long distances in crowded areas to fetch water or to access sanitation
- Less than 20% of the world's population washes their hands with soap and water after using the bathroom

- The WHO and UNICEF measure progress towards these goals with the following indicators:
- SDG Global Indicator 6.2.1: Population practicing open defecation
- SDG Global Indicator 6.2.1: Population using safely managed sanitation services
- SDG Global Indicator 6.2.1: Population with a basic hand washing facility with soap and water available on premises
- SDG Global Indicator 1.4.1: Population living in households with access to basic services (including basic drinking water, sanitation and hygiene)
- SDG Global Indicator 3.2: Ending preventable deaths of newborns and children under 5
- SDG Global Indicator 3.3: Ending water-borne diseases
- SDG Global Indicator 3.9: Substantially reducing deaths and illness from water and soil pollution and contamination

The WHO/UNICEF Joint Monitoring Programme for Water Supply Sanitation and Hygiene (JMP)

Defining Safely Managed Sanitation

A facility that hygienically separates human excreta from human contact and where "excreta [are] safely disposed of in situ or treated off-site."

WHO/UNICEF Joint Monitoring Programme for Water Supply and Hygiene (JMP)

[34] WHO, and UNICEF. 2017. "Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines." Vol. 11. https://doi.org/10.1371/journal.pone.0164800.

defines "safely managed sanitation" as services where "excreta [are] safely disposed of in situ or treated off-site".[35] As of 2015, an estimated 39% of the world's population uses safely managed sanitation; another 29% use basic sanitation and the balance have access to limited or unimproved sanitation. Twelve percent of the world's population only have access to open defecation. While the number practicing open defecation decreased globally between 2000 and 2015 from 1.3 billion to 892 million, the number in sub-Saharan Africa increased from 204 to 220 million.[36]

90% of people in rural Niger defecate in the open, and 51% don't have access to improved water. (World Bank 2017)

In terms of hygiene and hand washing, while data are incomplete, in most sub-Saharan countries fewer than 50% of the population have access to basic hand washing facilities including soap and water. In some countries it is as low as 15%. A meta-analysis found that handwashing with soap ranges between 13% and 17% for all low- and middle-income countries (Freeman et al. 2014). Handwashing is a vital step in preventing the spread of fecal-oral diseases.

The following discussion and model are based on the assumption that the sanitation intervention will shift the target population from either open defecation or unimproved sanitation to safely managed sanitation, as defined by the JMP, such as community lavatories with lockable doors, lights, handwashing facilities and soap with privacy for washing hands after managing menstruation materials, no places where an assailant could be hidden, and preferably a guardian or attendant.

In Mozambique, 90% of underweight mothers only have access to unimproved sanitation. (World Bank 2017)

Time Poverty

The Economics of Sanitation Initiative of the Water and Sanitation Program of the World Bank estimates that in many Sub-Saharan countries, the average time to find a place for open defecation is about 10 minutes per trip. They acknowledge that this burden is likely to be higher for women than men, as women are more likely to accompany children and the elderly. A study in villages in India puts the time at 30 minutes to an hour per trip, with at least two trips per day (Abdul Azeez, Negi, and Mishra 2019). These estimates do not take into account that women are likely to accompany children and elderly household members, which will increase the time, or necessitate additional trips. As discussed earlier, the burden of time poverty means that a woman has no choices about how her time is spent. With the time saved several times per day in travelling to and from a location for open defecation, a woman will be able to choose a range of activities, from paid work, household production or leisure.

Cost of Fecal-Oral Diseases and Associated Healthcare

As mentioned above, a total of 842,000 diarrhea deaths occurred in 2012, where 502,000 were due to water, 280,000 to sanitation and 297,000 from hand hygiene (WHO 2019). A meta-analysis of sanitation studies found that improved sanitation reduces diarrheal illness, with a pooled relative risk of 0.68 (95% CI 0.53-0.87), which means that the probability of contracting diarrheal disease with a sanitation intervention is 68% the probability of contracting diarrheal disease without a sanitation intervention. In other words, the probability is reduced by 32% (Fewtrell et al. 2005). Handwashing with soap reduces the risk of diarrheal disease by 42-47% (WaterAid

In Indonesia, children are 11 percentage points more likely to be stunted if living in communities with higher levels of open defecation during their first 1000 days of life. (World Bank 2017)

[35] WHO, and UNICEF. 2017. "Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines." Vol. 11. https://doi.org/10.1371/journal.pone.0164800, p.10.

[36] Ibid.

2020). Sanitation and handwashing complement eachother, but are not additive.

Diarrhea is a leading cause of mortality for children under the age of five, and a significant cause of illness. The disease burden on children often falls to women to care for and so is included here as a cost to women. Estimates for the number of diarrheal episodes experienced per year for children under the age of five range considerably. A 2006 World Bank study places the global median at 3.2 episodes per child. (Feachem and Jamison 2006). A 10-year study of 400 children in a Brazilian shantytown town saw 2.55 episodes per year (Moore et al. 2010) and a study of several villages in Gujarat found an average of 3.4 (Sutariya, Talsania, and Shah 2011).

Diarrheal mortality is highest in areas where children are underweight for their age, lack access to Vitamin A and do not have access to oral rehydration therapy (World Bank 2017), and so it is in these areas that WASH investments may have the biggest impact on child deaths. Mortality rates from diarrhea for children under 5 years of age are 0.27% in Western Africa, 0.13% in Eastern Africa and 0.11% in Southern Africa.

Globally, 4 in 5 people do not wash their hands after using the bathroom. (WaterAid 2020)

While it is difficult to quantify the cost of grief and trauma, the tangible and immediate expenses related to a child's death, such as funerals and missed work, can be explored. These lost wages and funeral costs should be considered only as the immediate and short-term costs of a child's death. This is *not* in any way an attempt to put an estimate of the value of the life lost, or the long term costs in terms of distress to the family. As such, they should be considered a lower bound on the costs of child mortality.

Expensive funerals are the norm for much of southern and eastern Africa, with 63% of Kenyan households that had fallen into poverty citing funeral costs as the reason (Krishna, Kristjanson, and Radeny 2004). The cost of a funeral for a child in South Africa has been estimated at USD 770, a little over half the USD 1500 for an adult's funeral (Collins and Leibbrandt 2008). Another study put the costs of an adult's funeral in South Africa in 2003 at USD 415 (Case et al. 2008). Many people in southern Africa have insurance for funerals, but are typically underinsured. In addition, some costs are borne by relatives, but nearly a quarter of households turn to money lenders charging interest rates of 30% per month (Case et al. 2008). The funeral of a child will also mean that a woman will miss work, forgoing up to one week of wages.

Cost of Stunting

Fecal-oral disease and diarrhea due to poor sanitation and hygiene can also lead to stunting in children. In Niger, Guatemala, DRC, Mozambique and Bangladesh, more than 40% of children under five are stunted. In many countries, there is an urban/rural divide in stunting. For example, in Pakistan, stunting affects 48% of the rural population and 37% of the urban population, where as in Bangladesh, the gap is only 2%. Not surprisingly, household wealth also has an impact on the level of stunting (World Bank 2017). Stunting can result in life-long reduced cognitive capacity, socio-emotional issues, reduced physical stature and strength, and increased vulnerability to communicable diseases. The lifelong effects of stunting are also seen in a country's GDP. The World Bank estimates that the GDP per capita of countries in Sub-Saharan Africa and South Asia would rise by 9-10% if stunting were eliminated. In particular, Ethiopia's per capita income would be 13% higher if none of its workforce had been stunted as children (Galasso and Wagstaff 2016).

In rural Tanzania, the stunting rate is 37%. (World Bank 2017)

While there are numerous factors that lead to stunting, such as inadequate healthcare and lack of micronutrients, inadequate WASH is a significant risk factor. A study of 24 villages in Ecuador showed that the community level of improved sanitation was more important to stunting in children than the child's own household. A neighborhood with 100% coverage of improved sanitation had

68% less childhood stunting. This effect was almost entirely manifested in girls who had experienced 100% sanitation coverage during her second year of life. These girls were 4.9 cm taller at the age of 2 than girls in areas with 0% coverage, even when controlling for other socio-economic factors (Fuller et al. 2016), which could lead to an average height difference of 10 cm in adulthood.

Cost of Gender-Based Violence

Access to improved sanitation does not automatically indicate that it will be used or that it will decrease the incidence of GBV. Some women express concerns of increased GBV if lavatories are constructed in a way that allows for men to conceal themselves nearby or inside the facility.

Overall, women in Kenya who practice open defecation have 39% greater odds of experiencing non-partner GBV than those with access to sanitation. Women who live in socially disorganized neighborhoods, where residential stability and wealth are below average and ethnic diversity is above average, are 13 times more likely to experience sexual assault by a non-family member than the women in those same neighborhoods with access to improved sanitation (Winter and Barchi 2016).

In Nairobi slums, only 24 percent of people have access to a toilet or latrine at the household level (Amnesty International 2010)

In Zambia, gender based violence costs the country 2.27% of its GDP (Ibrahim, Kuru-Utumpala, and Goulder 2018). Based on 2016 data, this amounts to $460 annually to the victim and her family. Lost income is responsible for $312 of that figure, with the rest going to medical, legal and relocation expenses. In Bangladesh, the annual costs are $227, more than one-fifth the average annual household income of $1,008 (based on 2010 data).

Cost of Poor Menstrual Hygiene

An estimated 1.9 billion women, roughly 26% of the world's population are of menstruating age, and spend, on average, 65 days per year menstruating (van Eijk et al. 2019). The age of menarche is typically between the ages of 10 and 15, and menopause occurs between the ages of 45 and 55. The World Bank estimates that 500 million women and girls lack the resources and facilities for menstrual health management (MHM). MHM is a complex topic as it both requires infrastructure, such as lavatories that provide privacy, disposal facilities for used menstrual products, and water for hand-washing, but also requires education and taboo elimination. The silence around the topic of menstruation leads to health risks at the individual level, as well as the exclusion of women and girls from fully participating in education, work and public life. For example, in Nigeria, roughly a quarter of women report having inadequately private toilet facilities. In Lagos, 85% of women said they have everything necessary to manage menstruation, but for rural women in Kaduna state, that rate drops to 37%.

500 million women and girls lack the resources and facilities for menstrual health management. (World Bank)

A great deal of literature is devoted to (MHM) in schools, and the possible affects menstruation may have on school attendance and drop-out rates. At the low end of estimates for missed school days is a finding of 0.35 days per school year for girls during menstruation in rural Nepal (Oster and Thornton 2011), and at the high end, 3 to 4 days per month. Another strain of the literature emphasizes the social and cultural changes that come with menstruation, such as the perceived eligibility for marriage, rather than menstruation, per se, as the cause of older girls' lower participation in schooling.

In the context of rural Nepal, Oster and Thornton provided a random subset of the girls in their study with menstrual cups to replace the menstrual cloths that were widely used. About 70% of the

girls adopted the menstrual cups and when they did, they reported a decrease in time spent on laundry of 20 minutes for each day of menstruation, and increased mobility.

In both rural and urban settings in Tanzania, older girls (16-19) expressed wishes for greater puberty education, private and lockable lavatories, facilities for hand washing either inside or very close to the lavatory, and also a close-by incinerator for disposal of their menstrual pads or napkins. They also expressed concern over the cost of menstrual pads, saying that the schools should provide them (Sommer 2010).

Defining Menstrual Hygiene Management (MHM)

"Women and adolescent girls are using clean menstrual management materials to absorb or collect blood that can be changed in privacy as often as necessary for the duration of the menstruation period, using soap and water for washing the body as required, and having access to facilities to dispose of used menstrual management materials. Further, women and girls must have access to basic information about the menstrual cycle and how to manage it with dignity and without discomfort or fear."

WHO/UNICEF Joint Monitoring Programme for Water Supply and Hygiene 2012 (JMP)

In one of the few sources available that addressed MHM over the course of women's lives, a study in Odisha, India found concerns and preferences shifted through life. Most women worried about the menstrual cloths remaining clean between periods. For unmarried and recently married women, this expressed itself as a preference for disposable pads. All women expressed the desire for privacy to change menstrual materials, but among those with access to latrines at home, the vast majority did not use those latrines for changing cloth or pads, preferring to find another private place within the home.

There were challenges in using soap and water for bathing during menstruation. This group's cultural practice was to have a ritual bath at the beginning of menstruation, but the conception that a menstruating woman would contaminate bodies of water meant that the water needed to be fetched by another member of the household. In addition, several women expressed concern over the price of soap. Most women did not express concern about disposal of menstrual materials and either buried them or disposed of them in the pond, river, or jungle. A few put them in the toilet. The women had many questions about the menstrual cycle, worrying about pain and irregularity. In addition, they did not have information about why their periods might be late, suggesting a lack of overall understanding of reproductive health.

The JMP definition of MHM missed some of the concerns expressed by this group of women. First of all, beyond the materials being clean and absorbent, the women were concerned about leaks, stains, and embarrassment if the cloth might fall out of their underwear. Women also wanted privacy for bathing, washing, storing and disposing of materials, and for urination and defecation, beyond just for changing materials.

WE-WASH SROI Model – Sanitation and Hygiene

This section presents a Women's Empowerment water, sanitation and hygiene (WE-WASH) social return on investment model focused on sanitation interventions, based on the existing literature and data. The section begins with the model assumptions and summary description, followed by a detailed description of the model variables, assumptions and WE-WASH: Sanitation Global Credit Value.

Model Summary: Sanitation and Hygiene

This section provides an overview of the variables included in the WE-WASH SROI model for sanitation, including the assumptions built in to the model. The goal is to quantify the financial value of the social and economic impact of sanitation investments on women's and girl's empowerment. This is based on existing data and research demonstrating outcomes of WASH interventions.

There are numerous variables that contribute to the empowerment of women and girls with improved access to sanitation. The model presented here makes the following assumptions:

- The sanitation intervention will reduce time poverty involved with traveling to a distant toilet or to an available outdoor space.
- The sanitation facility will have lockable doors, lights, soap and water for handwashing inside the latrine or in a place with some privacy.
- The sanitation intervention will avert costs for adverse health outcomes such as fecal-oral diseases resulting in diarrhea, and stunting.
- The sanitation intervention will reduce the probability of non-partner gender-based violence.
- A school-based menstrual hygiene management program including separate-sex lavatories with locking doors, private handwashing and disposal facilities for girls and education for both boys and girls.
- The financial value per woman of these variables is calculated on an annualized basis.

WE-WASH Global Credit Value: Sanitation & Hygiene

Annual value per woman of a nearby WASH investment providing Safely Managed Sanitation ($SROI_{sh}$)=

Value of Productive Time Gained (P_t) + Averted Diseases and Healthcare Costs (C_h) + Averted GBV Costs (C_{gbv}) + Value of Menstrual Hygiene Management in Schools ($C_{mhm\text{-}s}$)

Model Variables and Assumptions

This model assumes that the value of a woman's time is equivalent to the GNI per capita for low-income countries divided by the number of working hours in a year. The weighted average GNI per capita in 2018 was USD 840/per capita, and the number of working hours is assumed to be 2080. This value of time will be used throughout the rest of the model. This can easily be altered to country-specific or location-specific values for any project.

$$\frac{USD\ 840\ GNI\ per\ capita}{2080\ hours} = \frac{USD\ 0.40}{hour}$$

WE-WASH Global Credit Value: Sanitation & Hygiene

Annual value per woman of a nearby WASH investment providing Safely Managed Sanitation ($SROI_{sh}$)=

Value of Productive Time Gained (P_i) + Averted Diseases and Healthcare Costs (C_h) + Averted Stunting Costs(C_{stunt}) + Averted GBV Costs (C_{gbv}) + Value of Menstrual Hygiene Management in Schools ($C_{mhm\text{-}s}$)

=USD 146 + USD 13.18 + USD 29.4 + USD 9.60 + USD 43.70 = ***USD 241.88***

VALUE OF PRODUCTIVE TIME(PI) GAINED

Local and country-specific data may be used to populate this value for each project context. The calculation below makes the following assumptions:

- Shift from open defecation to nearby, usable improved sanitation
- Conservatively, 1 hour per day for trips to open defecation location

$$P_i = \frac{Time\ Saved}{Day} \times \frac{Value\ of\ Time}{Hour} \times \frac{365\ Days}{Year}$$

$$P_i = \frac{1\ Hour}{Day} \times \frac{USD\ 0.4}{Hour} \times \frac{365\ Days}{Year} = \frac{USD\ 146}{Year}$$

Value of productive time (Pi) gained from nearby community sanitation investment, on an annual basis

USD146

VALUE OF AVERTED COSTS OF FECAL-ORAL DISEASES AND ASSOCIATED HEALTHCARE

This measurement assumes that women are primarily responsible for any sick child in the household, and therefor the cost of caring for that child falls to a woman. A meta-analysis study of sanitation found that improved sanitation decreases diarrheal disease by 32% (Fewtrell et al. 2005). In addition, handwashing with soap and water has been shown to decrease diarrheal disease by 42-47% (WaterAid 2020). These efforts are not additive, but are complementary.

In addition, there is a small chance that the child may die from dehydration due to diarrhea, which will incur the short-term costs of a funeral and missed wages. The calculation of these costs is not to be considered the value of the child's life or the burden of grief, but only to be the short-term and immediate costs of the death. This calculation, then, is to be understood as a lower bound on the costs of child mortality.

Assumptions:

- Conservatively, assume that the combination of improved sanitation and handwashing with soap and water reduces diarrheal disease by 50% (World Bank)
- Each child under 5 has 3.2 diarrheal episodes per year without intervention
- Half of diarrheal episodes require a trip to the doctor, which including transportation costs (Haller, Hutton, and Bartram 2007), is USD3
- A sick child requires two days of care from a woman
- 88% of diarrheal death for under-5s is due to poor WASH and half of that due to sanitation and hygiene, so 44% is due to poor sanitation and hygiene
- Risk of mortality for children under 5 from diarrheal disease is 0.17% overall
- The cost of a child's funeral is USD300
- The death of a child requires one week of a woman's time

$$C_h\ per\ child = \frac{Reduced\ Diarrheal\ Episodes}{Year} \times \left\{Probability\ of\ Doctor\ Visit \times \left(\frac{Heathcare\ Cost}{Episode}\right) + \frac{Time\ Costs}{Episode}\right\} + \frac{Mortality\ Risk}{Year} \times (Funeral\ Costs + Time\ Costs)$$

$$C_h\ per\ child = \frac{50\%(3.2)Episodes}{Year} \times \left\{\frac{1}{2} \times \left(\frac{USD3}{Episode}\right) + \frac{16hours * USD0.4}{Episode}\right\} + \frac{0.17\%}{Year} \times (USD300 + 40hours \times USD0.4)$$

$$C_h\ per\ child = \frac{1.6Episodes}{Year} \times \left\{\left(\frac{USD1.5}{Episode}\right) + \frac{USD6.4}{Episode}\right\} + \frac{0.17\%}{Year} \times (USD300 + USD16)$$

$$C_h\ per\ child = \frac{1.6Episodes}{Year} \times \left\{\frac{USD7.9}{Episode}\right\} + \frac{USD0.54}{Year} = \frac{USD12.64}{Year} + \frac{USD0.54}{Year}$$

$$C_h\ per\ child = \frac{USD13.18}{Year}$$

Value of averted costs of fecal-oral disease and associated health care

USD13.18

VALUE OF AVERTED COSTS OF CHILDHOOD STUNTING

While local and country-specific values can be used to make this more applicable to a specific project, the model presented here represents a guide for general use. This is a lower bound on the cost of stunting, as it takes into account only the effect on wages and omits higher disease burden, and socio-emotional issues among others. The assumptions made are:

- A girl who experienced 100% of improved sanitation in her neighborhood during her second year will avoid stunting, which would occur with a 35% probability
- A non-stunted girl will have 10% higher wages as an adult

$$\frac{Benefit}{Year} = \frac{10\%\ Higher\ Wages}{Year} * Probability\ of\ Stunting$$

$$\frac{Benefit}{Year} = \frac{10\% * USD840}{Year} \times 35\% = \frac{USD\ 29.4}{Year}$$

Value of averted stunting costs (C_{stunt})

Value of the reduced probability of being stunted x Wage difference between stunted and non-stunted adult

USD 29.40

VALUE OF AVERTED GENDER-BASED VIOLENCE

In the Kenya study, the overall average incidence of non-partner assault in a 12 month period for those who defecate in the open is 7.5%, whereas it is 5.4% for women who do not (Winter and Barchi 2016). If we take the cost of GBV from the Zambia data to be USD460 (Ibrahim, Kuru-Utumpala, and Goulder 2018), then the annual benefit to women is the reduced likelihood of non-partner GBV times the cost of assault. This value assumes that women are shifting their sanitation practice from open defecation to a latrine with improved sanitation (not a pit latrine), a lockable door, lights and a trust-worthy guardian. This value does not take into account the psychological costs of the fear of rape, assault and GBV.

In addition, this represents only the average reduction in non-partner GBV and vastly underestimates the benefit of improved sanitation for those women living in unstable neighborhoods. In socially unstable neighborhoods are more likely to be found in urban slums, women who practice open defecation are 13 times as likely to experience non-partner GBV as those who have some access to improved sanitation (Winter and Barchi 2016). While the anecdotal and qualitative evidence linking sanitation and GBV is plentiful, the quantitative evidence connecting sanitation and GBV is sparse. Indeed, Aqua for All's implementation of WASH projects might be an opportunity to make a contribution to the literature.

Assumptions:

- Non-partner GBV reduces from 7.5% per year to 5.4% when a woman is able to shift from open defecation to improved sanitation, a reduction of 2.1 percentage points
- The improved sanitation has locking doors, lights, a guardian, no places where an assailant can hide
- The cost of GBV to a woman and her family is USD460

Value of averted GBV costs (C_{gbv})

Value of the reduced probability of non-partner GBV for women who do not rely on open defecation because of a WASH investment (USD)=

USD 9.60

$$\frac{Benefit}{year} = \frac{\%\ Fewer\ women\ experiencing\ non-partner\ GBV}{year} * Cost\ of\ GBV$$

$$\frac{Benefit}{year} = \frac{2.1\%}{year} \times \$460 = \$9.60/year$$

VALUE OF MENSTRUAL HYGIENE MANAGEMENT (MHM)

Studies of MHM have primarily focused on how to keep girls in school once they have reached puberty. This is the aspect of MHM that is best understood and has quantitative estimates that can be used here. This is not to suggest that MHM for older women is a problem that does not need to be addressed.

A comprehensive Menstrual Hygiene Management program for schools will include more than physical lavatory infrastructure, comprising:

- Education to both boys and girls about menstruation, both in terms of biology and to reduce stigma
- Education to the community to decouple menstruation from eligibility for marriage
- Sex-specific latrines that are private and lockable
- Privacy for girls to wash their hands and dispose of used menstrual materials
- Access to menstrual materials, such as napkins or cups

Sex-specific latrines alone have been shown to increase enrollment of pubescent-age girls (grades 6-8) in India by 10 percentage points (Adukia 2017). Staying in school is associated with higher earnings throughout life, later age of marriage and motherhood and better outcomes, including reduced mortality, for children. Each additional year of primary school increases girls' wages in adulthood by 10-20 percent. In addition, each additional year of secondary school increases her wages by 15-25 percent (UNICEF n.d.).

Assuming:

- Wage is the GNI per capita discussed above, USD840
- Three additional years of primary school (6-8th grades)
- Affecting 10% of girls
- 15% increase in lifetime wages for each additional year of school

The annual benefit to a woman having been exposed to MHM in upper primary school, given a 10 percentage point increased chance of having an additional 3 years of primary schooling, is as follows:

Value of having been exposed to school-based Menstrual Health Management ($C_{mhm\text{-}s}$)

Annual value of a 10% chance for 3 additional years of school = 10% x (Increased annual wage – base annual wage)

USD 43.70

$$\frac{Benefit}{Year} = 10\% * \{(USD840 * 1.15^3) - USD840\}$$

$$\frac{Benefit}{Year} = 10\% * \{USD1277 - USD840\} = 10\% * USD437$$

$$\frac{Benefit}{Year} = USD43.70$$

Limitations and Data Availability

This model has limitations and will be most useful when and where there are locally available data. Many of the values here have come from studies that were project-specific in a number of different locations, with a wide variety of cultural and economic settings. So, the values used here have been used as proxies, given the educated judgment of the modeler in order to give a sense of the order of magnitude and importance of each of the effects included.

Some variables, or aspects, have been omitted altogether because of the difficulty of attaching monetary values to them. In particular,

- **Value of productive time gained**, in terms of how women themselves value that time, which could possibly be valued at either higher or lower than the average wage
- **Value of avoided oral-fecal disease**, in terms of malnutrition leading to stunting or wasting with lifelong implications for cognitive and physical development
- **Value of avoided oral-fecal disease**, in terms of the value of the life of child who dies from diarrhea or other oral-fecal disease and the costs, both financial and emotional, to the mother
- **Value of avoided oral-fecal disease**, in terms of putting a monetary value on adverse pregnancy outcomes such as pre-term delivery or low birth weight
- **Value of MHM**, in terms of avoided anxiety and emotional distress from leaks, teasing or unwanted attention
- **Value of averted GBV**, in terms of the cost of emotional distress and possible psychological issues
- **Value of averted GBV,** in terms of more data about the connection between open-defecation and GBV

Additional Factor Not Included in Model

Urinary Tract Infection

Urinary Tract Infection (UTI) is the most common non-intestinal infection in women globally, with at least half of all women suffering from UTI during their lifetime. Poor sanitation, however, increases the likelihood of UTI significantly. Untreated or undertreated UTI can have serious health consequences, such as impaired kidney function, sepsis and adverse pregnancy outcome. In addition, UTI has an impact on quality of life with suffers reporting social isolation, depression and low self-esteem (Kawade et al. 2019).

A study in Maharashtra, India of randomly selected women without individual toilets living in slums, found the incidence of UTI to be 24.4% overall in the past month. Many of these women describe modifying their behavior in order to avoid trips to the toilet. This includes urine holding, avoiding the intake of liquids and modifying dinner consumption to avoid having to visit the toilet at night. (Kawade et al. 2019). For those describing the distance to the community toilet as close, the incidence of UTI is 20.4%, but for those describing it the distance as neutral or far, the incidence

increases to 32.3%. In other words, having a toilet nearby decreases the likelihood of UTI on by 37%, or that women with nearby toilets experience 2.9 UTIs each year and those needing to travel farther to a toilet experience 3.9 UTIs each year.

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