

Technology Brief Report

Improving rural household's access to safe water using solar water disinfection

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What is a technology brief for?

The industries, researchers, policy makers and other stakeholders who have an interest with the technology addressed by this technology brief

Why was this technology brief report prepared?

To inform deliberations about the solar water disinfection technologies by summarizing the best available evidences about a technology and its public health importance.

What is an evidence-based technology brief?

Evidence based technology briefs bring together local or global technology evidences to inform policy makers about best available technologies which have public health importance

Background

Globally, an estimated 1.9 billion people use either unimproved water source or an improved source that is fecally-contaminated. About, 1.5 million children under the age of five die each year, because of unsafe water. This is equal to around 4,000 children every day (1).

Developing countries, share the largest portion of the problem in that 80% of all illness and deaths in these countries derive from insufficient or contaminated drinking water supply. Over 50% of all hospital beds in developing countries are occupied by people who suffer from diseases caused by contaminated water (2)

Access to safe water supply in rural Ethiopia is the lowest among Sub-Saharan Africa countries, which is 57% for the rural households. Only 21.8%, 7% and 13.9% of the rural households have access to drinking water from piped water, protected dug well and protected spring respectively. Unsafe drinking water is resulted in diarrheal diseases, which is the major contributors of high child mortality rates in Ethiopia, which is 67 out of 1000 (3)

According to the World Health Organization (WHO), using households water treatment (HWTS) is one of the recommendations given for achieving universal access to safe water for households, where piped water systems are not possible and where people are relying on source water that may be contaminated. HWTS and safe storage, have the potential to have rapid and significant positive health impacts in reducing diarrheal diseases by as much as 45% (1)

From EDHS survey of 2016, only 7.9% of the rural population was used some kind of households water treatments: boiling (2%) , using Chlorine (2.5%), strained through cloth (1.9%), ceramic, sand filter (0.9%), solar disinfection (0.1%) and letting stand and settle (0.3%) and other methods (0.1%) (EDHS, 2016). This indicates the lowest accessibility of HWTS in rural areas of Ethiopia (3).

Therefore, using low cost HWTS, like SODIS-WADI can improve the accessibility of safe water for rural house-holds in Ethiopia by comparing its advantage over the currently existing small scale water treatment options. .

Objectives:

To synthesize an evidence & highlighting the public health importance, accessibility of SODIS and its potential for reducing diarrhea and mortality among children of under five years age.

Methods

Technology evaluation criteria of the Ethiopian intellectual property office (EIPO) are taken in to consideration to select SODIS technology: use of locally available resource and skills, cost of the technology, use of renewable sources of energy and materials, potential of scale up of the technology and the social benefits of the technology were taken in to considerations (4).

Then database search of goggles, and WHO websites was conducted, to get evidences on the public importance, accessibility of SODIS and its potential for reducing diarrhea and mortality among the under-five children.

Description of SODIS and WADI

SODIS is a natural process, in which the UV-radiation of the sun inactivates harmful pathogens in PET-bottles filled with water. The process only requires polyethylene terephthalate (PET) bottles, which are filled with contaminated water and are then exposed to the sun for six hours. Over time, the sun's UV-radiation will deactivate the harmful pathogens in the water (5).

WADI (water disinfection) is an easy-to-use solar powered UV measurement device that is used as an indicator for the solar water disinfection (SODIS) method. A happy smiley face on the WADI display indicates the point in time at which the UV-radiation of the sun has made contaminated water in a PET-bottle safe to drink. Its happy smiley face on the display guarantees at least a 99.9% reduction of coliform bacteria in the water (5).

According to the information provided by the manufacturers, WADI can be placed next to an unlimited number of PET plastic bottles and shows a happy smile face when sufficient UV radiation has made the water in the PET plastic bottles are safe to drink (1)

For this technology brief, SODIS is selected among the eight WHO's priority water disinfection technologies that were found to be met the WHO performance targets of the 2016 (Annex 1)

,because of its low cost and the polyethylene terephthalate (PET) bottles can be re-used once bought and the using natural sun light could be a good opportunity.

Another good opportunity of SODIS is, it has the same performance standard of 1* as that of aqua-tabs, chemical disinfection we are currently using in our country. They have a targeted protection of high removal of bacteria and protozoa with some removal of viruses (1)

Current practice of Household water treatment in rural Ethiopia.

The most common source of drinking water in rural areas is water from the public tap or standpipe (19%) or bore hole (13%) and a protected spring (14%). More than 9 in 10 (92.1%) of the rural households do not treat their drinking water. The most commonly used method of water treatment in rural households of Ethiopia is adding bleach or chlorine (Wuha-agar, Aqua-tabs, Bishangari) which covers only 3% of rural households and 0.1 % of them used SODIS without WADI and only 7% of households use an appropriate water treatment method (3).

Impacts of the Technology

Treating water at the household level is more effective than the conventional improvements in water supplies in ensuring the microbiological quality of drinking water at the point of consumption, because it prevents recontamination of water in the home (6)

A systematic review, covering more than 38 randomized controlled trials (RCT's) in 19 countries found that house-hold-based interventions were about twice as effective in preventing diarrheal diseases (47%) than improved wells, boreholes, and communal standpipes, which is 27% (7)

Technical effectiveness of SODIS

In the laboratory, SODIS has been proven to inactivate the viruses, bacteria, and protozoa that cause diarrhea disease .Different studies have showed positive effects of SODIS in reducing or inactivating bacteria and virus and had also showed that SODIS has been proven in reducing protozoal parasites (8).

Field data has shown in reduction of bacteria in developing country waters treated with SODIS. In four randomized, controlled trials, SODIS has resulted in reductions in diarrheal diseases incidence ranging from 9-86% (HWTS in developing countries (8)).SODIS can reduce diarrhea

up to 45% and can protect in case of cholera, typhoid epidemics and parasitic diseases with having 99.99% of effectiveness (1)

Social acceptability of SODIS

SODIS has a high social acceptance of ranging from 20% to 80 % .Accepted by users because of the minimal cost to treat water, ease of use, and minimal change in taste of the water. There is less probability of recontamination, water is consumed directly from the small, narrow-necked bottles (with caps) in which it is treated (9).

Currently, over 4 million people in 30 countries are using SODIS worldwide, for daily drinking water treatment and is proven to reduces diarrheal diseases incidence by 45% in developing countries. It has the potential to reduce bacteria, rota virus by 99.9% after sunlight exposure of water filled pet bottles for 6 hours (5)

Scalability of SODIS

Different water treatment technologies are better suited for different situations. solar water disinfection, for example, may be especially suited for very poor-house-holds in sunny regions for treatment of water (8) The poor house-holds in Ethiopia can utilize this opportunity, as there is 13 months of sunshine in our country.

Therefore, SODIS could be easily scaled and widespread easily in its application. Because, SODIS technique can be used simultaneously many PET-bottles, it doesn't require any maintenance, no spare parts, easily practicable at household level and environmental friendly; in that it doesn't require batteries, chemicals and no CO₂ emissions. However, its cost is similar with aqutabs and wuhagar, which is 0.1-0.5 USD (8). **Opportunities for adopting SODIS**

Household water treatments (HWT's) program, is included among common household interventions utilized by the community health workers network which is a nation-wide scheme aimed at improving health outcomes.HWT is also has a high visibility at the policy level: it is included both in the health sector development program (HSDP) of IV for 2010-2015 and health sector transformation plan of Ethiopia's 2016-2019/20. (10)

Barriers of adopting the technology

The drawbacks include the need to pretreat water that appears slightly dirt (with high turbidity level),the user acceptability concern, because of the limited volume of water that can be treated at once and the length of time required to treat, and the large supply of intact,clean,suitable plastic bottles required(8). SODIS, its process is also compromised by it can only disinfect 1 liter of water, which is very small when compared to the conventional household water treatments of aqutabs and Wuha-agar.

Next Steps

As per the available evidences shown, SODIS has similar effect in reducing diarrhea by inhibiting bacterias, virus and protozoa. However, it is used only for small scale water disinfection of up to 1 liter. In case of Aqutabs and Bishangari, we can use for large scale water disinfection (20 liters and more than this).

Therefor,this technology brief will be posed and no technology dialogue will be conducted, because of the above reasons.

Household water treatments which meet WHO performance targets (WHO, 2016)

S.no	Water treatment method	product	Manufacturer	Cost/person/year USD	performance	Performance classification(with correct & consistent use)
1	Solar disinfection	WADI	HeliozGamb H	0.63	*	Targeted protection: high removal of bacteria, & protozoa, some removal of viruses.
2	Chemical disinfection	Aqutabs	Medentech limited	-	*	Targeted protection: High removal of bacteria & viruses, no/limited removal of protozoa
3	Chemical disinfection	H ₂ gO	Aqua Research LLC	-	*	
4	UV disinfection	Waterlogic Hybrid	Qingdao Waterlogic manufacturing company	-	**	Comprehensive protection: high removal of bacteria, viruses & protozoa
5	Flocculation-disinfection	P& G purifier of water	The procter& Gamble company	4.95	**	
6	Membrane ultrafiltration	Lifestraw-family 2.0	Lifestraw SA	104.95	**	
7	Membrane ultrafiltration	LifeStraw Family 1.0	Lifestraw SA	74.95	***	Comprehensive protection: Very high removal of bacteria, viruses,& protozoa
8	Membrane ultrafiltration	LifeStraw Community	Lifestraw SA	329.95	***	

***: removes at least 4 log₁₀ of bacteria, at least 5 log₁₀ of viruses and at least 4 log₁₀ of protozoa

** : removes at least 2 log₁₀ of bacteria, at least 3 log₁₀ of viruses and at least 2 log₁₀ of protozoa

*: meets the performance targets for at least 2-star (□□) for *only two* classes of pathogens

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