Centre for Affordable Water and Sanitation Technology

Design, promotion, and adoption of Biosand Filters worldwide

Tommy Ka Kit Ngai, PhD.
Director, Research Learning
CAWST (Canada)
tngai@cawst.org

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Solution for water challenges of non-urban area with simple and low-cost technologies

History of the Biosand Filter (BSF)

Early 1800s: Slow sand filter (SSF) invented in Scotland

1900s: SSF used in major cities across Europe

1980s: Research started at University of Calgary to adapt SSF for household, intermittent use

1995: Biosand Filter (BSF) design standardized and published

2001: CAWST was formed for humanitarian distribution of BSF

2009: CAWST developed BSF version 10

2014: 650,000+ BSF in 55 countries, serving 4+ million people

UNIVERSITY OF CALGARY

CAWST Centre for Affordable Water and Sanitation Technology

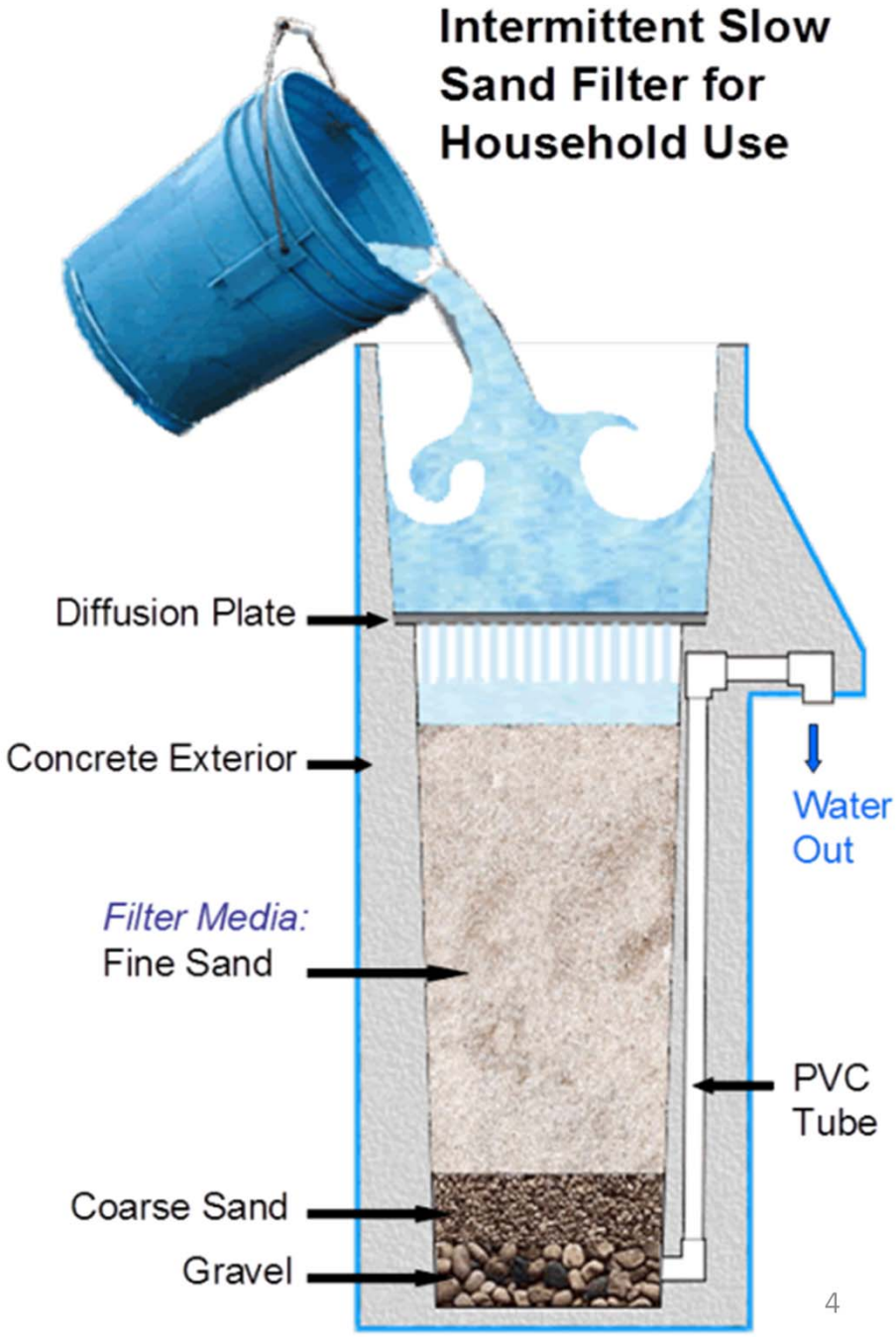
Features of Biosand Filter

Slow sand filter adapted for use in households in the developing world:

- Use any water source (ground, surface, rain)
- Intermittent flow
- Gravity driven
- Small size (~1 m tall, 0.3 m wide)
- Locally produced, composed of cement, gravel, and sand
- Production cost US$15 to $40 depending on country
- No consumables, no replacement parts
- High flow rate: Can treat 12 L/hour
- Lasts for 15+ years

How it works

- Pour water into the filter
- Water flows by gravity, passes through sand layers, and exits through a pipe.
- Pathogens and suspended solids removed by physical and biological processes (including straining, adsorption, predation, natural death).
- Maintenance required about once every 1-2 months by manually stirring the top few cm of sand to remove accumulated dirt.



CAWST – Centre for Affordable Water & Sanitation Technology

- Non-profit charity formed in 2001 in Calgary, Canada
- Purpose: widely disseminate appropriate and low-cost technologies in water and sanitation, including but not limited to the BSF.
- CAWST does not build or sell the BSF. We engage, educate and empower local organizations in different countries to implement → more sustainable.

Strategies to promote appropriate technologies (e.g. BSF)

- Research & improvements
- Education materials
- Training and Consulting

BSF research & design

Collaborated with universities to:

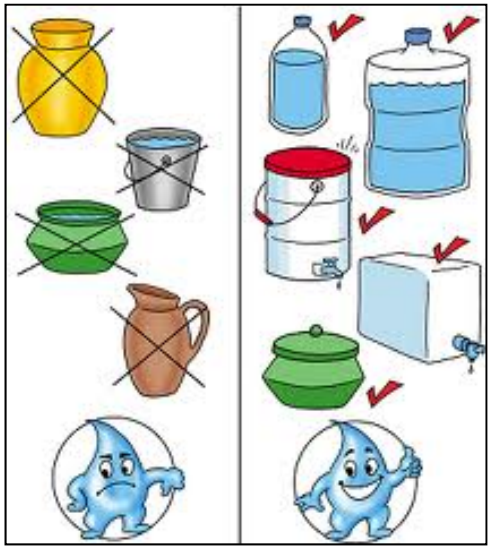
- Improve pathogens removal
- Improve user experience
- Improve construction

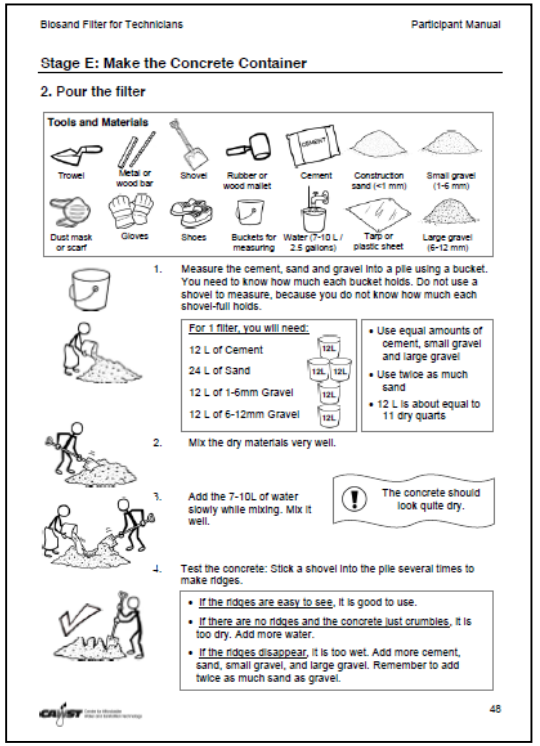
Research findings incorporated in the latest version of the BSF (v10):

- Retention time
- Filtration rate
- Sand specification
- Diffusion basin design
- Pause period
- Virus removal
- Construction method

Education materials

- Open content, freely available materials in 3 languages (English, French, Spanish)
- Different materials for different audiences, e.g. technicians, community health workers, end-users, project managers.




Biosand Filter for Technicians — Participant Manual

Stage E: Make the Concrete Container

2. Pour the filter

Tools and Materials

Trowel; Metal or wood bar; Shovel; Rubber or wood mallet; Cement; Construction sand (<1 mm); Small gravel (1-6 mm); Dust mask or scarf; Gloves; Shoes; Buckets for measuring; Water (7-10 L / 2.5 gallons); Tarp or plastic sheet; Large gravel (6-12 mm)

1. Measure the cement, sand and gravel into a pile using a bucket. You need to know how much each bucket holds. Do not use a shovel to measure, because you do not know how much each shovel-full holds.

For 1 filter, you will need:
- 12 L of Cement
- 24 L of Sand
- 12 L of 1-6mm Gravel
- 12 L of 6-12mm Gravel

- Use equal amounts of cement, small gravel and large gravel
- Use twice as much sand
- 12 L is about equal to 11 dry quarts

2. Mix the dry materials very well.

3. Add the 7-10L of water slowly while mixing. Mix it well.

The concrete should look quite dry.

4. Test the concrete: Stick a shovel into the pile several times to make ridges.
- If the ridges are easy to see, it is good to use.
- If there are no ridges and the concrete just crumbles, it is too dry. Add more water.
- If the ridges disappear, it is too wet. Add more cement, sand, small gravel, and large gravel. Remember to add twice as much sand as gravel.

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Training and consulting on BSF

- Conducts training workshops around the world
- Offer email and phone support, site visits, troubleshooting
- Online training, instructional videos

Where BSF have been implemented

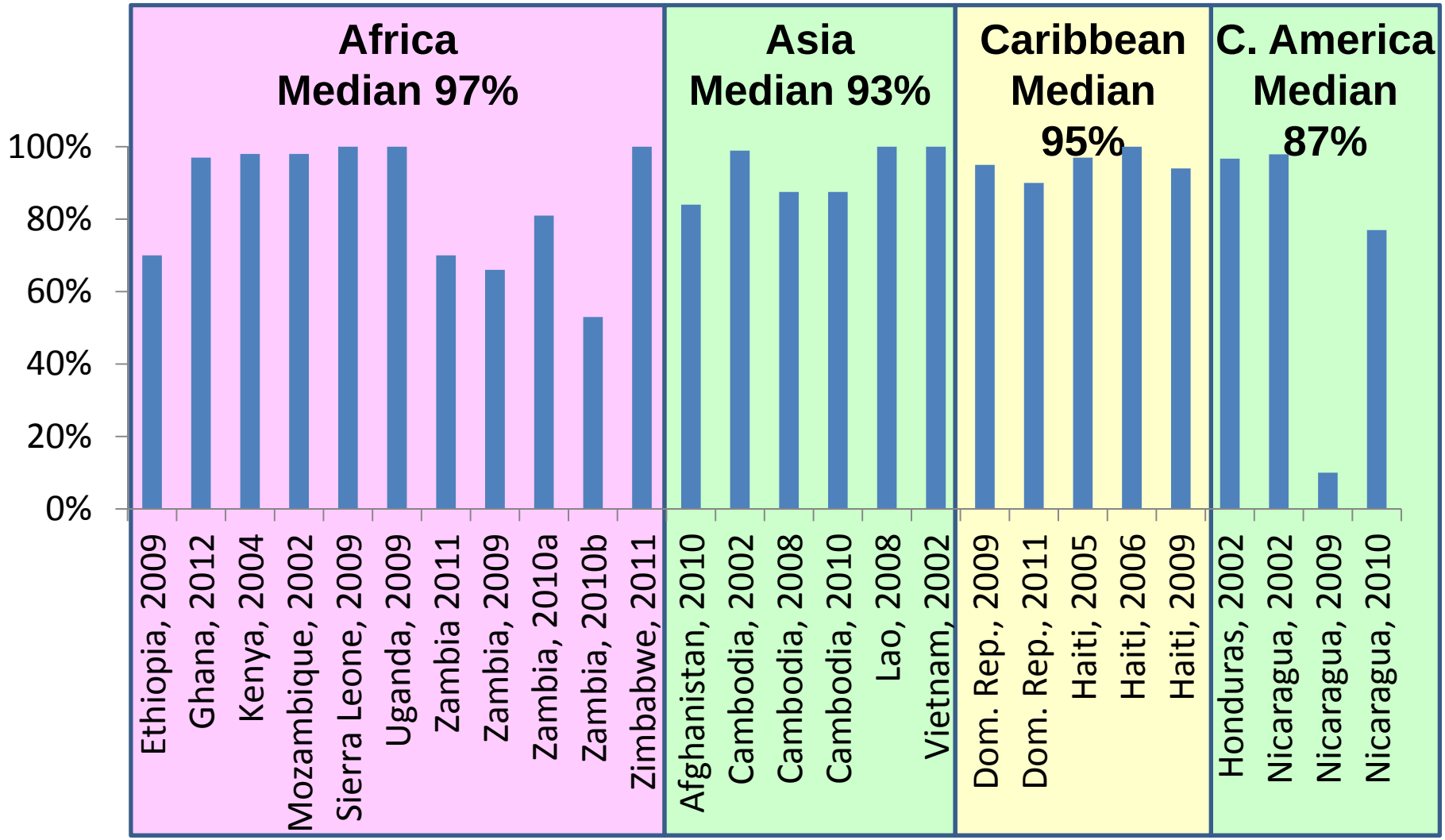
- 55 countries
- > 650 000 filters
- > 4 million people

2014 Review of adoption, use and performance of BSFs

- We found 32 evaluation studies between 2002 and 2012
- Including published and unpublished reports
- 19 countries
- Total of 3139 households

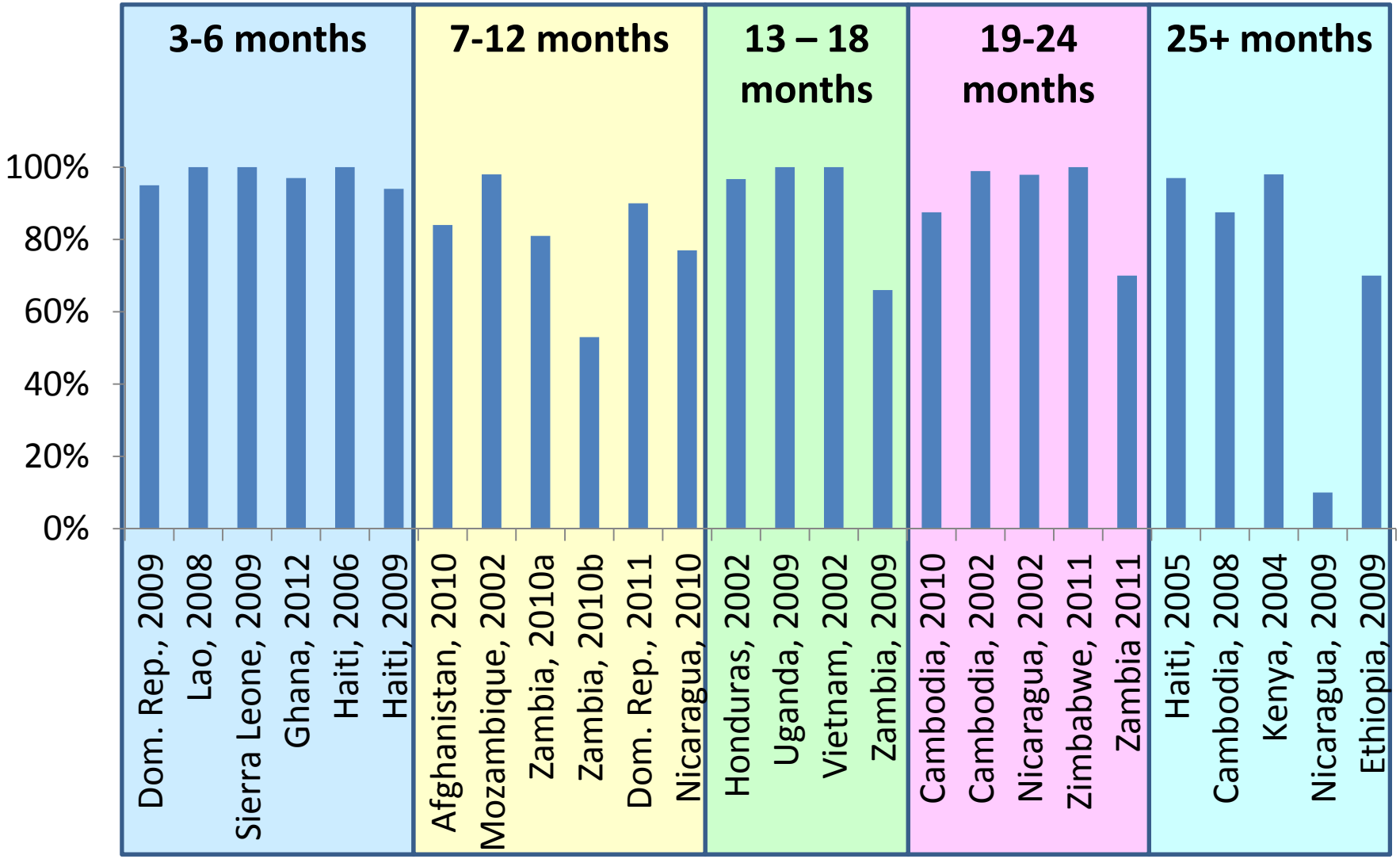
Summary results: adoption

Households using the filters every day, by region



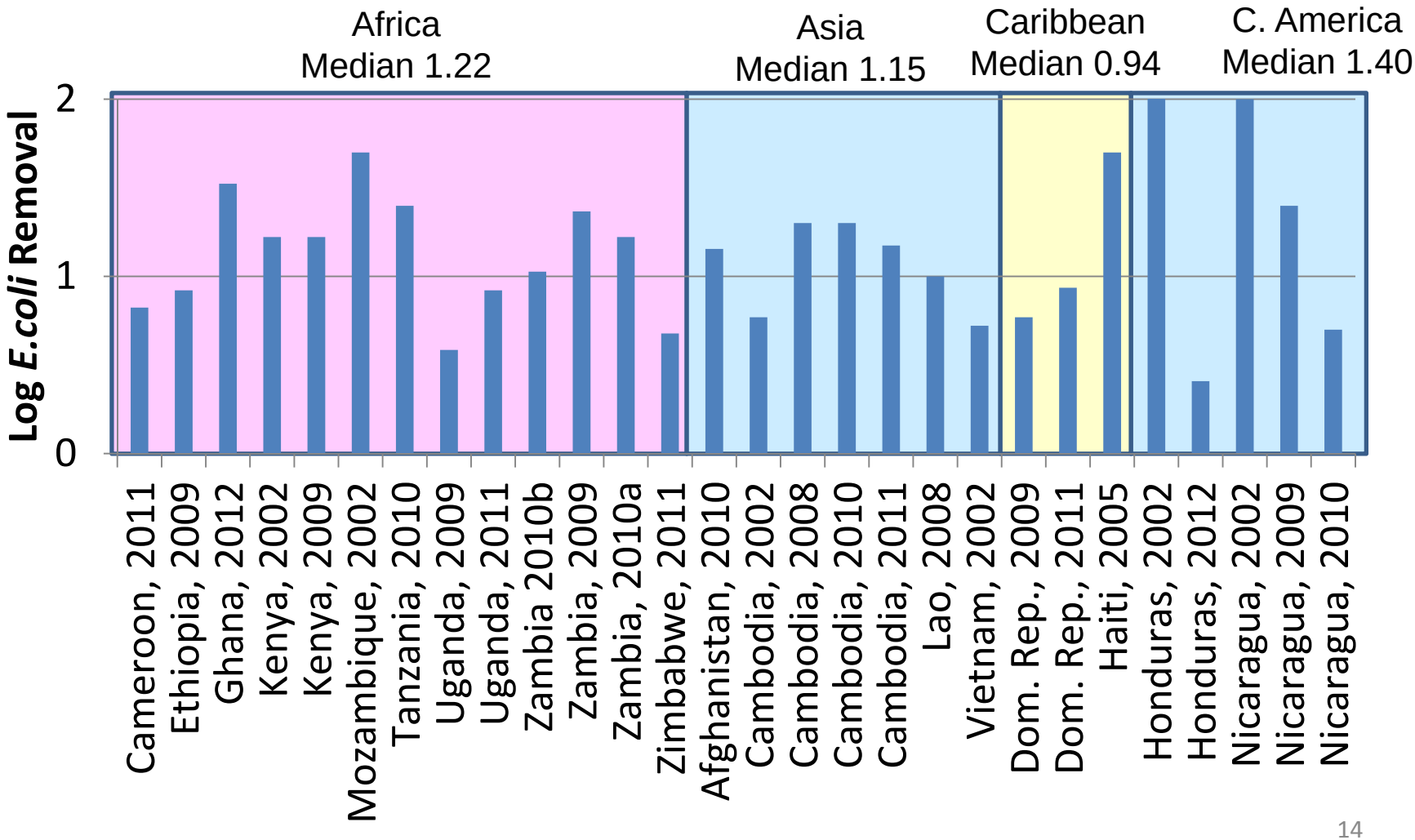
Summary results: adoption

Households using the filters every day, by time since installation



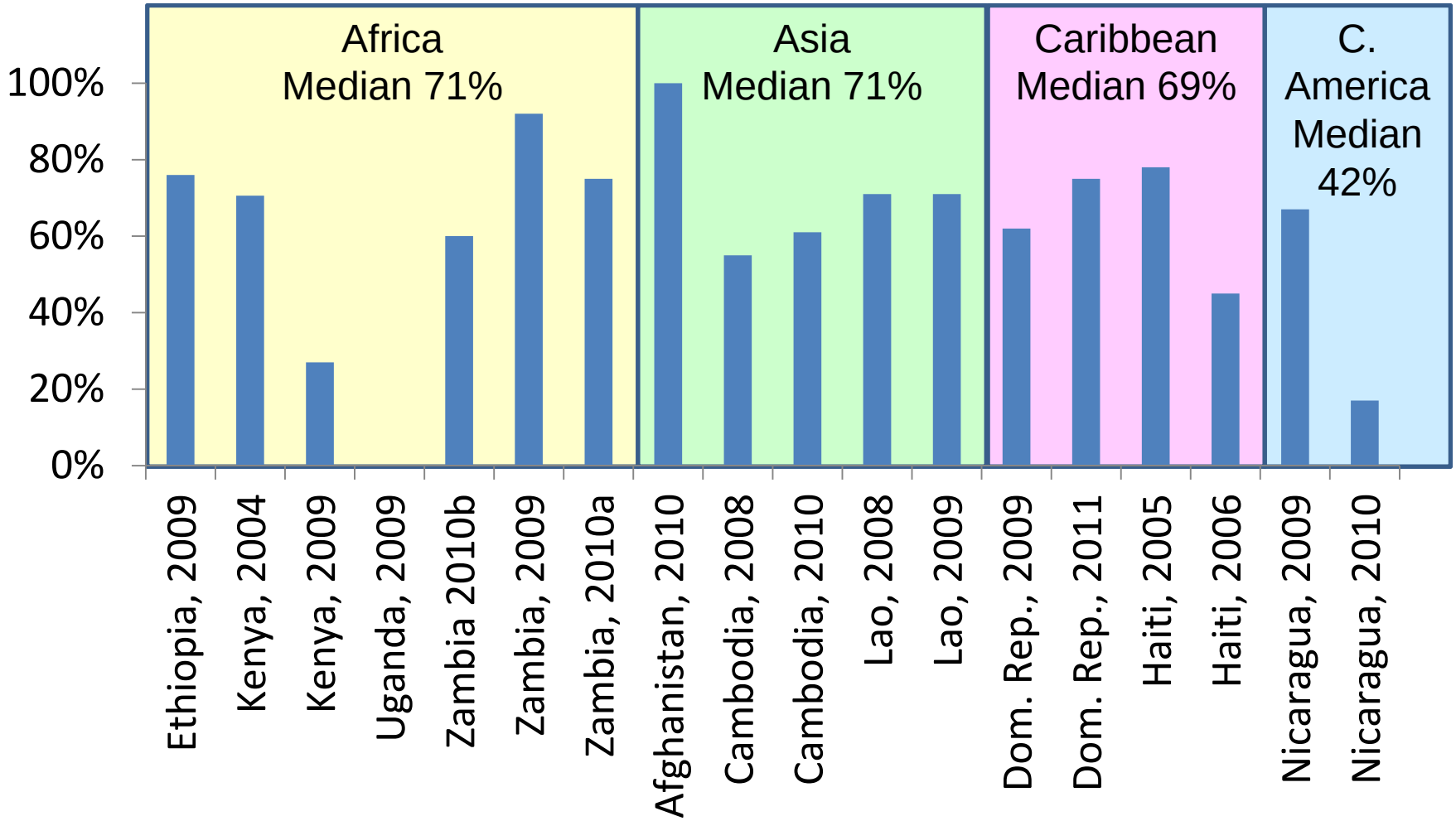
Summary results: field performance

E. coli log removal by study



Summary results: field performance

% of samples with *E. coli* < 10 cfu/100 mL



Summary results: common problems

- Leaks and cracks of filter box
- Sand not properly selected and prepared
- Damaged or incorrectly used diffuser plates
- Recontamination of water during storage
- Improper cleaning by end-users

Recommendations

- Improved training to project managers, filter technicians, end-users
- Continued research and improvement of BSF design and construction
- Understand and communicate the applicability and limitations of BSF
- Making BSF knowledge widely available

Conclusions

- **BSF is an appropriate technology for non-urban area**
  - Simple construction, operation, maintenance
  - Affordable
  - High user acceptance and sustained use
  - Effective removal of pathogens and turbidity

- **Continued learning and improving both technology design and knowledge transfer process will accelerate BSF dissemination.**

For more information on the BSF:

Research knowledge-base:
http://biosandfilters.info

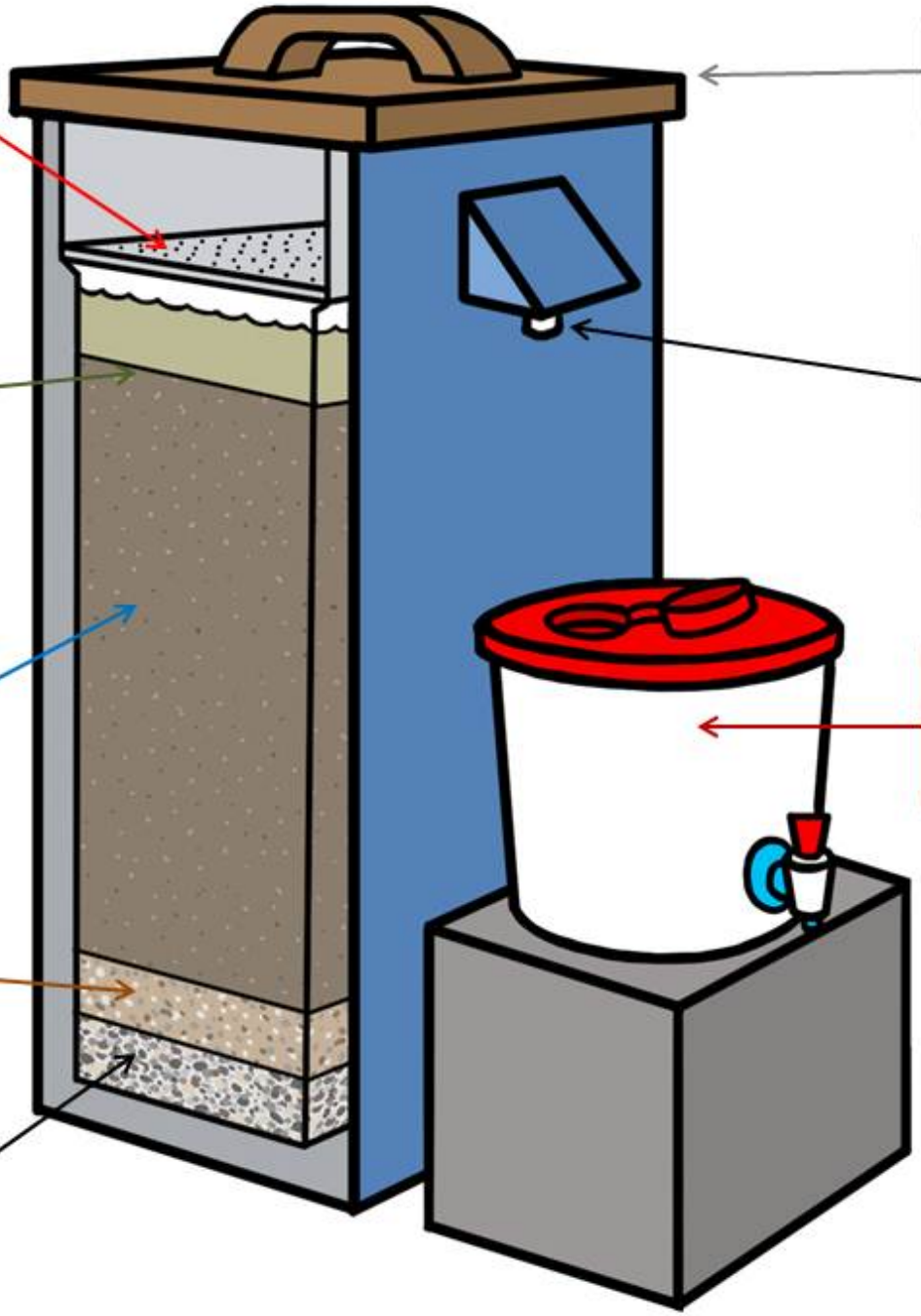
Education materials:
http://resources.cawst.org/

Training schedule:
http://cawst.org/training

Technical support:
http://cawst.org/support

Thank you

Centre for Affordable Water and Sanitation Technology



Diffuser – *Protects the top of the sand and the biolayer from being damaged when water is poured into the filter.*

Biolayer – *A community of micro-organisms that live in the top 1-2cm of the sand. The micro-organisms eat some pathogens in the water, helping the filter treat the water better.*

Filtration Sand – *Removes pathogens and suspended solids from water. The filtration sand is specially selected and prepared to treat the water well.*

Separation Gravel – *Supports the filtration sand and prevents it going into the drainage gravel and outlet tube.*

Drainage Gravel – *Supports the separation gravel and prevents it going into the outlet tube.*

Lid – *A tightly fitting lid prevents contamination and pests in the filter.*

Outlet Tube – *After the water flows down through the sand and gravel, it collects in the tube the bottom of the filter. Gravity pushes the water up the tube, and it flows out the end of the tube on the outside of the filter.*

Safe Water Storage – *A water container with a lid and a tap protects the water from being contaminated again.*