



Cubes carried by porters to a village for distribution in Nyal, Panyajar County, South Sudan. Photo Credit: Angus McBride/Oxfam

# LIFESAVER CUBE

## Oxfam's Experience in South Sudan

The Lifesaver Cube ('the Cube') is a household water filter developed in collaboration with Oxfam. Dirty water is stored inside the Cube, which resembles a tough five litre jerry can. The small pump on the cap is used to increase the pressure inside the Cube, forcing water through an internal membrane filter which removes bacteria, viruses and other pathogens.

Over 2,300 units have been distributed by Oxfam in South Sudan to date. This report summarises why we are using the Cube, lessons learned so far, recommendations and plans for the future.

# TECHNICAL SPECIFICATION

<b>Weight:</b>	1.2 kg	<b>Dimensions:</b>	20 x 20 x 20cm
<b>Container volume:</b>	5 litres	<b>Packaging:</b>	180 per pallet
<b>Filter type:</b>	Membrane	<b>Filter pore size:</b>	15 nanometres
<b>Flow rate:</b>	1 litre/minute	<b>Lifespan:</b>	5,000 litres
<b>Bacteria reduction:</b>	Log 6	<b>Virus reduction:</b>	Log 4
<b>Made in:</b>	UK	<b>Cost (in UK):</b>	£20 GBP

Key features of the Cube are:

- Virus Removal. Unlike some other methods of water treatment, the nano-membrane in the Cube removes viruses, such as Hepatitis, as well as bacteria.
- Reduced risk of recontamination. Because the water is stored dirty and is not cleaned until it is about to be used there is significantly less opportunity for recontamination of the water.
- No backwashing. To clean the filter the Cube is half filled with clean water then shaken for one minute. This dislodges sediment on the filter and this is then poured out. This is much easier than backwashing, a common process for other filters.
- Longevity. Although by no means a permanent solution, the filter should last a family for more than a year, assuming 12 litres of water per day is treated and depending upon the turbidity of the raw water. After this the flow rate will begin to decrease, although it will maintain the same treatment efficacy.

## Tap Outlet

The tap is where filtered water is delivered. The cap on this side should never be removed.

## Filling Cap and Pump

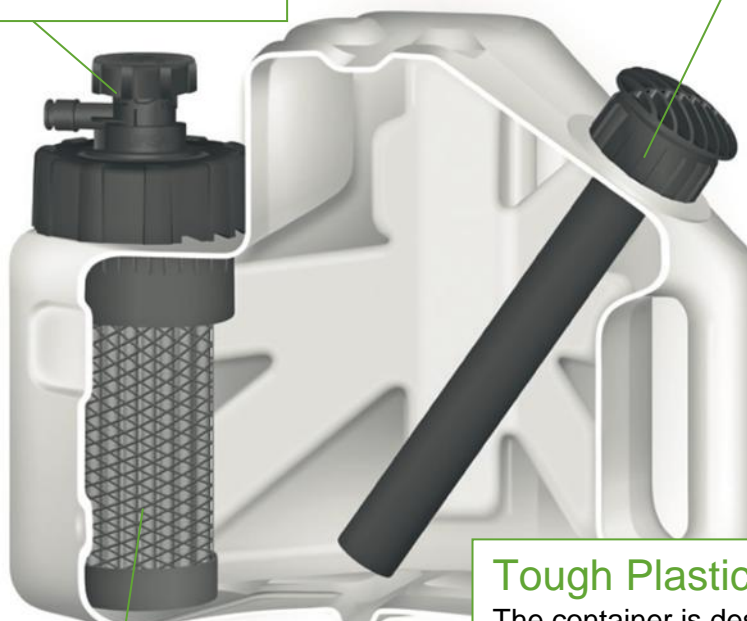
The Cube is filled through this cap and the integrated pump is used to build pressure in the Cube.

## Membrane Filter

The 15 nanometre filter is protected by a mesh.

## Tough Plastic Container

The container is designed to resist the internal pressures built up when in use, so is very robust.



# USE AND MAINTENANCE

## How to Use

1. Fill the Cube with the highest quality of water available.
2. Pump the handle approximately 10 times until a pressure has developed inside the Cube.
3. Twist the tap to start the flow of water.
4. Continue to pump whilst the water is flowing to maintain the pressure inside the cube.
5. The Cube can be used upright, on its side, or held like a jug.



Cecilia Kiden demonstrating how to use the filter. Photo Credit: Angus McBride / Oxfam

## First Use

The membrane filter has a glycerine coating to prevent it drying out before it is first used. This gives the water an initial unpleasant, although not harmful, taste. To remove this coating the pump must be 'primed' before it is used for the first time. The method of doing this is slightly different between the 'Quick User Guide' and the full 'Instruction Manual'. The following is from the instruction manual:

1. Fill the cube with water fully.
2. Leave for ten minutes, then pour the water back out.
3. Refill with fresh water and pump all of the water through the Cube.
4. Refill with water and start to use normally.

## Storage

The filter inside the Cube must not be allowed to dry out. If it does the pores will close up irreversibly, and it will stop working. To achieve this, the Cube should ideally be left an inch of water inside. Alternatively, the manufacturer has advised that if both of the caps and the tap are closed the moisture retained in the filter should prevent it from drying out.



## Cleaning

The filter will eventually clog up, particularly if turbid water is used. This is cleaned by:

1. Half fill the Cube with water
2. Shake the Cube for one minute
3. Pour out the water through the inlet
4. Inspect the filter. Repeat the process if necessary.

The user manual gives an alternative method for cleaning the Cube by removing the filter and carefully washing it. This is only suitable for clean environments and risks damage to the filter. It should not be promoted for the South Sudanese context.



Using the filter is easy if the instructions are followed. Gariya, Mundri West County. Photo Credit: Angus McBride / Oxfam

# FEEDBACK FROM THE FIELD

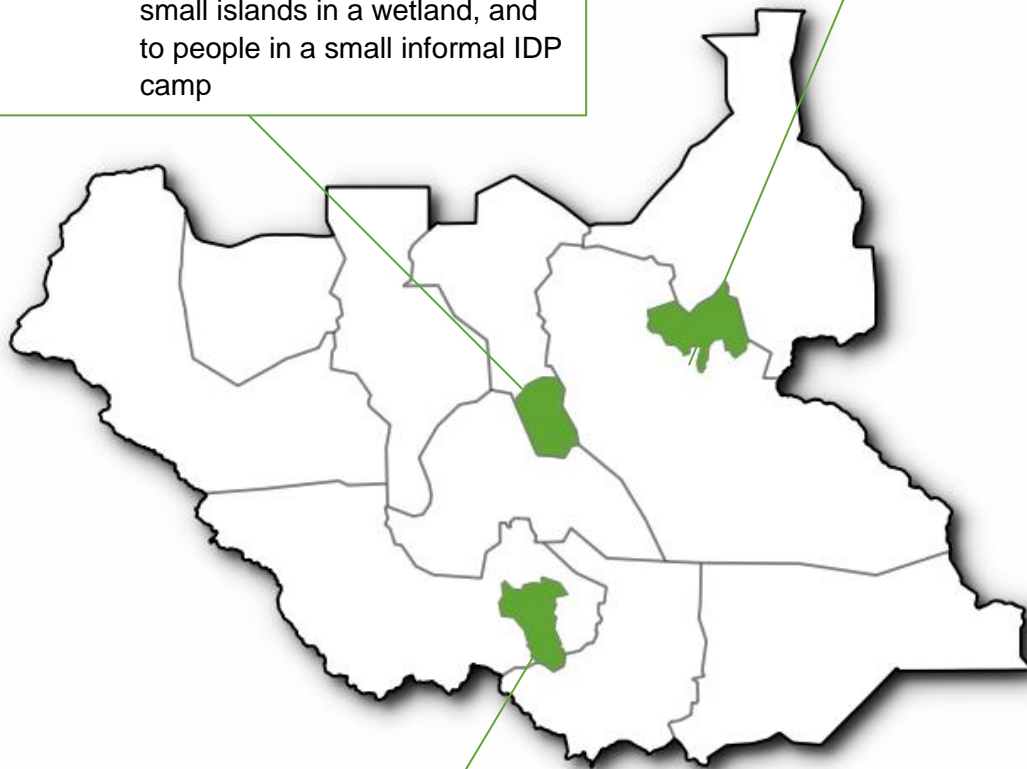
## Oxfam Responses using the Cube

### Panyijar County

**When:** Jan/Feb 2016  
**Where:** Nyal Islands, Reykey IDP Camp  
**Water source:** Swamp  
**Quantity:** 1215 cubes  
**Transport:** Plane then canoe  
**Response to:** Displacement of people onto small islands in a wetland, and to people in a small informal IDP camp

### Nyirol County

**When:** January 2015  
**Where:** Pultruk  
**Water source:** Swamp  
**Quantity:** 180 cubes  
**Transport:** Plane the pickup  
**Response to:** Displaced people living in the open near a swamp.



### Mundri West County

**When:** March 2016  
**Where:** Bangolo, Gariya  
**Water source:** River, ponds and boreholes  
**Quantity:** 955 cubes  
**Transport:** Truck  
**Response to:** Displacement of people into the bush.

## Logistics

- Easy to move to distribution site. The Cubes arrive packed efficiently on a pallet but this can easily be broken down into convenient smaller packages. The Cubes have been carried far by porter and by canoe with no issues. They are easy to pack and pile, and as a self contained unit there are no parts to forget or lose.
- It can break if handled roughly. When handled particularly roughly (for example dropping them down from a truck or if somebody drops it when carrying it from the water point) it is possible for part of the Cube to break. Up until the point of distribution the number of breakages is estimated to be no more than 1% of Cubes. Breakages that have occurred more than once are:
  - The threads on both of the caps have snapped
  - The tap nozzle, and the neck of the tap, have snapped
  - The plastic weld on the bottom of the cube can leak
  - If the pump handle comes up during transport it will break off.



Various breakages which can occur. Credit: Angus McBride/Oxfam



## Distribution



Kenyi A. Athanasius giving a demonstration of how to use the Cube during a distribution in Pachar, Panyajar County. Photo Credit: Angus McBride/Oxfam

- Thorough training at distribution essential. In Mundri West a distribution was undertaken as part of a rapid assessment. The Cubes were distributed as part of a larger hygiene kit and there was no time to give everybody proper training. The result was a high rate of breakages and disuse as some people didn't understand what it was for and often people did not understand how to clean it.
- May require support after the distribution. In Ganyiel, Panyijar County, it was felt that one demonstration was not enough to ensure people used the Cube correctly. Two people were hired to conduct follow up visits for one month after the distribution occurred and to support the recipients with any problems they had using it.
- Complimentary distribution of buckets and cups is necessary. The Cube can reduce the risk of recontamination of the water, but only if the user has a cup to pour the filtered water into. It is also too small to be used for water collection or storage. Buckets and cups should be distributed alongside the Cube where the population do not have them already.

## Use and Maintenance

- Recipients use it. A post distribution monitoring (PDM) survey undertaken in Nyal, Panyijar County, found that 95% of recipients understood how to use the Cube and that 92% of recipients reported using it.
- Improved taste. In Pulturuk many recipients reported using the Cube because they preferred the taste, not because of the safety of the water produced. The Nyal PDM reported that 25% of people used the Cube for this reason.
- Simple and safe to use. It is almost impossible to use the Cube in a way that results in the water produced not being safe to drink. For example, if the filter is not cleaned properly it will only reduce the flow rate, not the treatment efficacy.
- Cleaned the same way as a normal jerrycan. The Cube is cleaned in a way that intuitive to the users - in the same way as a normal jerrycan.
- Not carried when displaced. A unique opportunity to assess whether people would take them with them was had in January 2015 when some of the IDPs from Pultruk moved to Lankien, where Oxfam has a base. Unfortunately, none brought the Cube with them. Reasons given included that their Cube had broken, or that it was not a priority item for them.
- "It is easier for 'town' people to use." This is a quote from one recipient in Pultruk, who felt that people from towns would be more accustomed to using new technology.
- The Cubes are sometimes left empty. An evaluation of the Panyijar response noted that the cubes are often not left with an inch of water inside, although in Nyal 88% were found to contain water during the PDM. Subsequent information from the manufacturer has indicated this may not be a problem as was previously thought, so long as the caps and tap remain closed so that the filter is completely sealed.
- Difficult to fill. The cap through which water is poured is narrow, meaning that unless it can be submerged in water a bucket with tap or a cup must be used – neither of which is quick or easy.

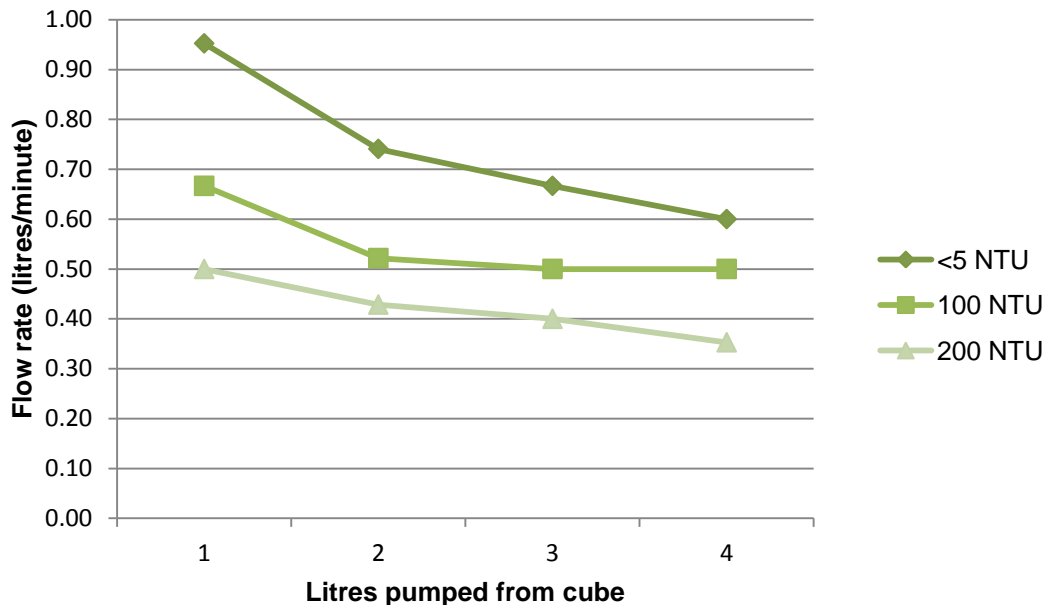


Filling the Cube with a jerrycan can result in spilt water. Photo Credit: Angus McBride/Oxfam



- Flow rate reduces with turbid water. The flow rate reduces significantly with turbid water, to the point where the Cube can become almost unusable. The flow rate also decreases as the water level in the Cube decreases. The figure below demonstrates this.

*Test Method:* A fully primed Cube that had been in use for some time was cleaned then different turbidities of water were poured in. The turbidity was measured with a turbidity tube. The time taken to pump the first, second, third and fourth litre through the Cube was measured. The pump was operated continuously at a steady pace throughout the test. It is not possible in practice to fill the Cube with a full five litres, so the test was ended at four litres with a small amount of water remaining inside the cube. Note that these results are only indicative of performance.



- Requires both lids to be screwed on tightly to work. If the screw tops are not tightened properly the air will escape, releasing the pressure and causing the Cube not to function. Some people are not used to using screw tops, and this is the most frequent cause of problems during initial demonstrations.
- O-rings can get lost. Removing the cap on the tap side of the Cube often results in lost O-rings, which render the Cube useless as the pressure can then escape. There is a locking mechanism to prevent the cap being removed, but in practice they can often be opened by twisting hard.



The top of the membrane filter and one of the O-rings which can easily be lost if the cap on the filter side is unscrewed. Photo Credit: Angus McBride / Oxfam

# DISCUSSION

## Logistics

The Cubes are not available within South Sudan but are easy for international NGOs to purchase, either from the Oxfam Humanitarian Procurement Centre or from the supplier directly. Airfreight into the country from the UK adds around \$5 to the cost of each Cube, and if they need to be moved within South Sudan this will add a similar cost again.

The fact that the Cubes arrive efficiently packed on a pallet but can then be broken down into individual units or tied together into smaller bundles is very useful. For onwards transport however they are likely to be roughly treated by loaders and unloaders. Whilst the number of breakages so far has been acceptable, improvements could be made – taping down the pump so that it does not pop up and strengthening the tap, for example. The manufacturer has suggested that they are shipped with a cup over the tap, which seems like a good idea: protecting the tap whilst also providing a container for drinking from once in use.

## Distribution

The training that happens alongside the distribution of the Cube is essential, as for any household water treatment product. At each of the distributions carried out so far the messaging for the Cube has improved, as feedback showed what was most important for using them.

The Cube has a disadvantage in South Sudan that recipients will not be familiar with it beforehand, whereas many people will have used PuR or Aquatabs in the past. This in itself is not a reason not to use the Cube, as to rule out the distribution of new products because people are familiar with PuR or Aquatabs would prevent a better product ever from being used.

To aid the distribution pictorial instructions will be created which can be used to aid the demonstration and can be left with people after the distribution is finished. Similar materials have been developed in the past to assist distributions of PuR and to disseminate other hygiene messages. Instructions are provided with the Cube but are aimed at a Western audience, and are not appropriate for distributions within rural South Sudan.

### Key Messages for Distribution

- On first use prime the Cube by filling with water, leaving it for ten minutes, then emptying. Refill the Cube and pump it all through the filter without drinking it. Shake the remaining water and then empty it.
- Never leave the Cube empty
- Make sure both lids are screwed on tightly. Never open the lid with the tap on it.
- When the flow rate decreases, clean the Cube by half filling it with clean water, shaking it for one minute and then emptying.
- Use the cleanest water available for best flow rate and lifespan.
- Carry it with you if you are displaced to allow you to always access clean water.

## Use & Maintenance

Recipients have generally been positive about the Cube. Most issues that have arisen can be overcome by good training and follow up.

The longevity of the Cube should be one its greatest strengths in comparison to other commonly used household water treatment products. The manufacturer has given the filter a 5,000 litre rating, which should provide enough drinking water for a family for more than a year. It is not yet possible to say if this lifespan will be achieved in practice. It was disappointing to find people from Pultruk not carrying them when they moved to Lankien a year later.

The inlet cap for the filter is too small for easy filling from a variety of sources. The same breakages that occur before distribution have also been seen occurring during use of the filter, although the frequency of these is not known.

The flow rate of the filter is the biggest technical drawback. The manufacture's given flow rate of one litre per minute it is acceptable, but in practice this is only achieved in ideal conditions. Lower flow rates are achieved when the Cube is not full or the raw water is turbid. This makes the Cube frustrating to use, particularly as during the waiting period whilst the water is flowing the Cube must be pumped continuously. In practice water treatment products will only be given to people in South Sudan who are drinking surface water, and this is likely to be turbid, meaning that this is the type of water the Cube should be expected to treat.

The Cube has a very high level of treatment (log 6 for bacteria and log 4 for viruses). It is the opinion of the author that this level of treatment is unnecessarily high and the focus should instead be on a high flow rate. The Cube is likely to be used more and therefore produce better public health outcomes if it produces a larger quantity of adequate quality water rather than a smaller amount of very high quality water.

The high treatment efficacy of the Cube is not required in most cases. There have in the past been viral outbreaks in South Sudan, for example a Hepatitis E outbreak in the refugee camps in Maban in 2013, but these are a relatively rare occurrence and the majority of water borne disease in South Sudan is caused by bacteria.



# CONCLUSION

There has been a lot of positive feedback about the Cube. It is simple to use and maintain in comparison to some other water filters, and it should last a lot longer than the most commonly distributed alternative in South Sudan – PuR water treatment sachets. However, PuR would require to be distributed in big quantities to meet the Lifesaver Cube lifespan. Therefore the Cube represents a more sustainable solution which reduces the dependency of targeted population to additional support.

The most significant piece of negative feedback about the filter is the flow rate, particularly when turbid water is being treated.

The Oxfam team are involved in the South Sudan WASH Cluster's Technical Working Group on household water treatment, and will give feedback to them on Oxfam's experience with the Cube so far.

Around 300 further Cubes will be distributed by Oxfam shortly, and a further 1,080 Cubes have been ordered as contingency stock for the Oxfam South Sudan programme.



In Nyal, Panyajar County, the Cubes were moved by dugout canoe to the islands where people were sheltering. Photo Credit: Angus McBride / Oxfam

# RECOMMENDATIONS

The following are recommended for distributions:

- Ensure everybody who receives a cube receives thorough instruction in its use and maintenance.
- Follow up visits should be arranged when possible to fix any issues the users are experiencing.
- Simple pictorial instructions should be created to assist the distribution that can also be left with the recipients.

The following changes to the design and packaging of the Cube are recommended:

- Strengthening of the threads on both of the caps.
- Taping down the pump so that it cannot pop up during transit.
- Making it impossible to remove the cap on the filter/tap side.
- Redesigning the tap to remove the sharp edges, which are weak points.
- Ensuring the area around the plastic weld is as strong as the rest of the Cube.
- Increasing the flow rate of the filter, particularly when the raw water is turbid.
- Increase the size of the cap on the pump side to make it easier to fill.



A child demonstrates using the Cube during a follow-up visit in Pultruk, Jonglei State. Photo Credit: Angus McBride/Oxfam

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The Cube can be procured by aid agencies from the [Oxfam Humanitarian Procurement Centre](#)

Sources: field experience, the [Oxfam Equipment Catalogue](#), the Lifesaver Cube User Manual, the Oxfam Nyal PDM report, the EP&R Echo 2015 Evaluation report, and the Oxfam Mundri West Rapid NFI Distribution PDM report.