

Impact case study (REF3)

Institution: Buckinghamshire New University		
Unit of Assessment: 7 Earth Systems and Environmental Sciences		
Title of case study: WATERSPOUTT – design, development, testing and evaluation of transparent plastic SoDis solar disinfection jerrycans and buckets in Malawi and Ethiopia		
Period when the underpinning research was undertaken: 1 June 2016 – 31 May 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name: Dr Lyndon Buck	Role: Principal Lecturer/Associate Professor (Education) – Product Design	Period employed by submitting HEI: 5/9/1994 – 31/3/2020
Period when the claimed impact occurred: 1 June 2016 – 31 May 2020		
Is this case study continued from a case study submitted in 2014? No		
1. Summary of the impact		
<p>The €3.6m EU H2020 funded WATERSPOUTT project (2016-2020) aimed to provide safe drinking water to communities in sub-Saharan Africa who rely on unsafe sources. The consortium carried out a technological development programme to advance 3 applications based on Solar Disinfection (SoDis), with the following outputs:</p> <ul style="list-style-type: none"> • Producing products which make water safe to drink after it has been collected and demonstrating the health and related social benefits of clean water to end users • In parallel, instigating a social science programme structured to ensure that technologies are adopted by the target communities in rural Africa, with the support of local authorities, in an economically and environmentally sustainable way • Proof of the suitability of polypropylene as a material for manufacturing large transparent SoDis containers such as buckets and jerrycans • Establishing that cloth filters can have greater efficacy than ceramic filters for SoDis applications, and can increase the efficiency of the SoDis process for turbid water <p>The products resulting from this work include a 20 litre transparent polypropylene SoDis bucket designed at Buckinghamshire New University (BNU) which has direct commercial and research exploitation potential. These findings fed into the €5m EU H2020 PANIWATER project (GA820718) where work continues (2019-2023) on SoDis transparent polypropylene containers in peri-urban India.</p>		
2. Underpinning research		
<p>The objective of EU H2020 2016-17 Societal Challenge 5 ‘climate action, environment, resource efficiency and raw materials’ which funded WATERSPOUTT was to achieve a resource and water efficient, climate change resilient economy and society, the protection and sustainable supply and use of raw materials, in order to meet the needs of a growing global population within the limits of the planet’s natural resources and eco-systems. International cooperation was encouraged, in particular with non-EU Mediterranean countries and Africa. The WATERSPOUTT consortium included 13 EU, 1 non-EU Mediterranean and 4 African partners (WATERSPOUTT final report, 2020)</p> <p>The World Health Organisation (WHO) estimate that in Africa ~156 million people rely on untreated sources for their drinking water. Contaminated water transmits diseases such as diarrhoea, which kills over 500,000 people each year (WHO/UNICEF 2015). The health costs associated to waterborne diseases represent more than one third the income of a poor</p>		

household. WATERSPOUTT designed, developed, piloted and field-tested a range of sustainable point-of-use solar disinfection (SoDis) technologies that provide affordable access to safe water to remote and vulnerable communities in Africa. These technologies were developed in collaboration and consultation with end users and include transparent 20 litre SoDis jerrycans (Ethiopia), combined 20 litre SoDis/ceramic pot filtration systems and transparent 20 litre SoDis buckets with cloth filters (Malawi). The project received funding from the European Union's Horizon 2020 research innovation programme (GA688928).

WATERSPOUTT aimed to improve sustainable point-of-use SoDis technologies and combine them with other established water treatment methods. It also aimed to manufacture products locally where possible in order to provide economic as well as social benefits (Buck and Harlow, 2019). Results of the transparent SoDis jerrycan in Tigray, Ethiopia (WATERSPOUTT final report) and Health Impact Assessment of May 2020 show baseline diarrhoea levels fall from 13.5% to 0 after 12 months, a complete disappearance in the 400 households in the trial. While it proved unfeasible to produce the 20 litre PET jerrycan locally, the study shows that the larger 20 litre jerrycans work as well if not better than the standard 2 litre PET bottles that are currently used for SoDis. They are more convenient as they hold a typical household's daily water in one container with less workload to collect water and less risk of cross contamination. The cost of the 20 litre PET container used in Ethiopia was less than 10 x 2 litre PET bottles. Long term transmittance of UV-A in PET shown to not reduce significantly after 300 hours in HIA analysis, therefore proving the long term sustainability of PET containers for SoDis (WATERSPOUTT final report, 2020).

Field trials of 835 households in Chikwawa, in Malawi showed an increase in efficiency of SoDis in water more turbid than 100NTU, typical values for standing or well water, with cloth filters (https://ec.europa.eu/research/infocentre/article_en.cfm?&artid=50428&caller=other). Participants were positive about their experiences with the SoDis bucket (Polo-López et al, 2019(a)) with a significant reduction in cases of diarrhoea reported by both participants and health workers (Polo-López et al, 2019(d)). There were no difficulties reported in using the buckets, though unlike in Ethiopia there was no decrease in workload reported from moving to SoDis water treatment (Morse et al 2020).

3. References to the research

- (a) M. I. Polo-López, A. Martínez-García, M. J. Abeledo-Lameiro, H. Gómez-Couso, E. Ares-Mazás, A. Reboredo-Fernández, T. Morse, L. Buck, Kingsley Lungu, Kevin G. McGuigan, P. Fernández-Ibáñez *Microbiological Evaluation of 5 L- and 20 L-Transparent Polypropylene Buckets for Solar Water Disinfection (SODIS) Molecules* 2019, 24(11), 2193; <https://doi.org/10.3390/molecules24112193>
- (b) WATERSPOUTT final report (2020) <https://cordis.europa.eu/project/id/688928>
- (c) Morse, T., Luwe, K., Lungu, K., Chiwaula, L., Mulwafu, W., Buck, L., Harlow, R., Fagan, H. and McGuigan, K. (2020) *A transdisciplinary methodology for introducing SODIS to rural communities in Malawi - formative research findings*. Integrated environmental assessment and management ISSN 1551-3793
- (d) Polo-López, M. I., Martínez-García, A., Abeledo-Lameiro, M. J., Gomez-Couso, H., Ares-Mazas, E., Reboredo-Fernández, A., Morse, T., Buck, L., Lungu, K., McGuigan, K. and Fernández-Ibáñez, P. (2019) *Evaluation of transparent 20L polypropylene buckets for household solar water disinfection (SODIS) of drinking water in resource-poor environments*. In: 20th International Symposium on Health Related Water Microbiology, 15 - 20th September, Interuniversity Cooperation Centre (ICC) Vienna
- (e) Buck, L. and Harlow, R. (2019) *Improvements in water intervention projects through product design methods*. In: DS 95: Proceedings of the 21st International Conference on Engineering and Product Design Education E&PDE Ethics and Social Issues 1 The Design Society University of Strathclyde, Glasgow ISBN 978-1-912254-05-7 <https://doi.org/10.35199/epde2019.58>
- (f) WHO/UNICEF *JMP 2015 Joint Monitoring Report* Available at: https://www.who.int/water_sanitation_health/publications/jmp-2015-update/en/

Grant details

(G1) WATERSPOUTT (Water – Sustainable Point of Use Water Treatment Technologies) European Union EU Horizon 2020 Research Innovation Programme under Grant Agreement no. H2020-2016-RIA-688928, €3.6m, June 2016-May 2020
 (G2) PANIWATER (Photo Irradiation and Adsorption Novel Innovations for Water Treatment) European Union EU Horizon 2020 Research Innovation Programme under Grant Agreement no. H2020-SC5-12-2018-GA820718 and Indian Department of Science and Technology (DST), €5m, February 2019-January 2023

4. Details of the impact

The impact of the work undertaken at BNU for WATERSPOUTT can be further categorised as clean water and health impact (in Ethiopia and Malawi), economic impact (in Africa and India), sustainability impact (Africa), gender issues impact, educational impact, and potential research and economic impacts including exploitation models for SoDis buckets and jerrycans.

Clean water and health impact (Ethiopia and Malawi)

1650 PET transparent jerrycans were field trialled and tested in rural villages in the Tigray region of Ethiopia between January and June 2018. Results from tests conducted by WATERSPOUTT partner at Mekele University showed complete inactivation of *E. coli*, *C. parvum* and MS2 after 6 hours of direct sunlight at 30 W/m². The results were disseminated at Shared Dialogue Workshop at the Harena Women's Development Army (WDA) in order to educate the end users and allow them to gain the benefits of the research. A further 595 (Ethiopia) and 627 (Malawi) respondents participated in baseline socio-spatial surveys of households to further demonstrate the benefits of the SoDis technologies on health, in particular children under 5. Health Impact Assessments (HIA) for Ethiopia and Malawi have been registered with the Pan African Clinical Register to further disseminate good practice in SoDis (Net4Society, 2017).

Economic Impact (Africa and India)

The WATERSPOUTT experience and knowledge is continuing through the PANIWATER project which is expected to further advance WATERSPOUTT systems (CORDIS, 2020). PANIWATER is jointly funded by H2020-SC5-12-2018 grant 829715 and Department of Science and Technology of India (DST). The polypropylene developed for the SoDis buckets is being used and further refined to make jerrycans of a 10 litre capacity that is optimal for peri urban India, down from 20/25 litres in WATERSPOUTT. These jerrycans are being produced by a local manufacturer who are benefitting from design, materials and manufacturing input from WATERSPOUTT/PANIWATER EU partners.

WATERSPOUTT partners University of Strathclyde, University of Malawi and BNU developed solar filtration units in Malawi with local manufacturer Arkay Plastics, Blantyre which is producing the 20 litre transparent SoDis buckets for both controlled and field testing for €2.70/bucket transparent PP with 1% UV stabiliser by weight in body and lid to increase life in service. Dedza Plastics, Malawi produced the ceramic filters for field testing. Blantyre based NGO Tiyamike Sewing used for cooperative manufacture of cloth filters according to BNU design at a unit cost of €3.19. Economic impact on local SMEs and NGOs was positive, with positive knowledge and design transfer to the local businesses, and all prototype components manufactured locally in Malawi (UNESCO/IHE 2020).

Sustainability Impact (Africa)

H2020 is promoting WATERSPOUTT in their CORDIS results pack and the October 2020 newsletter of DG DEVCO, the EU Commission's Directorate General for International Cooperation and Development "Tackling Water and Sanitation Challenges to Contribute to a Green Transition (EU DEVCO 2020).

Gender issues impact

Development of water supply & sanitation technology, systems & tools, and/or methodologies – Societal Challenge 5 – Topic WATER-5-2014c WATERSPOUTT ranked A for integration of gender integration, knowledge and expertise in the project (Net 4 Society 2017)

Educational impact

Educational programmes were developed and developed by the WATERSPOUTT consortium such as the Safe Water School Training Programme, Chikwawa, Malawi and talks to the Health Development Army and Women's Development Army, Tigray, Ethiopia. These programmes are designed to allow end users to gain health and social benefits from WATERSPOUTT research.

Spanish NGO Fundación Etiopía Utopia investigated potential deployment of SoDis technologies to disinfect drinking water in 2 community schools in Tigray region, Ethiopia in 2018 where some students have fights over drinking water and is now fully implementing this. WATERSPOUTT partner Juan Carlos I University participated in practical workshops in the field, to those who will facilitate and disseminate the SODIS technique (Etiopia Utopia, 2020)

Potential future impacts

Upcoming chapter in book (2021) details the work undertaken in WATERSPOUTT and described in this ICS: "Design and evaluation of large volume transparent plastic containers for water remediation by solar disinfection" in book "Integrated processes for removal of contaminants of emerging concern (CECs)".

SoDis bucket trials were conducted in Southern Malawi from January 2019 with disruption caused by Cyclone Idai until March 2019. Results from July 2019 showed: Economic impact: Cost to treat 20 litres of water €0.007 against €0.030 for chlorine tablets, saving on average €0.30 per month on water treatment when average family pay is less than €40 per month. Environmental impact: 0.15kg CO₂ produced. Social impact: SoDis buckets were used for disaster relief after Idai, leading to potential future social impact for #1000solutions below.

Exploitation Model for transparent SoDis jerrycan

The SoDis jerrycan research has been transferred to the H2020 funded PANIWATER project to continue investigation and development of an improved version of the jerrycan in PP which is optimal for SoDis (WATERSPOUTT final report, 2020).

Potential future impact for bucket: UN #1000solutions

The SoDis bucket has been put forward to the #1000solutions initiative for UN SDG6 (United Nations Sustainable Development Goal 6): ensure access to water and sanitation for all, linking up research priorities and timelines with policy agendas to further the research on technologies for drinking water in Africa, aiding the implementation of SDG6 and other relevant SDGs (UN, 2018). These are important to policy and decision makers and the development cooperation, and future research will contribute to the Water Action Decade (2018-2028). For #1000solutions:

Target Market: Potential target market size by a conservative fraction (1%) of the Disaster Relief global market in 2025. **Market opportunity:** The SoDis bucket may have applications as a stage-two drinking water treatment technology during disaster relief operations and be supplied through UNICEF procurement services. Due to the large size of the potential market, market penetration is limited by manufacturing and logistics and capped at 1000 units per year, +20% each year. **Estimated size:** €262 300 000 in 2025. **Estimated Time To Market:** 6 months. **Estimated investment** €10 000. **Estimated break even:** 31 months (WATERSPOUTT final report, 2020)

5. Sources to corroborate the impact

- (a) CORDIS EU Research Results – WATERSPOUTT (2020) 24 April 2020
<https://cordis.europa.eu/article/id/415839-using-the-sun-for-water-disinfection-in-africa>
- (b) Net4Society (2017) Success Stories in SSH (Social Sciences and Humanities)
Integration http://www.waterspoutt.eu/images/Rep02_U4.pdf

- (c) Etiopia Utopia Fundación *buletina June 2020*
<https://etiopiautopia.org/contenido/media/2020/06/Etiopia-Utopia-3-buletina.pdf>
- (d) UN (2018) Sustainable Development Goal 6 Synthesis Report on Water and Sanitation
https://sustainabledevelopment.un.org/content/documents/19901SDG6_SR2018_web_3.pdf Malawi local governance
- (e) UNESCO/IHE/Brockliss, S. (2020) Assessment of SODIS household water treatment technology under field conditions – SoDis bucket in rural Malawi, TU Delft [PhD Thesis]
- (f) WHO 2019, June 14 Drinking water fact sheet <https://www.who.int/en/news-room/fact-sheets/detail/drinking-water>
- (g) EU DEVCO (2020) EU DEVCO newsroom newsletter 12/10/2020
https://ec.europa.eu/newsroom/devco/item-detail.cfm?item_id=690203&newsletter_id=227&utm_source=devco_newsletter&utm_medium=email&utm_campaign=Green%20Development%20News&utm_content=Tackling%20water%20and%20sanitation%20challenges%20to%20contribute%20to%20a%20green%20transitio&lang=en
- (h) WATERSPOUTT final report (2020) <https://cordis.europa.eu/project/id/688928>