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Introduction to WASH concepts and complimentary application to sustainable agriculture and development

Ron Orcajada, Samaritan's Purse Canada
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Overview

1. WASH Overview
2. Introduction to key WASH principles
   - Water Safety Plan for the Household Level
   - Sanitation approaches
   - Hygiene and behavior change approaches
3. Case study: School WASH and Environmental Stewardship

Samaritan's Purse Mission Statement

Samaritan's Purse is a nondenominational evangelical Christian organization providing spiritual and physical aid to hurting people around the world. Since 1970, Samaritan's Purse has helped meet needs of people who are victims of war, poverty, natural disasters, disease, and famine with the purpose of sharing God's love through His Son, Jesus Christ.

The organization serves the Church worldwide to promote the Gospel of the Lord Jesus Christ.

What is WASH?

- WASH – **Wa**ter, **S**anitation and **H**ygiene
- The Challenge:
  - 884 million lack access to basic water services
  - 2.3 billion people lack basic sanitation services
  - 73% of persons living in the least developed countries lack handwashing facilities with soap
  - Preventable water borne diseases account for 361,000 deaths among children under five each year.

(Progress on Water, Sanitation and Hygiene, JMP 2017)

Questions

1. What is the percentage of basic water access in the Philippines?

62% to 100%

2. What is the percentage of basic sanitation access in the Philippines?

22% to 86%

WASH in the Sustainable Development Goals

Goal 6 – Clean Water and Sanitation for All

Targets	Indicators
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	**6.1.1** Proportion of population using safely managed drinking water services
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	**6.2.1** Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	**6.3.1** Proportion of wastewater safely treated **6.3.2** Proportion of bodies of water with good ambient water quality

WASH in Emergencies

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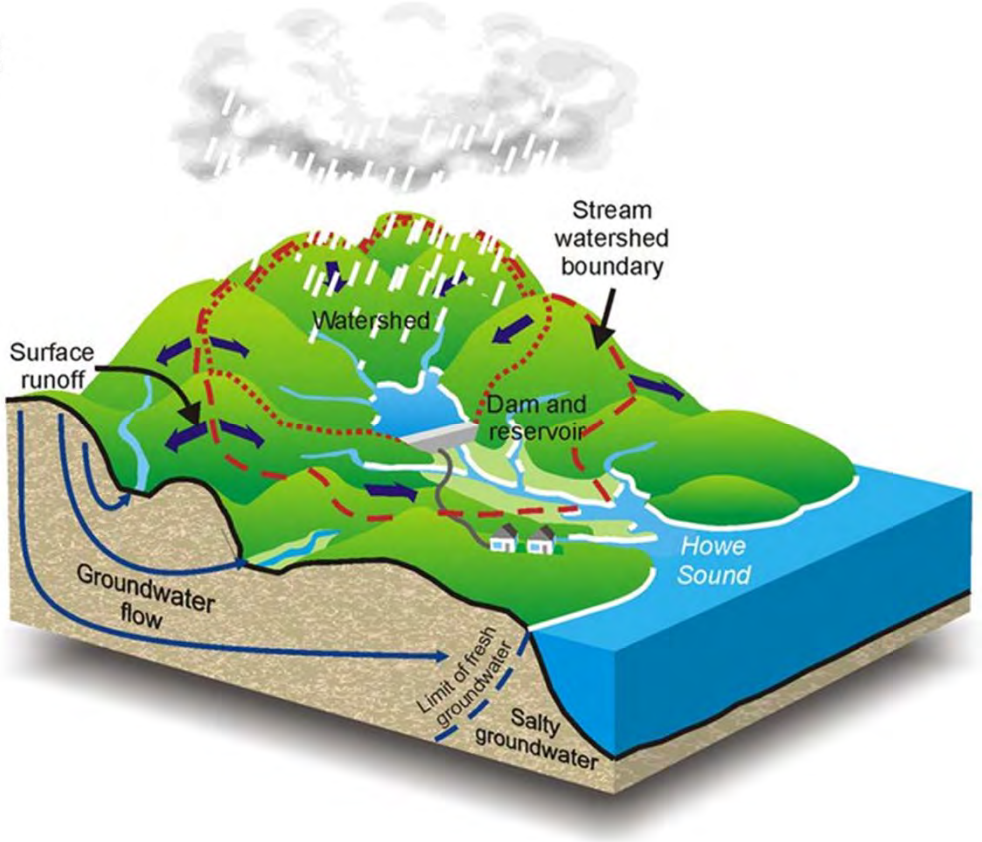
WASH in Emergencies

- Rapid access to safe water and sanitation for persons
- Hygiene training and kit distribution
- Vector control
- WASH services for Key institutions

Humanitarian Mandate: Save lives. Reduce suffering.

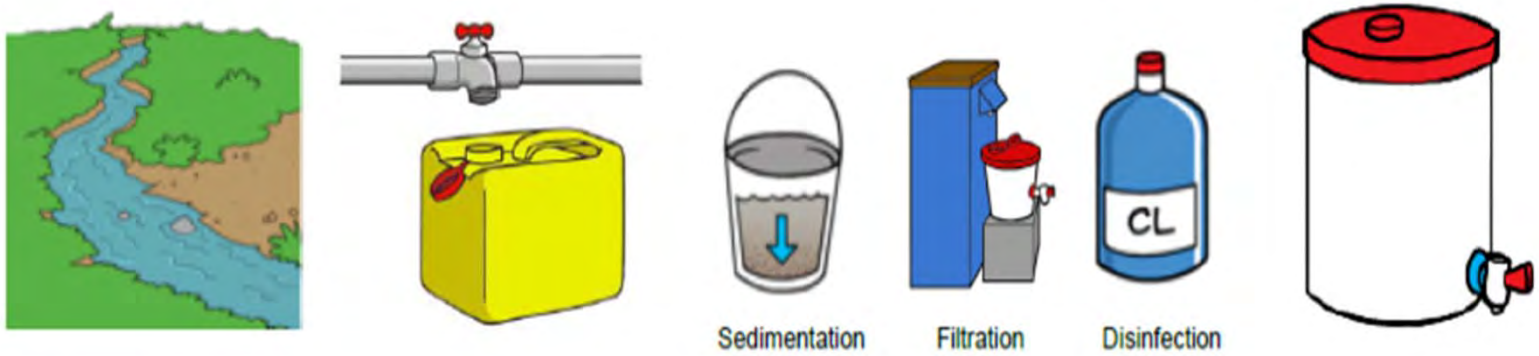
Water Safety Plan

A Water Safety Plan has the goal of protecting water from any contamination at any point from the water ***catchment to the consumer.***



Rural Point of Use Water Safety Plan

Figure: Multi-Barrier Approach to Safe Water



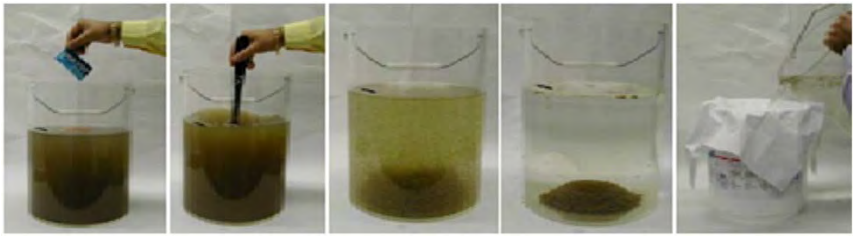
Source Water Protection | Safe Water Transportation | Water Treatment | Safe Water Storage

For more information about the multi-barrier approach and HWTS options, see CAWST's HWTS resources (https://.resources.cawst.org) and HWTS Knowledge Base (https://hwts.info).

Point of Use (POU) Water Treatment Options

- Chlorination
- Solar Disinfection
- Filtration
- Combined flocculation/disinfection
- Boiling water
- Others

Point of Use (POU) Water Treatment Options



A woman uses a sari cloth to strain water

Cross Section of Plastic Biosand Filter
(Credit: TripleQuest)

Air Rahmat, Indonesia
(Credit: Tirta/JHUCCP)

(Credit: EAWAG/SANDEC)

Cross Section of Ceramic Pot Filter
(Credit: Filter Pure Inc)

Flat Bottom Ceramic Pot Filter
(Credit: Potters for Peace)

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PVC Pump – Positive Water Displacement

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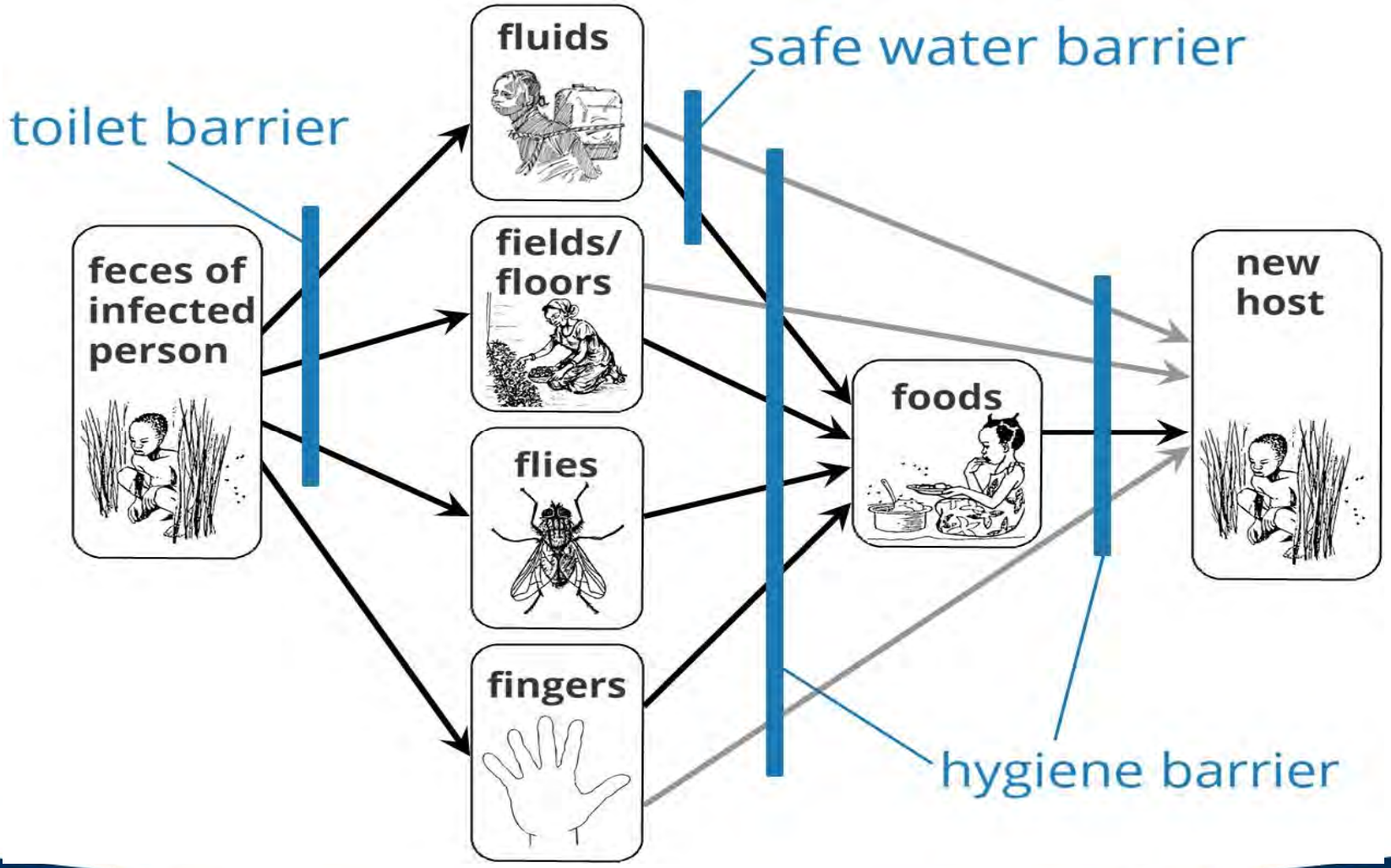
Rural Sanitation



Rural Sanitation – Examples

Promote improved latrine usage and decrease open defecation

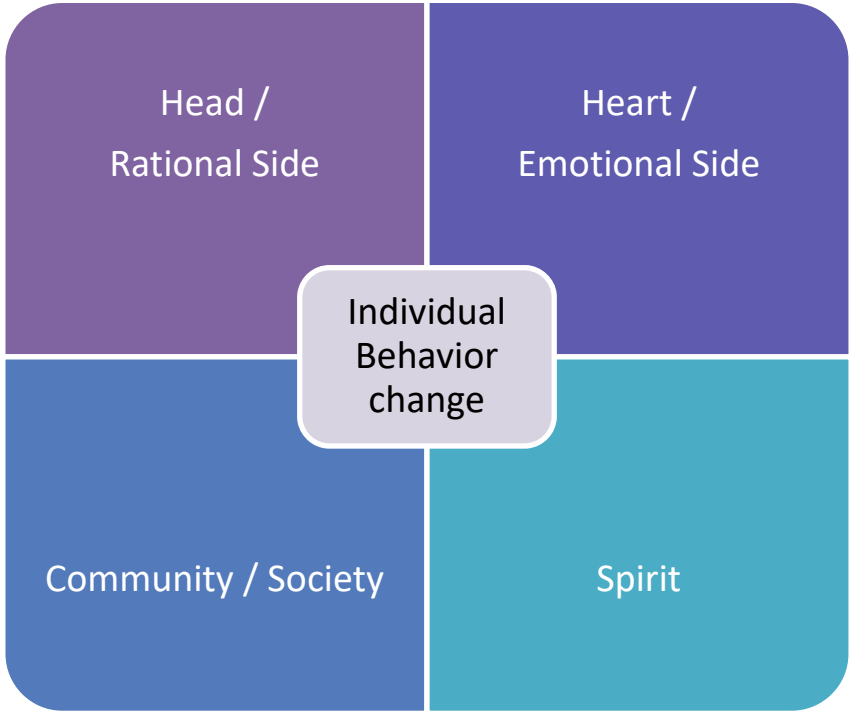
Address MHM Issues in community

Hygiene and Behavior Change

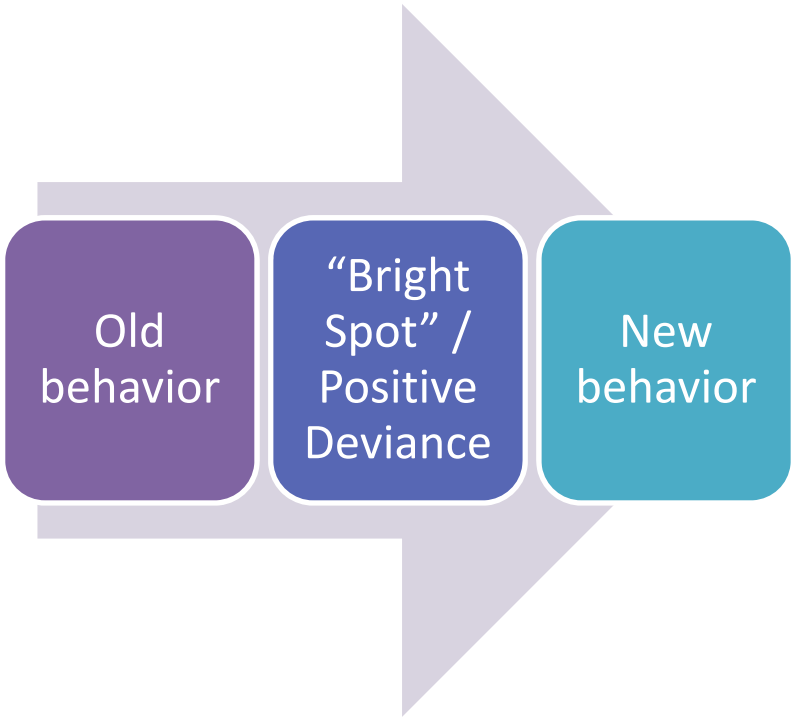
- ***Behavior change*** aims to develop new, eliminate or curtail specific habits in individuals or communities.

Question – If you were the head of the Department of Health for you Region and were tasked to reduce the practice of smoking, what strategies would you use? What would be your reasons for selecting such strategies?

WASH and Behavior Change



Behavior Change – Positive Deviation Strategy



Save the Children – Vietnam

- Malnutrition addressed
- **Positive Deviance**

1. Identify examples of good behavior
2. Determine key factors (habits) locally practiced
3. Train based on modelling.

Finding Bright Spots

They found that the mothers of the healthiest children did things differently:

1. They feed their children smaller portions of food but more often during the day.
2. They used “low class: food which were highly nutritious. (They took brine shrimp from the rice paddies and greens from sweet potatoes grown in their gardens and adding these to their daily soups or rice dishes.
3. Third served children from the “bottom” of the pot after it cooled. It was in fact the most nutrient rich portion of the soup.

Leader mother strategies were developed to share these practices in the community.

FAITH GARDENS through Churches an example of a bright spot

1. Participants as POSITIVE DEVIANTS
2. Trainer of trainer models – able to introduce best practices to neighbours
3. Uptake of best practices can be incremental yet progressive
4. Replicable

Behavior Change – Social Marketing Approach

Social Marketing – One KEY message

We want Filipino Farmers to Use Biosand Filters (BSFs).

Multiple communication before inquiry and ownership

Uses Social/Peer Normative Influence

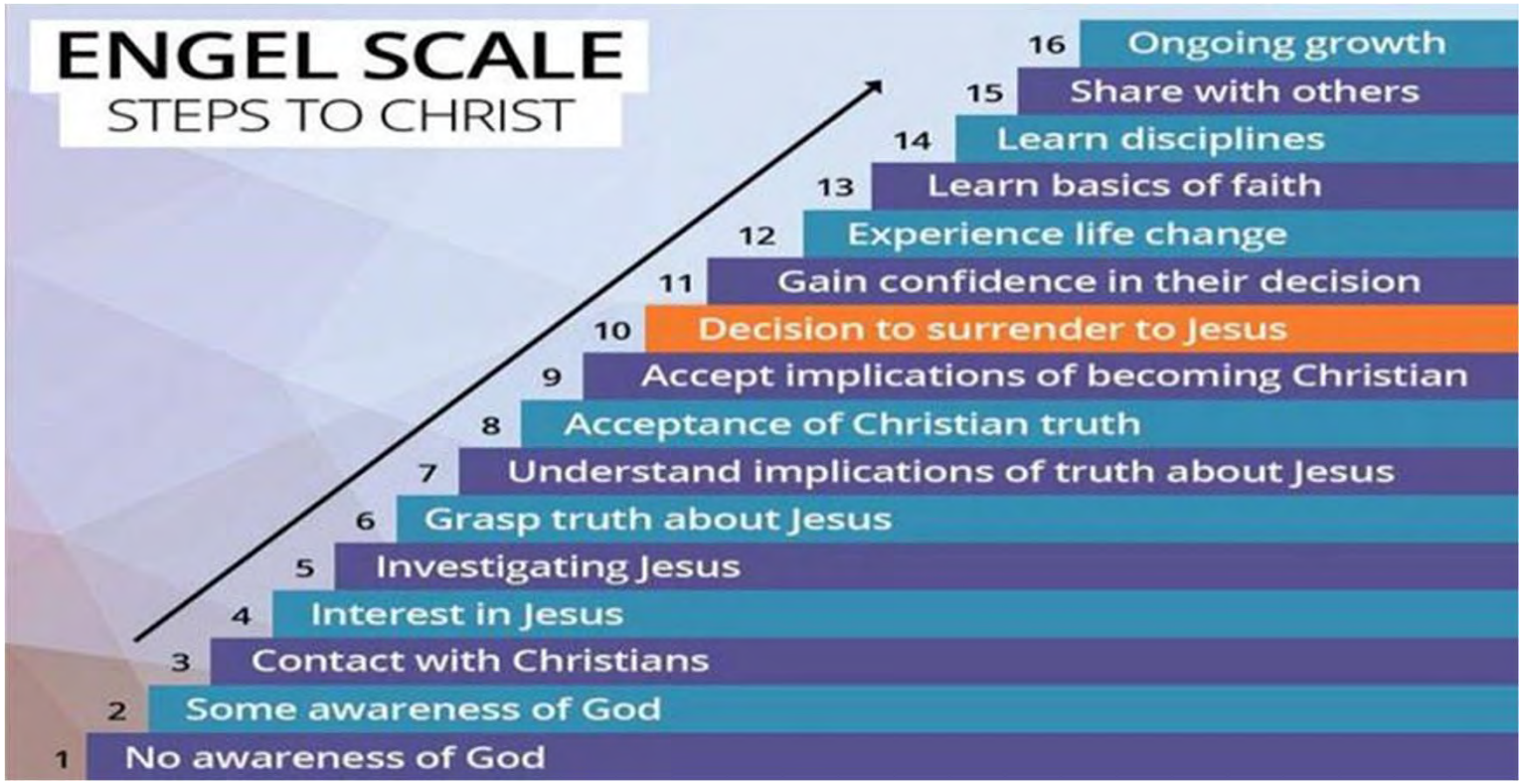
Compliments habit formation

Involves/targets all stakeholders

Focuses approach and resources

How did you

We want Filipino Farmers to To follow Jesus.



Key Message – Health Homes

We want Kenyan Villagers to Have a Healthy Home.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Healthy Home Certificate

THIS CERTIFIES THAT

Beneficiary Name
(filled out by Monitoring Staff upon completion of reverse qualifications)

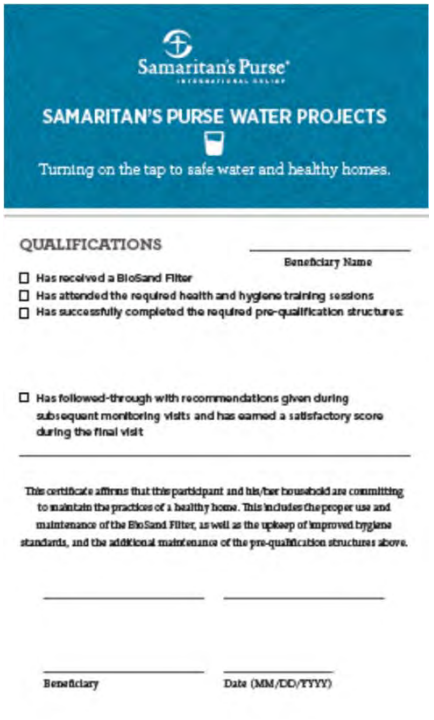
received a BioSand Filter and related training,
and completed the Healthy Home requirements of the

and is therefore awarded a

HEALTHY HOME CERTIFICATE

Sponsored by Samaritan's Purse Canada through the support of Canadian donors

Fred Weiss
Executive Director, Samaritan's Purse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SAMARITAN'S PURSE WATER PROJECTS

Turning on the tap to safe water and healthy homes.

QUALIFICATIONS

Beneficiary Name

- ☐ Has received a BioSand Filter
- ☐ Has attended the required health and hygiene training sessions
- ☐ Has successfully completed the required pre-qualification structures:

- ☐ Has followed-through with recommendations given during subsequent monitoring visits and has earned a satisfactory score during the final visit

This certificate affirms that this participant and his/her household are committing to maintain the practices of a healthy home. This includes the proper use and maintenance of the BioSand Filter, as well as the upkeep of improved hygiene standards, and the additional maintenance of the pre-qualification structures above.

Beneficiary

Date (MM/DD/YYYY)

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What would be your Key Message be for Sustainable Agriculture?

We want Farmers to To practice sustainable agriculture.

Who are the Key Stakeholders Involved that need to coordinate their focus and messaging?

Trainers ex. SEED, Local government partners, farmers and churches, supply chain – ex. Organic market.

What would be your Key Message for Schools?

We want _____Students_____ to _____To be Healthy_____.

Who are the Key Stakeholders Involved in a Local School?

Department of Education, Municipal Office, Barangay Leadership, School Leadership, Teachers, Student Leaders, Students, Parents, Household

School WASH and the Samaritan School Filter

For our filter manual: www.cawst.org

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WASH Outcomes

- Improved access to safe drinking water that results in the improved health of users. (44% decrease in diarrheal diseases)
- Increased uptake and use of toilets/reduction of open defecation
- Improved hygiene practices – particularly handwashing with soap.
- Development of ongoing community change through ‘change agents’.

How the Filter works

Storage Tank
Stores the filtered water

Filter Tank
Filters the raw source water

Reservoir Tank
Stores the source water

Float Valve
Controls water level by restricting flow

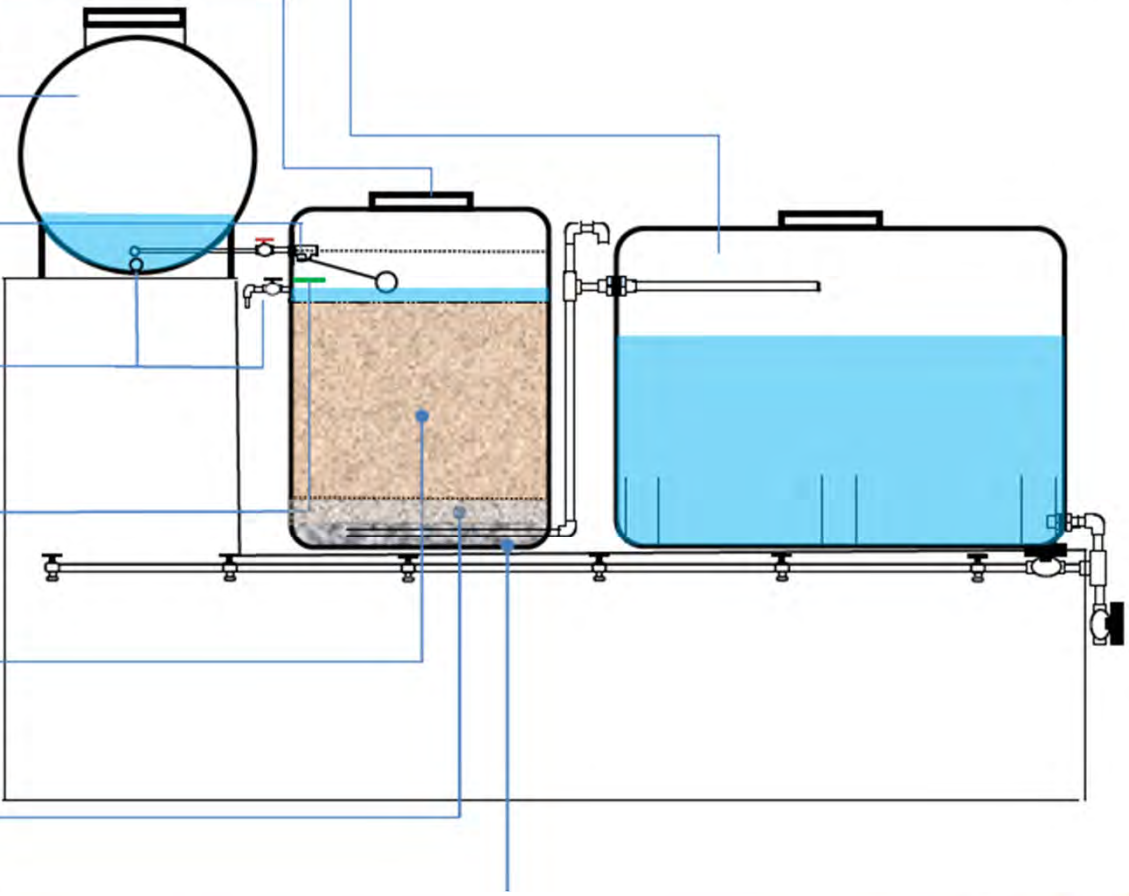
Wash Valves
Can be opened for maintenance

Splash Plate
Protects the biolayer from damage

Filtration Sand
Fine sand removes pathogens and particles

Coarse sand Separating Layer
Prevents fine sand from plugging the underdrain pipe

Figure 1
iSSF Water Filtration System



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Quick performance Review

- Mean E. coli removal rate of 97.8% was found (n = 66).
- 75% of the filtered water samples had no E. coli, and 95% of the samples (188 of 198) had < 10 E. coli colonies in 100 ml.
- Mean filtered water turbidity was 0.56 NTU (n=24), below 1 NTU WHO guideline

Quick performance Review

Performance of Intermittently Operated Slow Sand Filters in Rural Schools in Cambodia

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3 Samaritan's Purse Canada, Calgary, AB, Canada, 4 Samaritan's Purse Cambodia, Phnom Penh, Cambodia

INTRODUCTION

Safe drinking water is important in a school environment, as children are often vulnerable to water-born disease. Schools in low income settings present a challenging context for the provision of safe water. There are many environmental (e.g. poor water quality), technological (e.g. little technical knowledge) and practical (e.g. no electricity) challenges to having sustained access to safe water.

In 2012, Samaritan's Purse and Clear Cambodia began implementing intermittently operated slow sand filters as an appropriate, sustainable solution to improve water quality in rural schools in Cambodia. At the end of 2015, 170 of these filters were installed in schools in 7 provinces of Cambodia.

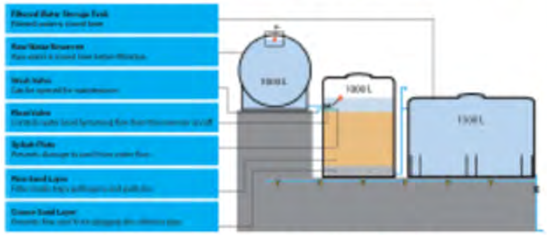

Figure 1. Schematic of an intermittently operated slow sand filter

The intermittently operated slow sand filters considered in this study were composed of three tanks: a 1000 L raw water reservoir, a 1000L vertical tank with sand as a filter medium and a 1500 L filtered water storage tank. Water is pumped (manually or by motor) to the raw water storage tank. Raw water flows by gravity to the filter. The driving water head above the filter is limited to 20 cm by a float-controlled valve. The vertical tank is filled with 75 cm of filtration sand, (effective size of 0.15-0.20 mm; uniformity coefficient of 1.5-2.5; silt content < 4%) which is supported by 15 cm of coarse sand. Water is filtered at a peak hydraulic loading rate of 0.2 m/h. This is approximately a quarter of the hydraulic loading rate of a household BioSand filter. Filtered water is collected from the coarse sand via a PVC perforated pipe underdrain. The water is propelled up the PVC riser pipe and over a weir to an integrated filtered water storage where the water is then available on demand from taps. The filter has the capacity to produce over 3,000 L/day, if operated continually. This could provide each student with 10 L of filtered water per day for a school of 300 students.

METHODS & MATERIALS

The primary objective of the study was to document the quality of the water produced and the performance of the filtration system to improve microbiological, chemical and physical parameters of the water. *E. coli* samples for source water, filtered water and stored water were collected by spot checking and were analyzed by an Aquagenx Compartment Bag Test. These samples were collected by field staff during monitoring visits between January 2014 and August 2015 (n=172).

In addition, the following parameters were considered in an independent spot check conducted in January 2015 at 24 schools four provinces (Kompong Chhnang, Kompong Thom, Prey Veng and Svay Rieng): *E. coli*, turbidity, pH, UV absorbance at 254 nm, nitrate, nitrite, ammonia, conductivity, total hardness, and calcium concentration. Turbidity, pH and conductivity were analyzed onsite. The remaining tests were conducted at the Resource Development International laboratory near Phnom Penh, Cambodia.

Figure 2: Typical slow sand filter installation

RESULTS & DISCUSSION

Filtered Water Quality

- Mean raw water *E. coli* was 28.2 colonies/100 mL, lower than typically reported in rural Cambodian household water supplies.
- Mean filtered water *E. coli* was 4.1 colonies/100 mL.
- Mean *E. coli* removal rate of 97.0% was found when considering only the data where source water *E. coli* was 5 colonies/100 mL or greater (n = 66).
- This *E. coli* removal rate is higher than typically reported for household BioSand Filters (e.g. 90%[1]), and is consistent with expectations of approximately 2-log for a slow sand filter based on the literature[2].
- 75% of the filtered water samples had no *E. coli*, and 95% of the samples (158 of 166) had < 10 *E. coli* colonies in 100 mL.
- Mean filtered water turbidity was 0.56 NTU (n=24), which is below the WHO guideline of 1 NTU.
- The mean turbidity removal was 82%.
- Mean UV absorbance at 254 nm decreased from 0.047 cm^{-1} for raw water to 0.029 cm^{-1} for filtered water (38% removal, n = 24), suggesting the some organics removal.
- Mean calcium levels increased from 43 mg/L as $CaCO_3$ in the raw water to 71 mg/L as $CaCO_3$ in the filtered water (n=24). As calcium hardness is an aesthetic concern to many users, calcium leaching from the filter sand warrants further investigation.

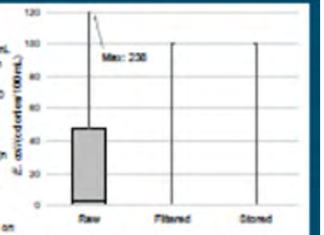

Figure 3: Summary of *E. coli* results (n=190)

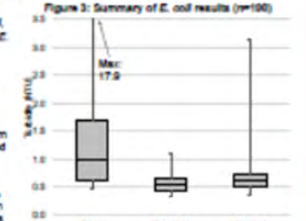

Figure 4: Summary of Turbidity results (n=24)

- No changes in conductivity (p=0.44), total hardness(p=0.14) or temperature were observed across the filter or during storage (n=24).
- No change in ammonia, nitrate or nitrite levels was observed, possibly owing to low ammonia levels in the raw water (Mean = 0.05 mg/L as NH_3, n=24).

Stored Water Quality

- The mean stored water *E. coli* was 3.8 colonies/100 mL. 75% of the stored water samples had no *E. coli* and 95% of the samples (158 of 166) had < 10 *E. coli* colonies in 100mL, similar to the filtered water. Only 14% of stored water samples (27 of 190) had *E. coli* levels greater than the filtered water. Taken as a whole, there is little evidence of contamination or growth during storage.
- Mean stored water turbidity increased by 0.32 NTU to 0.87 NTU (n=24), but remained below the WHO guideline of 1 NTU for 88% of the samples (21 of 24).

References

1. Ngai T.K.K., B. Duff, D. Reiner, R. Lentz (2014). Global Review of the Adoption, Use and Performance of the Biosand Filter in Progress in Slow Sand and Alternative Biofiltration Process. WH Publishing pp 309-317.
2. Wilis R.V. and Wood W.N. (1982). Slow sand filtration. Critical Reviews in Environmental Control. 13 (4): 315-354.

CONCLUSIONS

- An *E. coli* removal rate of 97.0% was measured across the filter (n = 66); this is better removal than typically reported for household BioSand Filters and is consistent with 2-log removal in the literature for slow sand filters.
- A mean turbidity removal of 82% was observed resulting in a mean filtered water turbidity of 0.56 NTU, below the WHO guideline of 1 NTU.
- Mean calcium levels increased from 43 mg/L as $CaCO_3$ in the raw water to 71 mg/L as $CaCO_3$ in the filtered water, warranting further investigation around calcium leaching from the sand medium.
- No changes in conductivity, total hardness, temperature, ammonia, nitrate or nitrite levels were observed across the filter.

This data, collected for filters between 1 and 12 months after installation, indicates that the filter meets design expectations for the removal of E. coli and turbidity. The long term (> 1 year) performance of this intermittently operated slow sand filter when raw water E. coli or turbidity levels are higher should be determined.

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‘Easy’ to build

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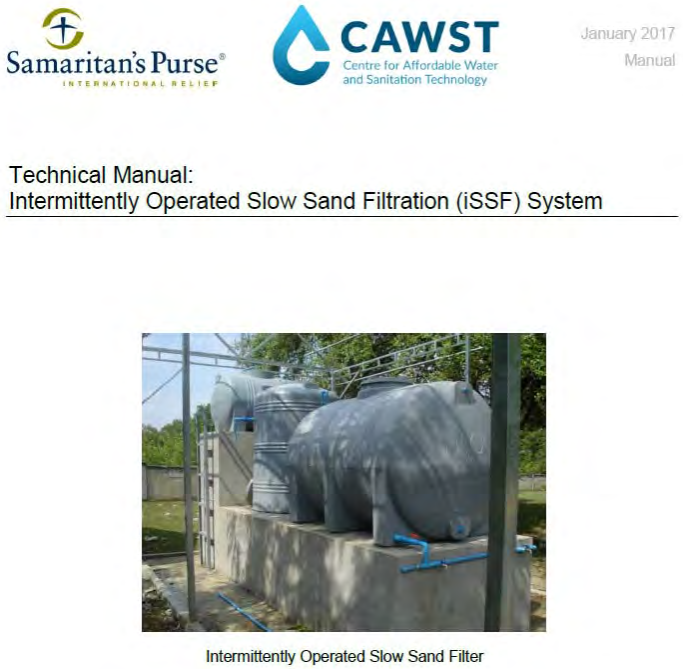

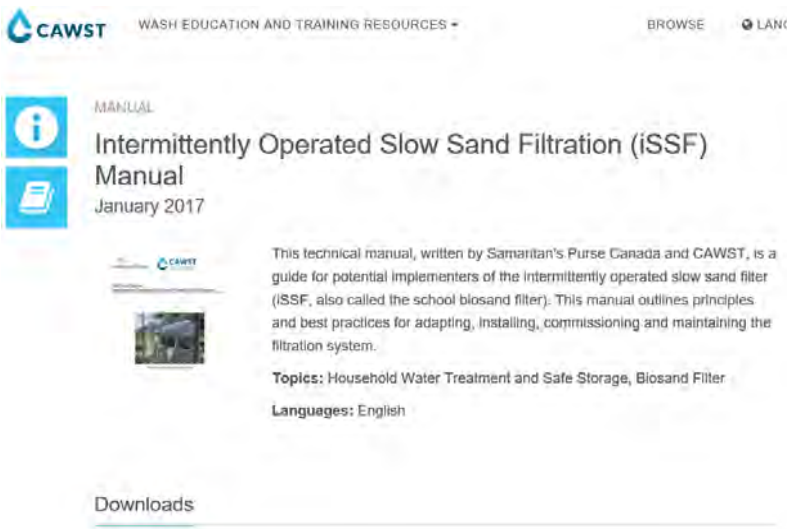

Additional Resources: The iSSF Manual

https://resources.cawst.org/manual/2a86b2de/intermittently-operated-slow-sand-filtration-issf-manual

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Innovative Behavior change methods

Case Study: School WASH Project – Western Kenya

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Students as Change Agents

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School Environmental Health Clubs

- WASH component as an INITIATOR
- Focus on Key Agents:
  - Teacher Leaders
  - Student Based Leadership
- Pursuit of COMPLIMENTARY objectives – Environmental Health and Natural Farming
  - New and traditional technique recovery

Questions?

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