



Water For Impact

2021

*Our Drivers and Example
Projects to Create Impact
Around the World*



Colophon

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Many thanks to all researchers, students and others for their valuable contributions.

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*TU Delft | Water
for Impact is about
valuing water. Water
is a basic human
right.*

What is Water for Impact?

TU Delft | Water for Impact is about valuing water. Water is a basic human right and should be available to all.

Water for food, water for hygiene and water for drinking. The less we have to worry about the availability, quality and cost of water the better human lives and human societies become. Our aim is to promote water research that contributes to the United Nations Sustainable Development Goals.

Multidisciplinary science, technology, and innovation are at the core of our work. We believe in implementation, testing our sustainable technologies and ideas in the field. We are convinced that a low level of available resources should not necessarily result in low tech solutions.

The best way to learn and make progress is by doing. We believe in action and having the courage to try out new ideas and learn from our mistakes and failures. We call this “actionable science”.

We know our strengths and weaknesses and seek to build partnerships that are greater than the sum of their parts. Building and fostering strong interdisciplinary relationships with a wide variety of stakeholders will make us stronger and allow us to go the furthest.



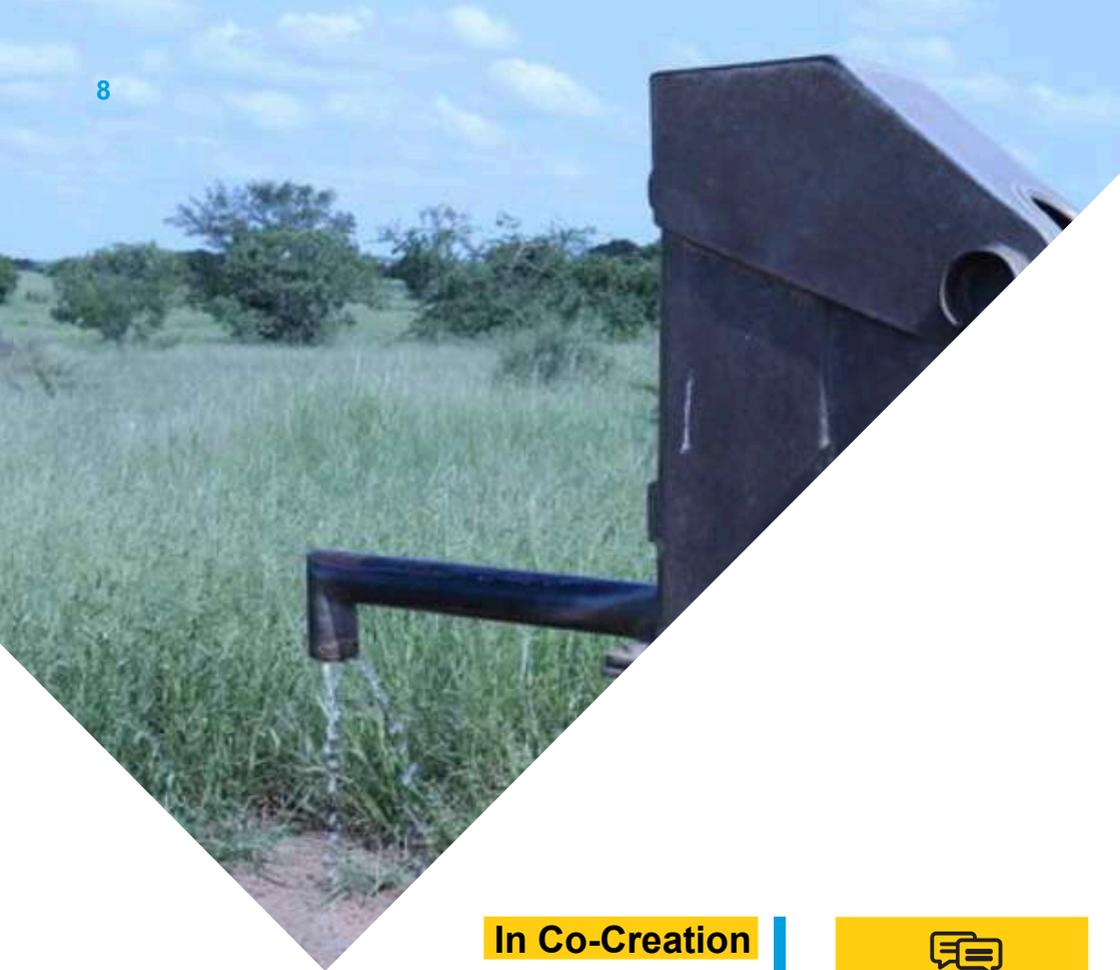
A photograph of a tall, modern glass skyscraper with 'TU Delft' written on top, situated behind a line of green trees. The sky is overcast. The image is partially obscured by a large white diagonal shape that cuts across the page.

TU Delft

Top education and research are at the heart of the oldest and largest technical university in the Netherlands. Our 8 faculties offer 16 bachelor's and more than 30 master's programmes. Our more than 25,000 students and 6,000 employees share a fascination for science, design and technology. Our common mission: impact for a better society.

Global Initiative

Scientists from Delft University of Technology use their expertise to find concrete solutions for worldwide problems, in close cooperation with local partners. TU Delft | Global Initiative is their portal, platform and booster of Science and Technology for Global Development.



In Co-Creation

We do not have a monopoly on expertise or knowledge. We are very good at what we do but also recognize that we do not know all the answers. We seek to learn voraciously from diverse fields, professions and peoples. We teach and share our knowledge, skills and expertise to the best of our ability.



With Local Partners

Change must be led and guided from the ground. We seek to support local partners in achieving their objectives with our combined expertise. Building and fostering strong interdisciplinary relationships with a wide variety of these stakeholders will make us stronger and allow us to go the furthest.



How Do We Work?



Leading to Impact

The best way to learn and make progress is by doing. We believe in action and having the courage to try out new ideas and learn from our mistakes and failures. We believe in implementation, testing our ideas in the field and that low resources should not necessarily mean low tech. We measure our success by the tangible impact we have on the ground.



Focus on Science and Technology

Multidisciplinary science, technology and innovation are at the core of our work. We believe that the challenges of water can be solved or alleviated by better collection of data, improved understanding of natural and human systems, through innovations in technology, and through the sustainable implementation of results.

Our Impact

Water for Impact aims to have real impact using multidisciplinary science, technology, and innovation in co-creation with local partners. Our work extends to countries in Africa, Asia and Latin America, and covers a wide range of water topics, including water for food, health, environment and drinking.





Our Focus



Water for Food

Water for Food

Addressing inefficiencies, irrigation practices and developing new technologies to provide sufficient water for growing the world's food.



Water for DRINKING

Water for Drinking

Developing new technologies, methods and systems to ensure equitable and affordable access to safe drinking water.



Water for Cities

Water for Cities

Supporting the development of urban areas by minimizing the gap between available water sources and the water demands by reducing inefficiencies, exploring new sources, and identifying linkages and synergies between sectors.



Water for Industry

Water for Industry

Exploring new sources and sectoral synergies to optimise water usage for industrial practices.



Water for Values

Water for Values

Understanding the fundamental role of water in human flourishing and economic development and recognising that role in research and implementation.



Water for HEALTH

Water for Health

Providing access to good sanitation to reduce the economic and societal burden of water-borne diseases.



Water for Environment

Water for Environment

Stewardship of the entire water cycle to minimise the negative effects of human activity on the environment.





Projects

LOTUS^{HR}

Local Treatment of Urban Sewage Streams for Healthy Reuse



Water Challenges

The megacity New Delhi, with a very high population density, serves as testing ground for knowledge development on sustainable integrated water reuse in metropolitan areas. The water challenges New Delhi faces are aggravated by the Indian climate, which has big fluctuations due to dry and monsoon periods. Moreover, a significant part of the 10 million residents lack proper access to sanitation resulting in the conversion of open storm water drains into open sewage channels.

Re-using Water

The LOTUS^{HR} project demonstrates a novel, holistic (waste-) water management approach that aims for the **Local Treatment of Urban Sewage streams for Healthy**

Reuse. The goal is to demonstrate that by combining existing cost-effective technologies, targeting potential pollutants at the source, and addressing social perception on water reuse, effective water reuse plans can be formulated.

The required treatment and reclamation steps are determined by the waste water quality and the quality that is needed for safe and healthy reuse in households, industry, and urban agriculture at the source. Reuse and cascading of water is extremely important since it can optimize the water treatment, as each subsequent user in the cascade requires a slightly lower quality than the user before. Additionally, the recovery potential for nutrients, plants, energy and chemicals is also an objective and provides local people an opportunity to sustain their livelihood by selling these by-products. By providing an



incentive that could directly generate additional income, social acceptance becomes easier. Therefore, the inclusion of a research partner that takes into account the socio-economic values of the end-users is a very important aspect of LOTUS^{HR}.

Together

In co-creation with a broad consortium of NGOs, governmental agencies, universities and research institutes, companies and end-users in both India and the Netherlands, a novel holistic conceptual treatment system has been developed.

Given the complexity of the New Delhi urban water networks, technology alone cannot provide a comprehensive solution. Therefore, 'Water Reuse Safety Plans' (WRS plans) will be developed that incorporate the safety aspects of water reuse. For short- and long-term water strategy and policies, the WRS Plans are extremely valuable. They combine the socio-economic and legal impact with quantitative (microbial and chemical) risk assessments of the produced water qualities and the associated risk reduction by applying specific water treatment technologies.



As the social perceptions may differ for different utilisation purposes, socio-economic status, gender and age classes, the study will make use of a diversified sample. These perceptions will be related to the implemented hygiene practices of the end users in order to assess if potential health risks are minimized or increased for the particular reuse application.

“ By combining existing cost-effective technologies, targetting potential pollutants at the source, and by addressing social perception on water reuse, effective water reuse plans can be formulated. ”

Sustainable Development Goals



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Climate Proof Vietnam



Capacity Building in Deltas

Climate Change

Vietnam is amongst the most vulnerable nations to climate change impacts. These impacts include increased pressure on (integrated) water resources. More extreme weather, more frequent and intense natural disasters and sea-level rise have led to, amongst other effects, droughts, floods, the salinisation of farmland and freshwater bodies and serious threats to valuable ecosystems. The water challenges that Vietnam faces are actually comparable to those of the Netherlands.

Collaboration

The current and future challenges

faced by Vietnam require water professionals with deep and broad system understanding, practical skills, and a constructive critical attitude. By building upon the long-term and trustful collaboration of the TU Delft and ITC Twente with the Hanoi University of Natural Resources and Environment (HUNRE) and Thuyloi University, the OKP Climate Proof Vietnam project implements curriculum updates and drives educational development in the field of Integrated Water Resource Management at the partner universities in Vietnam. Through the educational and research project activities, OKP Climate Proof Vietnam aims to provide the current and future water engineers in Vietnam with a wide





set of knowledge and skills and practical experience, so they are well-prepared to enter the labour market.

The project also supports the Vietnamese partners in their organisational capacities, as well as their educational facilities (i.e. (open air) labs, libraries, IT facilities). Furthermore, there is support for the promotion of the universities to diminish the rapid decline of students and to ensure sufficient human capital for the Vietnamese water

sector. Finally, the project aims to increase the link of the universities with the labour market through close involvement of public and private stakeholders in the water sector in a Community of Practice.

“ This project aims to provide the current and future water engineers of Vietnam with a wide set of knowledge and skills to deal with local climate change impacts. ”



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Water

Reclamation

for Mozambique



Reducing Agricultural Water Shortages

Water Shortage

Mozambique is facing severe water shortage. From the total available water flow, only 46% is produced in the country. Agriculture uses around 80% of the water that is available and projections indicate that urban water demand will increase by about 40%, with industrial use being expected to augment by about 65%. The problem is made worse due to low storage capacity and this further limits the expansion of agriculture, industries, and the overall economic development of the country.

On top of lack of water, access to sanitation services, both in cities and rural areas, is deficient. Less than half the population has improved sanitation systems, and in some areas wastewater is unsafely reused in irrigation. In urban areas such as Mozambique's capital Maputo, many of these issues can be identified, with the situation being further exacerbated by population growth.

Water Reclamation

A possible solution to address these issues is water reuse. Some studies have pointed out positive effects of



“*Water reuse in agriculture can contribute as additional water source, as well as add nutrients for crops and thereby increase yields.*”

water reuse in agriculture: adequate water reclamation can contribute as an additional water source as well as add nutrients for crops, thereby increasing yields and contributing to urban development.

Therefore, the aim of this study is to evaluate the potential for water reclamation for agricultural uses in Maputo.

Local Partners

This can only be done in collaboration with local partners. From the beginning, the project team has been involved in decision and opinion making such as public discussion groups, national and international conferences. In addition, other stakeholders such as Eduardo Mondlane University have



been involved in supporting the research design, implementation of the research, and access to research facilities. The municipality of Maputo is also an active collaboration partner, which has allowed for field work in the city.

Impact

All in all, the results of this study will help to reshape the current status of water reclamation for irrigation, and better inform the areas of improvement to enable secure water reclamation in Mozambique.

Sustainable Development Goals



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Horticulture in Ghana



Training for a Brighter Future

Education

Horticultural production (fruits and vegetables) is a market of increasing interest and potential. This project is a Ghanaian-Dutch cooperation to bring about growth in the Ghanaian horticulture sector. The TU Delft, together with the Kwadaso Agricultural College and supported by Holland Green Tech and the Kumasi Business Incubator of the Kwame Nkrumah University of Science and Technology, has developed a 4-month vocational and technical training programme in the horticulture sector, in close collaboration with farmers and agricultural companies in Kumasi, Ghana.

The training is catered to young people who want to study

horticulture and who would like to find employment in the horticulture sector of Ghana, either as an entrepreneur/farmer or employed at an agricultural company. Next to this group, a selection of agricultural companies is targeted directly by this action since they will benefit from suitably skilled new employees. The partnership, public-private, will ensure that the youth is trained according to the private sector needs and therefore matches the demand of labour that the horticulture sector in Ghana needs in order to grow and improve.

ARCHIPELAGO

The project is part of the EU ARCHIPELAGO programme, an inclusive economic development





programme which focuses on youth and vulnerable groups' employability by increasing their professional skills as well as boosting employment opportunities. More specifically, Archipelago will increase local employment opportunities and employability by developing local training and vocational resources adapted to private sector needs.

More information:
<https://www.tudelft.nl/citg/vietnam>.

“ We study how to nurse plants, transplant them, choose the correct planting distances and much more. Through this, we can improve our yields. ”

Sustainable Development Goals



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Intermittent

Water

Supply in Uganda

Creating Smart Solutions



Supply Issues

Developing cities in many parts of the world have very low access to continuous supply of safe drinking water from the tap. Expanding services to an even more rapidly growing urban population will mean that Intermittent Water Supply (IWS) will be the norm for some time to come. IWS exists partly because there is not enough capacity to pressurize the system to supply all consumer taps at the same time, and partly due to the leaky infrastructure. In some cities over 40% of water leaks through distribution pipes.

Leaky pipes can also degrade water quality and cause waterborne diseases because contaminants can enter the pipes and low pressure can lead to in-pipe deposits. The poorest communities are disproportionately affected by the need to buy storage tanks, to treat or boil water, or by having to deal with waterborne diseases. IWS also exacerbates gender imbalances, as in many communities, women and children are the ones who collect water for their household.



RE-Pumps for Smallholder Farmers

**Affordable and Sustainable
Irrigation**

Production Limits

Smallholder farmers are key actors to eradicate hunger and poverty in the Global South. Yet they face restrictions in accessing many crucial resources. Many of them remain water and energy-insecure, which compromises their successful production.

Renewable Energy Pumps

Renewable energy-powered water pumps (RE-pumps) are appropriate and affordable solutions to support smallholder irrigation. Unlike many other pumps, they do not



“ *Smallholder farmers are key actors to eradicate hunger and poverty in the Global South.* ”

operate on polluting, expensive, and potentially inaccessible fossil fuels. Although RE-pumps are environmentally sound and less cost-intensive alternatives, their adoption is a complex process that depends on multiple factors. This project aims to study how innovative business models may facilitate their sustained adoption in smallholder communities. This is done together with partners in the Netherlands, Spain, Nepal, and Indonesia.

Q-Methodology

The project uses both Q-methodology and semi-



structured interviews with experts in smallholder farming systems and with smallholder farmer communities in regions in Nepal and Indonesia where a RE-pump was implemented in recent years. Q-methodology is a highly participatory, bottom-up research method, characterized by giving voice to the participants. The researcher becomes a facilitator of the methodological implementation.

The data and the results emerge from the participants themselves. The knowledge is thus co-produced with the studied population. This is essential since adoption of agricultural technologies is a complex process that cannot be seen from a top-down approach. Expectations, needs and desires of the grassroots users need to be understood. Therefore, fostering collaboration with local partners and actors is needed. Establishing long-term, solid relationships brings about more successful outputs to all parties involved.

Aim

The project aims to shed light on



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how innovative business models may stimulate the adoption of sustainable small-scale irrigation technologies. By translating this knowledge into practical terms, agribusinesses, retailers, NGOs and governmental organisations may provide context-sensitive, integrated interventions for smallholder farmers. These interventions will turn into more accessible and affordable solutions to support and secure food production in the Global South.

“ *This project studies how innovative business models may facilitate the adoption of RE-pumps in smallholder farmer communities.* ”



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The Sealink Project



Understanding the Effects of Coral Reef Pollution

Coral Reefs Degradation

Coral reefs are among the most biologically diverse and productive ecosystems on earth, providing tropical communities with wealth in the form of tourism, recreation, employment, fisheries production, shoreline protection, beach creation, and cultural heritage. Some of the best reefs remaining in the entire Caribbean region are found around Dutch Caribbean islands, especially Bonaire and Curaçao. As coral reef health continues to decline region-wide due to local and global stressors (especially wastewater, pollution, fertilizer, run-off, coastal

“

Coral reefs are among the most biologically diverse and productive ecosystems on earth.”

”

development, overfishing, and global change), communities in the Dutch and wider Caribbean risk losing an increasing proportion of the economic, social, and cultural benefits provided by coral reefs.

The Effects of Pollution

How exactly inland pollution such as sewage water and chemicals gets into coral reefs is not yet known. These mechanisms need



to be studied if we want to maintain functional coastal ecosystems, protect infrastructure, and support economies across the region. Therefore, for the first time, Dutch and Caribbean scientists are looking at how the coral reefs are affected by pollution that flows from land into the sea and how subsequently water motion and marine organisms move and change these substances, and the overall impact that land-based pollution has on the coral reef ecosystem. The team of researchers will focus on Curaçao and St. Eustatius. The knowledge they gather is crucial for the preservation of coral reefs and biodiversity as well as for tourism and local communities in the Caribbean part of the Kingdom of the Netherlands.



are transported into the sea, overland or underground, or both, to ultimately support effective land and water management.

Together

The University of Amsterdam reached out to multiple partners to set up an interdisciplinary team to achieve multiple goals, and Dr. Boris van Breukelen of the TU Delft will lead the work package on the hydro(geo)logy to understand precisely how pollutants, including; nutrients, fertilizer, sediments, organic compounds and pathogens,

“

For the first time, Dutch and Caribbean scientists are looking at how the coral reefs are affected by pollution that flows from land into the sea.

”

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TWIGA

Improved Resilience in the Face of Climate Change



Geo-Information Services

Few places on Earth are served worse with geo-information than Africa. At the same time, the potential value of geo-information services in Africa is extremely large. TWIGA's overarching ambition is to fill this information gap by first enhancing satellite-based geodata with innovative in situ sensors and the development of actionable information services based on this geodata. This ambitious goal can be achieved thanks to recent advances in sensor and communication technology, as well as new sensing platforms such as Unmanned Aerial Vehicles (UAVs) and citizens' observatories. A defining characteristic of TWIGA's ambition is that the project develops complete value chains and not just links in that chain.

The scientific activities will lead to new products, such as maps of precipitable water vapor, energy fluxes, and crop development; humidity sensors to see when irrigation is required, and sensors that detect clogging in urban areas to reduce flood risk. Other possibilities include developing early warning systems for floods due to heavy rain, drought monitoring, heat stress indexing for livestock, and real time water balancing tools for dams to anticipate water scarcity. Combinations of these in situ observations, satellite products, and models will be well beyond the state-of-the-art, not just in Africa but for any continent. The consortium has been built to serve the complete chain with a mix of African and European partners, SMEs, academia, and governmental meteorological agencies.





“ Provide currently unavailable geo-information on weather, water, and climate for sub-Saharan Africa and develop services that answer the needs of African stakeholders and the GEOSS community. ”

Sustainable Development Goals



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TAPP Water

App



A Participatory Tool Towards End-user Inclusive Implementation of Safe Water Supply

Contaminated Drinking

Water

In Bangladesh drinking water is threatened by naturally-occurring arsenic, iron, manganese, and by microbial contamination. Often tube-well and surface water collection are used to obtain drinking water. However, piped water supply is a good alternative for these methods, as it targets the safest water source in the area, provides a degree of centralisation for water quality control and treatment, provides tap connections, and limits the number of (re)contamination events.

Yet the cost, water taste, and billing cause obstacles for the trust in and

uptake of these systems. Issues with operation and maintenance and lack of knowledge further diminish the uptake and acceptance of this solution.

TAPP Water App

The Tapp water-app is meant to assist operation and maintenance of piped water supply and to improve local knowledge of and trust in piped water systems. Tapp is a mobile crowd participation initiative intended to make use of the rapid growth of smartphone ownership and internet access to empower local communities to take ownership of their own drinking water supply and safeguard the delivery of safe, palatable drinking water.



The app is unique in combining five different domains in a single app, where most water apps focus either on service or billing, or on water quality. These five domains are: water quality testing, payment, service delivery, connection and knowledge. While meant for piped water supply systems, the app also includes service delivery and water quality testing for the hand-pumps installed in the area.

The Tapp project delivers a smart, open-access app for Bangladesh, which aids communities, local governments, community-based-organizations, non-governmental-organizations, and private water suppliers in end-user inclusive monitoring, operation, and maintenance of improved water service solutions.

The current app is meant for use in Bangladesh, but the idea behind the app and its set-up can be applied in other resource-constrained contexts as well.



“ The idea of TAPP can be applied in many areas in the world to improve water monitoring, operation and maintenance and to empower local communities to monitor and take ownership of their own drinking water supply. ”



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iwash

Sharing Knowledge and
Practical Solutions Online



Making Knowledge

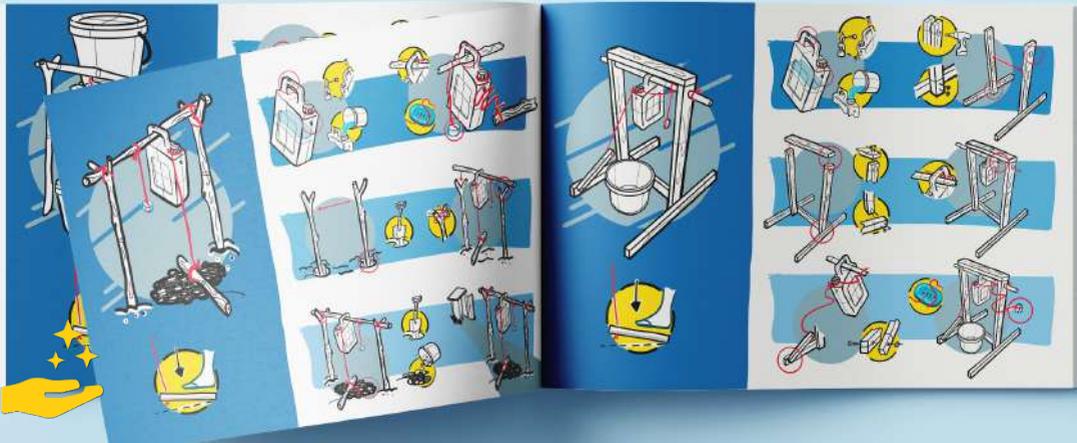
Accessible

To promote better hygiene practices at the start of the Covid-19 pandemic a DIY methodology on handwashing station designs was created and hosted as an open access platform (iwash.org). This initiative has grown into a mature knowledge sharing platform for open water technologies for WASH officers around the world. The core idea is to provide designs, blueprints, and instructions on how to create and implement certain water technologies and to inspire and empower others to create or implement these ideas.

We believe the solutions for many people lacking access to sanitation lies in self-empowerment and

making knowledge accessible. iwash provides sanitation agencies, companies, but also end-users, with understandable designs that can be made from local materials. We call this approach “open-technologies”. Local sanitation partners and university research institutes in Ghana support and expand the knowledge sharing and provide contextual research. Projects are developed and tested locally before being hosted on the iwash platform to ensure the technologies and ideas can actually be implemented.

“ Empowering people to
take sanitation into their
own hands. ”





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For a complete and up-to-date overview of our staff please have a look at our website www.tudelft.nl/waterforimpact.

Our Supporters

Project Partners

Our research projects are always supported by partners. Project partners can be funding agencies, like the Dutch Science Foundation (NWO) or European Union, but also partners from the water sector. We collaborate with water companies, water boards, technology companies and water NGOs.

Financial Supporters

Water for Impact envisions to accelerate development and implementation of innovative water solutions. Financial support allows us to move faster, spending more time on water projects and less time on acquiring funding. Therefore, we seek funders who are interested in supporting our “actionable science”. Our work extends to countries in Africa, Asia and Latin America, and covers a wide range of water topics, including water for food, health, environment and drinking. At present we receive funding from private donors, University Fund Delft and TU Delft | Global Initiative.

Student Community

TU Delft | Water for Impact is very lucky to have the enthusiastic support of our student community. Students from Bachelor’s and Master’s programmes, including Water Management, Environmental Engineering, Civil Engineering, Industrial Design Engineering, contribute to Water for Impact by developing prototypes, and testing water solutions in the field together with our local counterparts.

Are you, or your organisation, interested in becoming a supporter of Water for Impact? Please reach out by sending an e-mail to waterforimpact@tudelft.nl.





Water
for Impact