

Manufacturing and distributing ceramic filters for use in emergencies: An example from Viet Nam

SUMMARY

In rural Viet Nam, 20 per cent of the population still do not have access to basic drinking water services, leading to leaving children vulnerable to diarrhoea, dysentery, typhoid and other water-borne diseases. Following Cambodia's example, Viet Nam has invested in the production and distribution of ceramic filters to address the issue of water access, particularly in the rural areas. Led by the Ministry of Agriculture and Rural Development (MARD), the National Centre of Rural Water Supply and Sanitation (NCERWASS) and UNICEF, a public-private partnership among various stakeholders was formed to test the production of ceramic filters at the pilot location in southern province of An Giang.

Since the project's inception, over 31,000 ceramic filters have been sold on the market and over 3,200 ceramic filters have been distributed by UNICEF and its partners to schools, households, and commune health centres. On February 2018, the ceramic filter also passed quality tests administered by the National Institute of Occupational and Environmental Health under Viet Nam's Ministry of Health. Plans are currently underway to establish a second production site and advocate for the ceramic filter production partnership model to other private businesses on the one hand and to ensure access to safe water to the rural households at an affordable price.

Additionally, more than 1,139 ceramic filters are being distributed to drought/saline water intrusion affected households in Mekong River provinces (Soc Trang and Ben Tre) to ensure access of safe water to the drought affected households. Also, to contribute to COVID-19 prevention and control, 2,000 households, 781 schools and 124 commune health centers have received ceramic filters for accessing safe drinking water.

Introduction

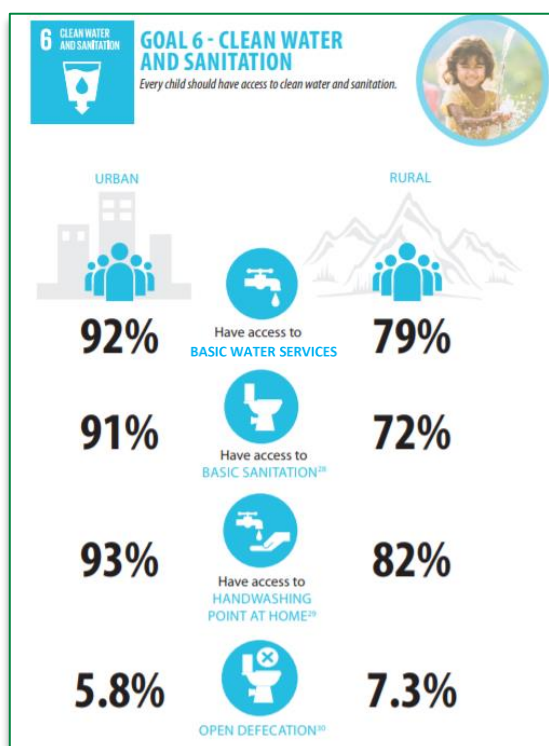
Despite significant improvements in urban areas, approximately 20 per cent of rural populations in Viet Nam still do not have access to basic water services (see Figure 1). Unimproved water is

associated with diarrhoea, dysentery, typhoid and other water-borne diseases, with young children particularly vulnerable.

Traditionally, Household Water Treatment and Storage (HWTS) has been promoted globally as a means of increasing access to safe water for rural

or at-risk populations in emergency settings¹ over the last 20 years. HWTS includes traditional water treatment methods such as natural sediment, cloth filtering, flocculation, slow sand filter and boiling as well as modern methods such as SODIS, RO filters and chloramine B during emergencies. However, many of rural population are not aware of these methods and do not practice proper HWTS before drinking.

Figure 1: Access to Water in Viet Nam



Source: *Children and SDGs in Viet Nam, (2017), UNICEF*

Description of Intervention

To address the issue of water access for rural households, UNICEF Viet Nam looked to innovative solutions from its neighbors, including Cambodia, which had been using ceramic filters in emergency situations (e.g. cyclones and flooding) when regular water sources often become contaminated.² Studies in Cambodia

¹ WHO. (2005). The international network to promote household water treatment and safe storage. Retrieved February 14, 2005, from http://www.who.int/household_water/en/

showed that using ceramic filters led to substantial savings of time and money, allowing users to save on diarrhoea treatment costs, time off school and work and time spent collecting firewood and boiling water. In a 2007 study conducted by the World Bank in Cambodia, the use of ceramic filters such as those shown in Figure 2, resulted in a 46 per cent reduction in diarrhoeal disease.

Figure 2: The 'flowerpot' ceramic water filter design used in the project



Source: *UNICEF Viet Nam\Truong Viet Hung*

These ceramic filters can produce up to 20-30 liters per day (with 2-3 fills), are easy to maintain and require very little training to use. They are also highly portable, weighing only 4.8 kilograms and, because the materials to produce ceramic filters are locally available, cost only just over US\$5 to produce.

Although the ceramic filters do not work with saline water—an issue that is relevant to coastal areas of Viet Nam, where many areas have to deal with the issue of saltwater intrusion—and cannot make saline water drinkable, the filters can be used to filter rain harvested water and fresh water from unsafe water sources for drinking purposes. Because using the filters means that households will no longer need to boil their water to make it drinkable, the filters help households and schools save fuel cost for burning.

Until recently, only wealthier households in Viet Nam used ceramic filtration systems as the available technologies (candle filters) required

² <https://www.unicef.org/vietnam/press-releases/unicef-has-supported-over-80000-people-affected-typhoon-damrey>

KEY MESSAGES

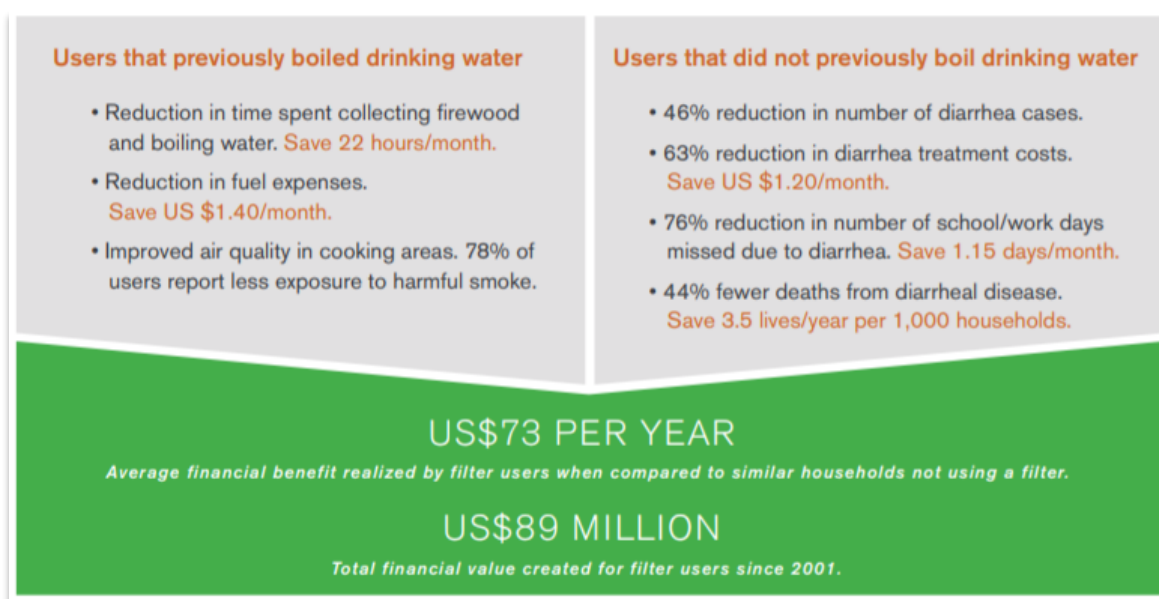
- Ceramic water filters have been proven effective in reducing diarrhoea and are simple, durable and efficient to use. Because they are relatively cheap to produce and highly portable, they are also easy to distribute to remote villages and emergency settings where drinking water is not accessible
- UNICEF supported the development of ceramic filter production and distribution in Viet Nam through public-private partnerships with the National Center for Clean Water and Rural Environmental Sanitation (NCERWASS), Safe Water Ceramic Filter (SWACF) Vietnam Ltd. and US experts from Partners in Hope and Resource Development International.
- UNICEF Viet Nam helped to initiate and maintain the partnership required to design and develop the filters and closely monitored progress of the partnership, providing support when necessary during implementation.
- UNICEF was actively involved in negotiating the contracts with plastic companies, ensuring costs are kept low to ensure affordability.

frequent procurement of spare parts and running costs beyond the means of the majority of population. Although ceramic filtration technology has been used for over 30 years, innovations over the last 10 years have significantly increased the technology's efficiency, with ceramic filter production in Viet Nam finally beginning in 2015.

Aside from the direct benefit of providing rural households in Viet Nam with access to affordable

and safe drinking water before, during and after emergency events, the use of ceramic filters has also led to business opportunities for the private sector. In Cambodia, families that used the ceramic filters saved US\$73 per year on medical bills and lost wages related to diarrhoea, compared to people who do not treat their water (see Figure 3).

Figure 3: Average health and financial benefits experienced by households using ceramic filters in Cambodia



Source: UNICEF Viet Nam\Truong Viet Hung

Who was involved?

In order to increase access to clean drinking water and promote the use of ceramic filters in areas prone to emergencies, a public–private partnership (PPP) (see Table 1) was created to develop the production of ceramic filters at the pilot location of An Giang, a province in southern Viet Nam bordering Cambodia.

An Giang was selected as the pilot site to produce ceramic filters due to the availability of brickworks as well as high levels of human and financial capacity, suitable clay and facilities for the scaling up production needed. The An Giang brick company has considerable experience in the type of ceramic production required including the mixing of rice husk with clay and firing skills to create the necessary degree of porosity to allow the water to flow at the right velocity.

What approach was taken and why?

First developed by an American group called ‘Potters for Peace’, ceramic water filters have been proven to be simple, durable, and efficient to use (essential, a one-time investment, if the product is not damaged). They are also relatively easy to distribute to remote villages and emergency settings where drinking water is not accessible. The production process begins with rice husks (or some other locally sourced combustible substance), which are mixed into clay before the clay is molded by a hydraulic press into the shape of a flowerpot. In the kiln, the rice husks burn off, leaving small holes. For biological safety, the ceramic filter needs to have a 0.1 – 1.0 micron porosity with a very slow flow rate (see Figure 4).

Figure 4: Testing flow rates of the filters



Once cool, the filters are coated with a colloid of silver, which helps inactivate bacteria and avoid pathogen regrowth on the ceramic surface (see Figure 5).

Figure 5: Coating of the ceramic filters



Source: UNICEF Viet Nam\Truong Viet Hung

The filter is then placed into a slightly larger plastic container with a lid and a tap. After being soaked in water for 24 hours, the flow rate must be checked. Each of the filters that passes the check has to be cleaned eight times with clean water to ensure all heavy metal remains be washed off. Once cool, the filters are coated with a colloid of silver nitrate, which can help increase bacteria removal. The filter is then placed into a slightly larger plastic container (this plastic is safe for food) with a lid and a tap. As the water passes through the filter and over the silver colloid, up to 99.99 per cent of harmful bacteria are removed in laboratory conditions. Extract of the results from the National Institute of Occupational and Environmental Health (VNIOEH) is shown in figure below (see Figure 6):

Figure 6: Laboratory test results

TT	Chủng vi sinh vật thử nghiệm	Lần lọc mẫu	Nồng độ vi khuẩn trước lọc M1 (CFU/100ml)	Nồng độ vi khuẩn sau lọc M2 (CFU/100ml)	Độ giảm vi khuẩn sau lọc (Log)	Tỷ lệ diệt khuẩn (%)
1	Coliforms	Lần 1	$3,1 \times 10^5$	$2,1 \times 10^1$	4 log	99,99%
		Lần 2	$3,1 \times 10^5$	$1,1 \times 10^1$	4 log	99,99%
		Lần 3	$3,1 \times 10^5$	$1,8 \times 10^1$	4 log	99,99%
2	E.coli	Lần 1	$1,1 \times 10^5$	$1,5 \times 10^1$	4 log	99,99%
		Lần 2	$1,1 \times 10^5$	$2,1 \times 10^1$	4 log	99,99%
		Lần 3	$1,1 \times 10^5$	$1,1 \times 10^1$	4 log	99,99%

Table 1: The organizations involved

Group	Role in the ceramic filter initiative
UNICEF experts	Helping the government to bring the private sectors on board to innovate some of the technologies
National Centre of Rural Water Supply and Sanitation (NCERWASS)	Facilitation of the partnership to develop the ceramic filters and in making connections between the different parts of the system.
Resource Development International (RDI) – an American NGO	Technology transfer and production advice - had an office in Cambodia and is well known for experiences in ceramic filter production. Helped to identify suitable filter production pilot site, An Giang
Partners in Hope (PIH) – an American NGO	Quality assurance for RDI.
Vietnam Certification Centre (QuaCert)	QuaCert checked the quality of the SWACF production chain and products and requested the quality check of Roto production chain and its product through SWACF.
Ministry of Agriculture and Rural Development (MARD)	Together with NCERWASS and UNICEF masterminded the ceramic filter initiative
An Giang Provincial Centre of Rural Water Supply and Sanitation (PCERWASS)	Facilitation of the process locally. Signed a Memorandum of Understanding detailing roles and responsibilities with NCERWASS, My Hiep Brick Company, RDI and PIH to form a partnership to develop ceramic filter production.
An Giang Provincial Management Unit	Supported the process at the local level
Safe Water Ceramic Filter (SWACF)/My Hiep Brick Company	Offered facilities and human resources for technical support and technology transfer
ROTO Plastic Company	Production of the plastic bucket surround for the ceramic filter, which had to be made of high-quality plastic but locally affordable. Agreed price of US \$5.5 (June 2017).

Continued bacterial reduction efficiency during daily use depends on the quality of the ceramic filter. It is important to clean the filter regularly.

Studies have shown that significant bacterial contamination can occur when poor-quality locally produced filters are used, or when the receptacle is contaminated at the household level. Because of the lack of residual protection, it is important that users be trained to properly operate and maintain the ceramic filter and receptacle (DFC Report 2011).

What problems were encountered?³

The process of identifying a supplier for plastic to surround the ceramic filter was challenging and prolonged due to the high-quality nature of the plastic required. The quality certification process was complex and took a while to complete as ceramic filter production is still new in Viet Nam.

Although the PPP functioned well, it took time for all parties to reach a mutual understanding about their respective roles and responsibilities.

The filter development process was drawn out with a long interval between the initial visit in 2014 to Resource Development International (RDI) in Cambodia to learn about the process and the project start-up in Viet Nam, formalized by the Memorandum of Understanding signing in June 2016, due to delays in scheduling.

Several issues were also encountered during the production process of the ceramic water filters. There was difficulty in regularly cleaning the filters, especially when the water was turbid (as it often is in emergencies). There are also considerable differences in the degree to which contaminants are eliminated when comparing test conditions (more than 99 per cent removal) and household use (60-70 per cent removal) due to poor cleaning of the filter or unsafe storage of the treated water, etc. requiring increased user

³ Information from: UNICEF Viet Nam draft report on 'Public Private Partnership (PPP) for An Giang Ceramic Filter Production 2015-2017'

training. Quality control of the filters is variable, and the filter are prone to breakage over time. This generates a need for spare parts as well as a distribution network for their replacement. Although the filters are relatively simple to use and maintain, there is a need for basic user training on how to correctly use and maintain the filters.

Tests have also found that the filters are less effective in removing viruses than in removing bacteria. Additionally, the kiln consumes a substantial amount of fuel to produce the filters which needs to be sourced locally and cheaply to ensure the end product is affordable and sustainable. This can be weighed against the approximately 22 hours each month that households save from not having to boil water or collect firewood.

What helped?

The motivation and collaboration of the organizations in the PPP was a big factor in the completion of the project, as was funding and support from UNICEF, without which the project would not have been complete.

The relevant experience of the An Giang brickworks to be able to produce ceramic filters to the right degree of porosity with local materials was another positive aspect that helped in materializing the filter production. Another helpful factor in the production of the filters was the availability of local sources of clay, other materials and fuel, hence emphasizing the importance of market research prior to the production process.

Outcomes

The pilot project to produce ceramic filters has been successful on many fronts.

On February 2018, the ceramic filter passed quality tests administered by the National Institute of Occupational and Environmental Health (VNIOEH) under Viet Nam's Ministry of Health. Following the certification and with all quality testing results sent to UNICEF Supply Division in Copenhagen, a long-Term Agreement was granted to the company to ease VN's procurement needs of ceramic filters for any future emergencies.

Ceramic filters are now available in Viet Nam to serve target groups, such as -vulnerable families in remote areas without access to clean water and emergency-affected people who had been without access to clean water before, during and after typhoons or droughts. Since the project's inception in 2018, SWACF has sold 31,000 ceramic filters on the market. Over 3,200 ceramic filters have also been distributed by UNICEF, MARD, PCERWASS and the Ministry of Education and Training to schools and rural households.

Currently, Safe Water Ceramic Filter (SWACF), the company contracted to produce the filters, is producing an average of 5,000 high quality filters per month. The company has also reported increased sales and continues to make improvements to the product design to make the filters more attractive and more environmentally friendly to a wider range of users. In the context of COVID-19 and natural disaster in Vietnam such as recent flood and storms, the need for ceramic water filters has been increased, therefore, it is further essential to consider the design production capacity of to 10,000 filter/month.

SWACF has also been working alongside the government and UNICEF to raise demand for the filters in remote areas, where clean water is scarce. It has also established a sale agent

system on its own, which allows it to distribute the filters and expand its coverage to neighboring provinces.

BOX 1.

"We have never seen before in other countries such a strong partnership with various important partners coming together for a joint purpose to help poor households with access to improved drinking water, which has been happening and obviously seen in Viet Nam. You have achieved such massive results within only six intensive months while it took us, RDI and PIH, two years to complete." Mr. Marc Hall, Director of RDI.

Through the support of international experts, SWACF now has the technology and knowledge for high quality ceramic filter production and promotion. The government also has the capacity to scale up ceramic filter production when needed, particularly for addressing the needs in disaster prone areas.

The Ministry of Agriculture and Rural Development, which has supported for this technology development, are in discussions to start a second site of production, which will be very helpful to address the needs of affected people.

Many organizations including the Asian Development Bank and other Viet Nam Government WASH related programs/projects, and international NGOs have indicated their interest in buying filters for use in emergencies.

Given the ongoing production of the filters by SWACF, it is anticipated that approximately 12,000 ceramic filters will be available for sale during emergencies.

Lessons Learned

The Memorandum of Understanding has benefited from having legal basis to ensure all relevant parties comply with respective agreements willingly and treat their responsibilities as mandatory tasks. This will save time should there be complaints or disagreements in the future.

To ensure that the increasing sale and expansion of production do not affect the quality of the filters, UNICEF will retain an advisory role in quality assurance, but will gradually transfer this responsibility to the producers for sustainability.

The Ministry of Agriculture and Rural Development will also play a surveillance 'quality assurance' role in the production of the filters.

Next Steps

Advocacy activities to promote the use of filters as a high quality, low-cost and sustainable option to HWTS use still continues.

There are also plans to advocate for investment in ceramic filter production with the national Government of Viet Nam and private sector. These advocacy efforts will be directed towards encouraging the PPP to designate a second ceramic filter production site in the north of Viet Nam. Once a site has been selected, UNICEF intends to continue its support in the establishment of this second production site.

Workshops throughout Viet Nam are being planned to share the learnings from the pilot scheme and advocate for the ceramic filter production partnership model to other private businesses.

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