Field Filter Evaluation Manual Overview

Practical summary of the Manual for field evaluation "Selecting household water filters in emergencies".

This information sheet provides an overview of the main steps involved in the design and implementation of a filter evaluation study. For more detailed information, please refer to the filter evaluation manual: "Selecting household water filters in emergencies".

Before initiating the study

answer the following three main questions:

1 Purpose of the Study: Why is the study necessary?

The study aims to address one or multiple questions:

- √ Is the filter suitable for our context?
- √ Does the filter perform well and is it accepted?
- √ Which of the multiple filters suits better for our context?
- √ How should the filter be optimized to better meet the needs and context?

2 Selection of Filters: What filters to evaluate?

Given the vast array of products on the market, selecting filters for further evaluation can be challenging. The selection process may be influenced by personal preferences and biases. Therefore, it is crucial:

- √ To understand the variety of filters and their features
- √ To exclude filter obviously unsuitable for the context.

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Filter types

Features	Ceramic filters	Membrane filters	Biosand filters	Multistage filters	Reverse osmosis filters
Filter elements	Ceramic or compressed activated carbon candles or disks	Membrane (microfiltration or ultrafiltration) filter modules	Household sand filters	Combination of different elements	Multistage filters that partially or entirely remove salinity in water
Pressure generation	Gravity	Gravity and manual pumping	Gravity	Gravity	Electric or network pressure
Typical designs	Pot filters Two containers on top of each other Syphon filters	Filters with a hand pump Gravity filters in one or two containers	Locally constructed filters out of concrete or plastics filled with gravel or sand	Filters with multiple containers or elements. Often aspirational design	Filters with multiple cartridges usually installed under a sink, on a table or next to a well
Pathogens removal	Appropriate removal of protozoa and bacteria expected, limited removal of viruses possible	Appropriate removal of protozoa and bacteria expected, some filters also reduce viruses	Highly variable, depending on design and maintenance	Limited data, in principle high pathogen removal possible	High pathogen removal expected
Salinity removal	No	No	No	No	Yes
Main advantages	• Low cost • Sometimes locally available • Easy to use	• Large range of products • Variable designs available • Compact and robust • Some filters provide comprehensive protection for all three classes of pathogens	• Local production • Robust technoogy • Modular design for different sizes and demand	• Multi-barrier approach • Some filters provide residual protection or reduce organic contaminants or hardness and improve water taste and odor	• Addresses salinity • Produces high quality water with acceptable flow • Aspirational designs
Main limitations	• Ceramic candles and disks require replacement every 6-12 month • Fragile • Requires local containers and assembly	• Some filters clogg with turbid waters • Require backflushing • Robustness and performance is highly variable depending on the product	• Clogging and maintenance • Performance is highly variable depending on the maintenance • Not transportable	• Relies on cartridges that require frequent replacement • Usually higer costs than ceramics and membrane filters	• High price • Relies on tap pressure, or requires power supply • Requires reliable service provider for maintenance

The main parameters to consider include:

- √ Filter design features: filter elements, typical design, pressure generation, locally used supplies
- √ Filter operation features: filter flowrate, storage capacity, risk of clogging, life span of the filter elements and the filter, need for consumables
- √ Filter effectiveness and safety features: pathogen removal, salinity removal, regrowth, recontamination risk
- √ Filter logistics features: costs, transportability, logistical footprint, robustness, supply chain, availability of spare parts

Also address the following questions:

- √ Can the filter pose any harm? This encompasses unintended consumption of untreated water, potential release of toxic substances from filter materials or consumables, and whether filter elements can be easily detached, potentially causing harm to children or other household members.
- √ Is the filter susceptible to easy destruction?

Considerations for Appropriate Pathogen Removal:

Utilize the performance classification proposed by WHO based on the removal of bacteria, viruses, and protozoa:

Performance classification	Bacteria (log_{10} reduction required)	Viruses (log_{10} reduction required)	Protozoa (log_{10} reduction required)	Interpretation (with correct and consistent use)
***	≥4	≥5	≥4	Comprehensive protection
**	≥2	≥3	≥2	
*	Meets at least 2-star (**) criteria for two classes of pathogens			Targeted protection
-	Fails to meet WHO performance criteria			Little or no protection

WHO recommendatoins for evaluating HWT performance, International Scheme to Evaluate Household Water Treatment Technologies

3 Understanding the Needs of the Target Population and Context

Once filters and the context are identified, ensure:

- √ Identification of the target population.
- √ Understanding of WASH-related user needs.
- √ Availability of appropriate resources and support for procurement.
- √ Authorization to implement the project.
- √ Identification and evaluation of multiple products whenever possible.

Addressing user needs:

- √ Ensure the users understand the capabilities and limitations of filters. For example, the acceptance will be low for filters improving microbial water quality, when salinity is a main concern for the users.

- √ Ensure filter capacity and size match family size and safe drinking water needs. The Sphere standard for the drinking water quantity for survival is 2.5-3 liters. Thus, a filter that filters 1L/hour and has a storage capacity of 15 L will be too small for a family of 10 people, even when unsafe water is available to cover other needs.

- √ Ensure users can operate filters in the specific context. For example, users have an appropriate and hygienic safe water storage container available if filter requires it or it can be provided. Consider how to be more inclusive by addressing the needs of children or diverse individuals.

- √ Ensure filters are aspirational to users. For example, buckets used to provide water to animals might not be accepted to store drinking water.

- √ Ensure you understand people's motivations and barriers to use and maintain a filter, using a comprehensive behaviour change framework (e.g. RANAS model). For example, people may have certain beliefs related to water being stored too long, water having been in contact with plastic (from the filter) or similar that are culturally embedded.

  A survey, a focus group discussion with a community or interviews with key informants should be considered when unsure.

Sample size:

- √ Aim for a minimum of 40 to 50 participants per study group. Consider multiple study groups if more than one filter is evaluated or the results are compared to a group that does not receive a filter.

- √ Conduct a sophisticated sample size calculation based on the target population size if possible.

Prepare for the study

by following these steps:

- √ Ensure that all necessary materials for filter assembly (such as buckets, jerry cans, taps) are available. If any materials are lacking, evaluate options available on the market or whether there is a need for importation and initiate the procurement process.

- √ Conduct laboratory evaluations of the filters. Filters must demonstrate a minimum of 99% removal for bacteria and protozoa, and 99.9% removal for viruses across at least two out of three parameters.

- √ Establish and test methods, and procure consumables including microbial water quality testing materials, filter integrity assessment tools, as well as materials for observations and questionnaires. Protocols and examples of questionnaires are provided in the manual.

- √ Set up a data management system to effectively handle collected data.

- √ Identify and address any ethical concerns that may arise during the study.

- √ Apply for and obtain necessary authorization and ethical approval.

- √ Provide training to the team on the methods, data collection, and data management practices. Establish quality control procedures to ensure the accuracy and reliability of collected data.

The study

is structured around four main phases: baseline, filter distribution, monitoring and final data collection.

	Why is it needed?	What do you do?	What do you need for it?
Baseline	• Needed to understand the situation before the study to evaluate the improvement after the study • Helps to find out if the study population is suitable and filters are needed • Helps to understand needs and expectations of the users	• Explain the study to the potential participants and let them sign the consent form • Implement the baseline questionnaire • Analyse the data before you move to the next steps: Are there any reasons to not implement?	• Approved consent form • Trained enumerator team • Good planning of the visit and logistics • Baseline questionnaire form on the mobile phone • Official authorization
Filter distribution visit	• Your team distributes the filters and users experience the filter the first time • It is neededdnto understand if users can install and use the filters • To understand if filters are functional • To train the users to use the filters correctly	• Distribute the filters • Train the users on operation and maintenance of the filters • Conduct non-participatory observations • Conduct first monitoring using the monitoring questionnaire • Conduct technical monitoring that includes assessing microbial water quality, filter integrity, flow and use • Analyse the data before you move to the next step: Are there any severe health or ethical concerns? Are there any unclear data?	• Filters that have unique identification codes • Equipment to collect samples and to do water quality and flow analysis • Tools to fix any technical problems • Observation and monitoring questionnaire forms on mobile phone • Some spare parts and filters to replace if any damage is detected
Monitoring	• Monitor the use, performance and acceptance of filters • Provide support if needed	• Conduct monitoring using the monitoring questionnaire • Conduct technical monitoring that includes assessing microbial water quality, filter integrity, flow and use	• List and location of households • Equipment to collect samples and to do water quality and flow analysis • Tools to fix any problems • Monitoring questionnaire form on mobile phone • Some spare parts and filters to replace if any damage is detected
Final data collection	• Evaluate if the filters were used, functional and accepted • Understand limitations of the products in context and the preferences of the users	• Conduct technical monitoring that includes assessing microbial water quality, filter integrity, flow and use • Conduct final data collection	• List and location of households • Equipment to collect samples and to do water quality and flow analysis • Tools and spare parts to fix any problems • Final (Endline) questionnaire form on mobile phone • Plan on what will happen with the filters after the study: Can the users keep the filters? Who can users contact if they need assistance? Can they buy a new one or spare parts if one is broken and where?

The study results and outputs

1 During the study

During the study, it is crucial to analyze the data promptly after collection. You might have to modify the study by including additional visits or even terminate the study entirely.

Reasons to modify or terminate the study after the monitoring visit may include:

Filter functionality	Log removal values (LRV, measure of treatment efficiency, see L1) for integrity test are < 2 for > 60% of all samples	Safety concern: Filters are likely not to provide the required protection
Water quality	Water quality after treatment contains > 10 CFU/100 ml of E.coli in > 60% of all samples	Safety concern: Filters are likely not to provide the required protection
User acceptance	Drop out of the study exceeds 40%	Acceptance is low: Filters are likely not to meet the needs of the target population
Durability	Number of filters damaged during the study exceeds 40%	Durability is not sufficient

2 After the study

The results need to be analysed to answer the main questions. Focus group discussions and Co-design workshop can enhance understanding of the results.

Question	Attribute	Data source	Considerations
1. Ease of use Can people who need the filter use it?	Operation and maintenance	Observation checklist Monitoring	How easy is it to use the filter? How easy is it to clean the filter?
	Acceptability	Extended list (final data collection)	Perceived safety and look of water Cleaning of filter Further barriers to filter use
2. Performance Does it work?	Protection levels	Monitoring	Does the filter reduce bacteria in water? Does it improve household water quality?
	Treatment capacity and flow rate	Monitoring	Do users have enough treated water? Should the filter treat more water? Is the filter filtering fast enough?
3. Logistics Can it be deployed in an emergency?	Filter costs	Preparation Willingness to pay	What does the filter cost and are the users or implementers willing to pay for it?
	Logistical footprint	Preparation	Shipment volume and related costs
	Durability	Monitoring	Number of filters damaged