



Royal Academy
of Engineering

Symposium report

Frontiers of Engineering for Development

WASHing away inequalities

29-31 May 2019 | Mexico City



FOMENTO
MEXICANO



GCRF
Global Challenges
Research Fund



Introduction Frontiers of Engineering for Development

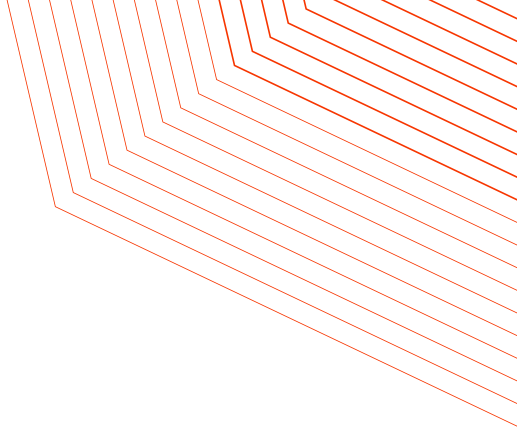
Frontiers of Engineering for Development brings together 60 of the best early- and mid-career researchers and practitioners from industry, academia, NGOs and the public sector in multidisciplinary workshops that address fundamental development challenges.

The objectives of these symposia are to encourage collaborative work that addresses international development challenges and to promote cross-disciplinary thinking among the next generation of engineering leaders.

Competitively allocated seed funding is available to strengthen the collaborations developed at the symposia.

Contents





From recovery to resilience

The seventh Frontiers of Engineering for Development event took place between 29 and 31 May 2019 in Mexico City. This event was organised in partnership with Fomento Mexicano (fomentomexicano.org) and was the first symposium under the overarching theme 'From Recovery to Resilience'.

60 delegates from different disciplines and countries came together to discuss how resilient and robust systems and innovative solutions in the water, sanitation and hygiene (WASH) field can help tackle inequalities.

The event was co-chaired by Professor Barbara Evans and Dr Darren Saywell.



Barbara holds the chair in Public Health Engineering in the School of Civil Engineering at the University of Leeds. Her research centres on sanitation, hygiene and water services in the Global South. She worked at the World Bank Water and Sanitation Programme as well as an independent consultant working with UNICEF, WHO, WaterAid and for the governments of Vietnam, Bolivia and Bangladesh.

Professor Barbara Evans



60 delegates from different disciplines and countries came together to discuss how resilient and robust systems and innovative solutions in the water, sanitation and hygiene (WASH) field can help tackle inequalities

This report summarises the key points from the discussions and activities that took place at the symposium. It aims to capture the wide variety of knowledge, experiences and insights that were present.

The Academy would like to thank everyone who made the symposium such a success, especially the event chairs, the Global Challenges Research Fund and the group of talented, experienced and engaged optimists who came together in Mexico City to WASH away inequalities.



Darren is an internationally recognised WASH expert with 25 years of experience in international operations, consulting, policy, practice, research and advisory work in water supply, sanitation and hygiene. As AECOM's Director of Water Services, he manages large USAID contracts worldwide, leads business development capture processes for the water sector and coordinates the environment and infrastructure approach to thought leadership and knowledge management.

Dr Darren Saywell

Infrastructure

What is the best way to optimise resources and ensure resilient systems?

Session co-chairs

**Andre Steele, IMC Worldwide
and Kaveh Madani, Imperial College
London and Yale University**

Presentations

1. Financing infrastructure – working out what and how to pay for it
Urvaksh Patel, Green Climate Fund
2. Choosing infrastructure – decision-making by national asset owners and national governments
Kaveh Madani, Imperial College London
3. Designing and constructing infrastructure – challenge of making sure it does what it should
Andre Steele, IMC Worldwide
4. Making it sustainable – revenue collection and customer interface
Anjalee Burr, eWaterpay

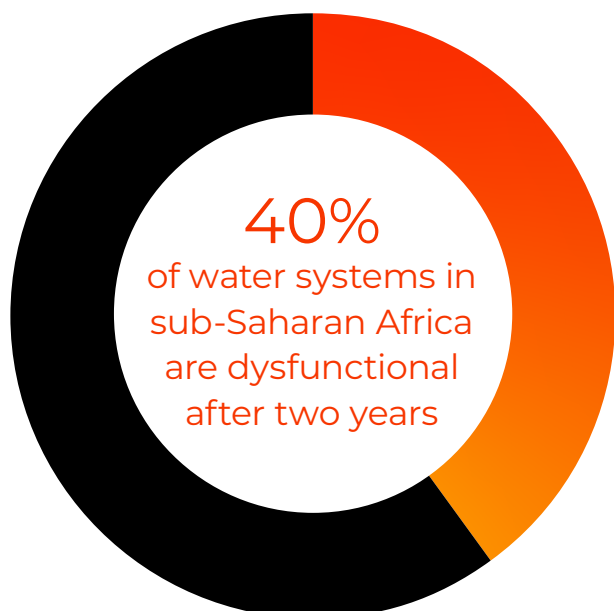
Two of the most poignant issues in WASH infrastructure are how to optimise resources and ensure system resilience. This session discussed the understanding of challenges in infrastructure decisions, delivery, operation and maintenance.

The session started by defining what a 'resilient infrastructure system' would look like. 'Infrastructure' was defined as the basic systems and services that a country, city or organisation need in order to function properly. 'Resilience' was defined as the capacity to absorb shocks, pressure or disturbances without suffering complete failure and the ability to recover from perturbations to maintain a healthy system. The following definition was agreed:

"A 'resilient infrastructure system' is one that can prepare and plan for, absorb, recover from and adapt to adverse natural/human perturbations."

Urvaksh Patel from the Green Climate Fund started his presentation by outlining some of the main elements involved with financing investments in infrastructure. He split these into two categories: the story (key factors) and the words (typical documentation) with the caveat: words don't matter unless you have the right story. It is important that the project derives from strategic programming while addressing the country's priorities. Each project should be built with a strong rationale for the type of funding sought and should incorporate efficiency, effectiveness and sustainability of the investment. Urvaksh explained that transformative change in the WASH sector requires an assessment of what kind of projects derive the most impact after implementation.

These must be context-driven, involve behavioural change, shift the paradigm from the 'business as usual' scenario, introduce new innovations or technologies and integrate public and private sectors.



The second presentation from Kaveh Madani of Imperial College London and Yale University, focused on decision-making by national asset owners and governments. Kaveh set the scene by describing how complex and dynamic the network of systems that relate to the WASH sector are. For example, a change in the field of energy or foreign policy can impact development of other fields like the food system or economy. From this perspective, WASH is a small part of a complex network, and careful consideration must be given to how best to influence decision-makers. Kaveh argued that decision-making in WASH is often reactive rather than proactive, owing to policy-makers preferring business-as-usual and having limited time and resources. WASH actors must consider how to best to pitch their projects. He recommended approaching decision-makers using simple terminology that bridges the gap between science, policy and society, while considering which aspects matter most to the politicians. For example, ideas that do not require major reforms and would not have high political costs are more likely to be taken up. Additionally, raising awareness in the community can be very effective, as politicians care what their citizens think. Getting the community on-side lowers the perceived risks of a government being penalised in elections for implementing projects that have long-term benefits but that may not be well understood by the public.



Next, Andre Steele, from IMC Worldwide, shared his insights on designing and constructing infrastructure. This was based on his experience of working in Freetown, Sierra Leone on a project to rehabilitate and expand its pipeline system. Before starting the project, there was no information available about the state of the existing infrastructure or the water quality, and a disagreement about why the information was needed erupted. By the time the water quality research was done, a lot of design works had already started. The whole planning and implementing process proved more and more complicated as no infrastructure system operates in a vacuum - there were hundreds of stakeholders who were involved in the delivery of that system. It was decided to use the water source from the surrounding hills due to the higher water quality. However, there was no direct access, which led to the need to construct distribution systems. To help with this a technological solution was developed – drone-mapping. Unfortunately, this proved unreliable because there was a significant variance between where a point was mapped and its actual location. This resulted in random placement of pipes and a policy of hoping for the best. A lesson was learned: practicalities often undermine excellent ideas.



Anjalee Burr of eWaterPay concluded the session by highlighting one of the key issues within WASH infrastructure – sustainability. Data indicates that 40% of water systems in sub-Saharan Africa are dysfunctional after two years. This presents a significant challenge to ensuring sustainable water provision. eWaterPay provides solar-powered, pre-paid water meters and water taps for rural communities who are in charge of the maintenance, thus ensuring sustainability of their water supply. This model enables communities to reinvest in their own water systems and to feel responsible for their water supply. eWaterPay ensures that the taps are simple to use, can collect data in an offline environment and that the communities have the right tools to sustain the system themselves by having teams of local technicians on the ground.

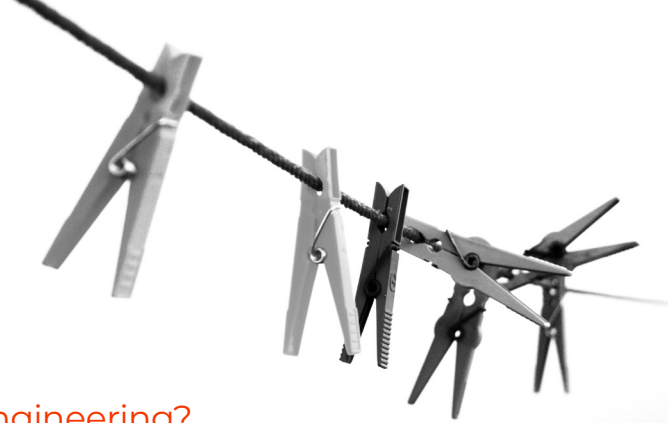
“A ‘resilient infrastructure system’ is one that can prepare and plan for, absorb, recover from and adapt to adverse natural/human perturbations.”

The presentations were followed by an interactive session where the delegates were asked to choose one of the following global themes to discuss the particular challenges of WASH infrastructure through that lens:

- managing data
- innovation and technology
- climate change
- sustainability and environmental protection
- empowerment
- collaboration.

Common themes from the discussions included the need to challenge tokenism because it stifles empowerment and collaboration, and the need to improve stakeholder engagement from the start in order to understand what the needs and challenges are in delivering solutions. Delegates expressed concerns about the lack of data and the need for context-based solutions and agreed that fool-proof solutions do not yet exist. They identified some questions that need further consideration, such as data quality, who creates the data, who controls the quality of data after it has been collected, and how data should be interpreted. It was agreed there is a need for trust, transparency as well as ownership and reliable data.





Design

Can creative design help water and sanitation engineering?

Session co-chairs

**Askwar Hilonga, Nanofilter
and Yi Wei, International Development
Enterprises (iDE)**

Presentations

1. Managing the design process with distributed development teams
Andrew Fox, University of Plymouth
2. Water and sanitation for everyday use: does such innovation necessarily leads to inclusion?
Hans Komakech, Nelson Mandela Institute
3. Learning how to listen: how a large corporation minimises bias when designing for base-of-pyramid users
Megan Farrish, Kohl

This session featured talks that considered challenges in the design process, including:

- designing when teams are dispersed across geographies and cultures
- designing to minimise the designer's bias
- designing for a specific context while minimising unintended consequences.

The speakers presented a range of perspectives including academia and a multinational corporation to illustrate emerging design innovations that solve critical water and sanitation issues.

Andrew Fox focused on the challenges of having design teams that are widely dispersed. Although distributed team structures are not new, they are becoming increasingly common. He pointed out that the challenges are not only related to physical distance, but also temporal, linguistic and cultural ones. He also noted that operational issues can include technical, management and cooperation challenges, and that establishing trust with stakeholders is critical. Despite these challenges, distributed team approaches are effective at leveraging the global talent pool and their adoption is increasingly easy thanks to new technology in communications that allow the formation of virtual teams and organisations. Andrew shared some helpful strategies to address distance, technological and culture issues in distributed development teams, including how to allocate tasks, agreeing a common system for collecting, analysing and storing data, choosing communication media, rotating management between locations, and creating a system to share socio-cultural links.

High failure rates of water supply systems in sub-Saharan Africa increase inequality. Often, the problem it is not the technology but the lack of consideration of the context in which it is being implemented. To illustrate this, Hans Komakech of the Nelson Mandela Institute shared his experience of working on water and sanitation innovation projects for everyday use in



Tanzania, describing various models of pre-paid water systems that are being piloted. WASH innovations are a component of complex socio-technical systems, and Hans explained that the 'human element' of the system can have the biggest influence on success or failure, so must be considered before designers start to think about the technology. Before designing a new intervention there should be a robust ethnographic study to find out what people really need. From these results designers and innovators can then develop the technology.

Megan Farrish, a product design engineer at Kohler, shared what she learned from designing and building a water filtration system in the US for implementation in low- and middle-income countries. Because the team was used to designing for consumers in a high-income country context this affected some of the assumptions they made. This highlighted the need to prevent bias from affecting design success, for which Megan recommended using human-centred design as a possible solution. This includes 'listening and learning' by using interview techniques that capture direct quotes, taking photos, paying attention to the environment and interviewing a variety of users and experts. These techniques help designers to capture the reality, rather than conducting work based on their assumption of what is best. Designers must ensure that the voices of the users are heard, while engineers should assess how people use the products.

Before moving into the interactive session, Yi Wei shared her perspective on the difference between engineers and designers. Engineers look for the most effective solution while designers look for the most usable solution, but she believes that the best solutions are at the intersection between the two. Centring system design on the people who will use it requires designers to have empathy and understanding of the users' needs. Designers need to check their assumptions and personal biases, and incorporate these learnings into the design. Much can be learned by asking seemingly

simple questions. In addition, WASH experts should always seek sustainable solutions, not just immediate solutions, and the solution must respond to the complexity of the situation in hand.

A participatory exercise followed, where participants were challenged to embody different user profiles with the aim of developing empathy and awareness of biases and 'blind spots'. The user profiles included a single mother who spends a significant portion of her day walking the 1.5 miles to collect water for her family, a family of nine living in a make-shift camp with restrictions on water collection, and a family in a Haiti refugee camp who lost their home and local water infrastructure in a hurricane.

All groups agreed that designing a solution for the user profiles was extremely challenging, and productive conversations and questions resulted. Despite the apparent similarity of issues of the different case studies, it became evident that the underlying challenges of each are much more complex, and the session highlighted the need for constant curiosity, iteration, and learning.



Implementation

How can we reconcile communal elements of WASH services with personal preferences and needs?

Session co-chairs

Tanvi Nagpal, John Hopkins University
and Rachel Cardone, Stanford University

Speakers

Sasha Kramer, SOIL Haiti and Anna
Clark, journalist/author

This session was held
as a panel discussion.

Inequality takes many forms and has long-term consequences on the ability of people to use their human capital to meet basic needs and plan for the future. Understanding how inequality impacts interactions between the marginalised and privileged is central to implementing successful and sustainable water and sanitation programmes.

The session kicked off with an interactive game that helped participants to reflect on their understanding of relative and absolute inequality. The delegates were split into three groups:

Triangles

Representing the agencies implementing projects in the field. Their goal was to convince the communities to 'build' WASH projects.

Circles

Embodying the lower middle-class in a community. Their objective was to try and increase their income while paying tax.

Squares

The most disadvantaged group with the least amount of resources, their objective was to ensure that they can pay tax.

Triangles reported finding it difficult to know what to do, how to work with the communities, and what their priorities were. Early in the game the Triangles agreed that to achieve their objectives they would need to offer financial incentives to the communities. However, by the end they felt that had they been transparent about the financial information, they would not have needed financial incentives in the first place. Related to the issue of a lack of transparency, the Triangles found it was very difficult to persuade the community to build and/or implement their projects, in part due to a lack of their own confidence in the product they were trying to implement. Initially they lost a lot of time and money because they did not use any agreed strategy. This drew a parallel to real WASH projects, where time and money is often invested in the initial stages of projects, at a loss.



Understanding how inequality impacts interactions between the marginalised and privileged is central to implementing successful and sustainable water and sanitation programmes

Despite their difficult circumstances, there was a real sense of community between the Squares as they all depended on each other and worked together. However, they were struggling to pay taxes and agreed to work for triangles out of sheer necessity, despite their lack of trust. There was a sense of distress between both Circles and Squares due to a lack of information about the Triangles, for example, they did not understand why the Triangles were coming into their communities and imposing rules.

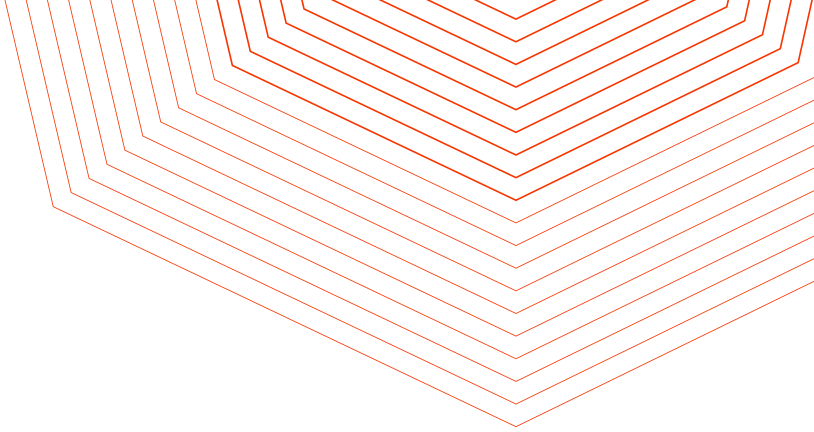
The bank employees responsible for collecting taxes reported that it proved difficult due to trading and 'shadiness' – Squares and Circles kept finding different schemes to avoid paying tax.

All groups agreed that their focus was on generating income rather than quality of life and that there was a lot of asymmetry in information and knowledge. The game stimulated a conversation about how much the insights and perspectives emerging from it mirror reality in WASH project implementation.

The second part of the session featured a discussion with Sasha Kramer, head of SOIL, a non-profit organisation that focuses on ecological sanitation in Haiti, and Anna Clark, an award-winning journalist who chronicled the water crisis in Flint, Michigan.

Sasha described how she became involved in sanitation in Haiti, following her earlier work focusing on human rights. She was interested to discover that sanitation used ecology to fulfil multiple human rights obligations. Based on her experience in Haiti, Sasha described a common bias among international development workers who expect communities with great need to also have high levels of volunteerism. In fact, where the need is greatest the ability to volunteer is the lowest. Although toilets are important and people want them, it is often not a priority when people are trying to address their primary needs. For example, when the choice is between helping to build community infrastructure or feeding their family, people will choose the latter.





This was a part of the reason why the toilets that SOIL built tended to fall into disrepair. Sasha realised that SOIL needed to move away from sourcing free public toilets, it needed to look at how best to create livelihoods in the sanitation sector while ensuring the maintenance of toilets. Incorporating business principles into the work made it more efficient and therefore achieved greater impact.

To truly help the issue of sanitation, Sasha thinks that a change of thinking is required. As long as the flush toilet is the gold standard, any other technology is going to be perceived as inferior. Providing different high-quality toilets using different mechanisms, such as dry (composting) toilets, to people in communities who can afford them can shift the aspiration away from the flush toilet. However, to help address inequality in sanitation, habits need to change globally.

Haiti is often referred to as 'the republic of NGOs', but the connotation is not a positive one. In Sasha's experience, communities trust neither NGOs nor their government. People have learned how to survive without help from NGOs and are especially sceptical when presented with 'mega-projects' that 'will change their lives'. For this reason, Sasha explained that NGO work must be done in small steps, for example by building one toilet in one community and waiting to see if it works and is taken up. This kind of small community-identified action can, in her experience, make a difference.

Anna gave an overview of the events she witnessed in Flint, Michigan, describing how the pattern of infrastructure inequality played out in a city that is disproportionately poor. The 'lived experience' of citizens was not listened to by decision makers. This resulted in a culture where the citizens felt that they needed to look out for themselves, rather than rely on government. In particular, people felt that they could not trust government bodies because they had repeatedly told them that water was safe to drink, when in fact it was not. Anna challenged participants to consider how this lack of trust can negatively



impact the situation and resilience of the whole system. In the case of Flint, communities were used to getting the short end of the stick, which made rebuilding trust a big challenge. It required responsible government bodies to take small steps and systematically demonstrate that they would keep their promises over a long period of time.

Anna concluded that when talking about resilience and making infrastructure resilient, practitioners must learn from case studies like Haiti and Flint. In both cases the government took the approach that 'when everything is an emergency, nothing is an emergency'. Citizens showed resilience out of necessity and were left to lobby for, and solve the issue of, water contamination themselves.

Frontiers insights

The Frontiers insights session was designed and run by the event's co-chairs, Professor Barbara Evans, University of Leeds and Dr Darren Saywell, AECOM. They asked the delegates to what degree they feel optimistic about the future of WASH using the metaphor of a sewage pit being half-full or half-empty. Next, delegates reflected on the past two days and everything they heard and learned, and categorised ideas in the following way:



Before asking delegates to share their thoughts with each other, the event chairs offered their insights.



Resonance Points

The chairs identified five highlights/ resonance points where they wanted the community to focus their energy:

1 Stronger link between programming and political economy

More effective programming requires political economy analysis and incentives that enable it. The adoption of messages and narratives by policy makers and politicians are important but a plan needs to be made on how best to discuss the narrative in a way that does not blind and overwhelm people with facts. To truly address inequality, practitioners must engage upstream and engage with politics. Failure to engage at these levels will likely lead to a lack of traction.

2 Stronger feedback mechanisms

There is a need to eliminate the disconnect between engineering and design by more informed engagement with end-users. This requires time and planning, evolving thinking, adaptive management and design as well as creating more effective feedback loops between users and programmers/ researchers. The sector needs a revolution, rather than token changes. It is revolutionary to put genuine feedback loops into research and programming because the traditional structures of interventions are felt to be non-reflective, non-adaptive and typically lack the input and voices of the most disadvantaged people.

3 Stronger institutions

Inequality has a number of different drivers, such as historical and structural ones, as well as societal, cultural, and institutional drivers. Understanding that these are factors that entrench inequality is fundamental to tackling the issue. Practitioners can only design effective interventions if they can properly diagnose the drivers.

4 Stronger/optimised delivery mechanisms are needed that involve public and private actors

These need to consider the nature of market relationships and the complexity of the existing systems into which they are being implemented. Mechanisms must take into account how different types of organisations work together. Stakeholders need to co-create frameworks that enable the public and private sectors to work together effectively while acknowledging their different priorities and needs.

5 Stronger link between data and programming

The way that data is collected, analysed and presented (or not!) can either embed or challenge inequality. The WASH community needs to think critically about the push towards data and the digital revolution. Careful consideration is needed to decide whether local institutions based in low- and middle-income countries have the capacity to analyse data, and if they can, how it will be used. Furthermore, a concerted effort to embed good data management and programming at all levels must be made a priority.

Issues to hear more about

The event chairs identified three issues to relating to programming and research activities:

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There is a need to eliminate the disconnect between engineering and design by more informed engagement with end-users. This requires time and planning, evolving thinking, adaptive management and design as well as creating more effective feedback loops between users and programmers/researchers. The sector needs a revolution, rather than token changes. It is revolutionary to put genuine feedback loops into research and programming because the traditional structures of interventions are felt to be non-reflective, non-adaptive and typically lack the input and voices of the most disadvantaged people.

Take-away

The event chairs' one take-away was that inequality is a persistent blind spot. They highlighted how transformative it could be if 'eliminating inequality' was a headline priority for all WASH projects and interventions.



Key points made by the delegates, in the same framework, are as follows:

Highlights/resonance points

- **Potential disconnect between engineers and design.** It is important to use human/community-centred design in the wider WASH system, rather than a top-down approach. Historically there has not been enough community engagement.
- **The importance of context, or, 'one size does not fit all'.** Every situation has unique geography, politics, culture, history, and quirks that may impact intervention design. Interventions need to thoroughly consider the contextual needs as well as sustainability if they are to have genuine impact.
- **The need for a more nuanced discussion on inequality.** Participants questioned the narrative of 'inequality' as the overall goal, as it could mean that people are equal but all live in poverty. Examples of other ways to shape the narrative would be to focus on needs rather than inequality, or consider inequality in a broader perspective than 'developed' versus 'developing.'
- **A feeling of optimism.** Delegates felt optimistic for the future of WASH and the possibilities of interdisciplinary collaboration to help address challenges in the field. They appreciated the diversity of topics, projects, perspectives and people at the symposium.
- **Push towards data.** Conducting WASH through data, monitoring and evaluation. It would be beneficial to measure and evaluate the short-, medium- and long-term impact of WASH interventions and think how to effectively monitor to influence inequality. It was noted that in the move towards data it will be important to ensure that a diversity of perspectives, including people who typically lack a voice in similar discussions, are captured.

Issues to hear more about

- **The bigger picture.** It is important to consider the bigger picture when tackling the WASH challenges. WASH experts need to ensure that they avoid creating other risks, for example by harming the environment. All projects should consider sustainability and the future-proofing of infrastructure.
- **Stakeholder management and equitable partnerships.** There is often a difference in influence between the stakeholders involved in a project. This can throw up questions about how to make sure that everyone is heard, how to build trust, who holds responsibility and who has decision-making power. Making sure roles are well understood and that people have agency can make or break a project.
- **WASH failures.** It is important to know more about, and talk more about, failures so that mistakes of the past can be avoided in the future. However, current systems and cultures do not typically incentivise publishing and discussions of failures, or allow funding to correct mistakes, so this usually does not happen as it should.
- **Financial investment for the WASH sector.** Current investment models are often top-down and unsustainable, so the sector must rethink how it is financed. Consideration must be given to capacity building for local people to be able to finance and invest in their own water and sanitation provisions.

Take-aways

- **Technology is the easy bit:** working with communities, governments and other stakeholders is where the greatest challenges lie.
- **Challenge Global North supremacy:** High-income countries are not necessarily leading the WASH field when it comes to best practice and addressing inequalities. Challenging this assumption would encourage learning to be shared in all directions, especially South-South and South-North, which is not currently the norm.
- **A revolution in WASH is needed:** but expectations must be managed.
- Successful WASH programmes must have the **right size, right format, right people, and right focus!**



Dr Greg Allgood

World Vision and University of North Carolina



During his presentation Dr Greg Allgood outlined his career and achievements. He holds a Master of Science in public health from the University of North Carolina – Chapel Hill, where he undertook research in water quality, followed by a PhD in Toxicology from North Carolina State University. He worked at Procter and Gamble for 27 years and founded the Children's Safe Drinking Water Program. During this time he helped to create and lead one of the largest efforts by the business sector to help address the global water crisis.

Greg subsequently moved to World Vision, where he is the vice-president. He leads global efforts to provide clean water and dignified sanitation and hygiene for all by 2030. World Vision is the leading non-governmental provider of clean drinking water in rural areas of the developing world, reaching a new person with clean drinking water every 10 seconds. His presentation included the lessons he has learned in building programmes that reach millions of people, including the importance of creating partnerships between academics, business, and the organisations responsible for implementing the projects.

Greg highlighted the importance of engineering, public health and marketing efforts to create impact for water, sanitation, and hygiene programmes. Greg pointed out that water crises disproportionately affect women and children. Having women in leadership positions on decision-making committees is often the critical element in achieving change. It is also important to make sure that WASH interventions aim to reach every individual in the community, because if they fail to do so infectious diseases will keep spreading. Greg is also Adjunct Professor at the University of North Carolina Water Institute.

Seed funding awards

Amplifying local voices to reduce failure in the WASH sector

- Dani Barrington, University of Leeds
- Rebecca Sindall, University of KwaZulu-Natal
- Jo Rose, York University
- Kristin Ravndal, Cranfield University
- Joanne Beale, Independent consultant
- Tracy Morse, University of Strathclyde
- Sneha Krishnan, London School of Hygiene and Tropical Medicine
- May Sule, Imperial College London
- Annatoria Chinyama, National University of Science and Technology
- Andrew Fox, Plymouth University
- Esther Shaylor, UNICEF Supply Division

Assessing behaviour towards the uptake of a novel low-cost water filtration system

- May Sule, Imperial College London
- Askwar Hilonga, Nelson Mandela African Institution of Science and Technology
- Safari Kinunghi, National Institute for Medical Research, Mwanza Centre
- Justina Mosha, National Institute for Medical Research, Mwanza Centre

Optimising constructed wetlands by biological design

- Stephanie Connelly, University of Glasgow
- Cindy Smith, University of Glasgow
- Flor Y. Garcia-Becerra, Metropolitan Autonomous University
- Carla Liera, Independent consultant

Sanitation for Urban Inclusion, Transformation and Equity (SUITE)

- Tracy Morse, University of Strathclyde
- Hans Komakech, WISE-Futures
- Rebecca Sindall, University of KwaZulu-Natal
- Annatoria Chinyama, National University of Science and Technology
- Flor Y. Garcia-Becerra, Metropolitan Autonomous University
- Elizabeth Tilley, University of Malawi

The circularity of biological wastewater treatment

- Luisa Orsini, University of Birmingham
- Kemi Akinola, United Utilities
- Luis Carlos Rosa, SEIP 7
- Karl Dearn, University of Birmingham
- Mohamed Abdallah, University of Birmingham
- Rafael Orozco, University of Birmingham
- Isaac Akinwumi, Covenant University

Attendee list

Name	Organisation
Ahmed Rezk	Aston University
Aisha Bello-Dambatta	Bangor University
Andre Steele	IMC
Andre Fox	Plymouth University
Anjalee Burr	eWaterPay
Anna Clark	Journalist and author
Annatoria Chinyama	National University of Science and Technology
Askwar Hilonga	Nelson Mandela African Institution of Science and Technology
Barbara Evans	University of Leeds
Beth Koigi	Majik Water
Bruño Fraga	University of Birmingham
Carla Liera	SIMO
Chris McGahey	Hillaria International
Cindy Smith	University of Glasgow
Claudia Mendez-Jaime	SCS Global Services
Dani Barrington	University of Leeds
Darren Saywell	AECOM International Development
Divya Subramanian	Indian Institute of Technology Bombay
Eleanor Wozei	Uganda Christian University
Elena Bernalte Morgado	University of Bath
Farnaz Nickpour	University of Liverpool
Fernanda De la Pena	Fomento Mexicano para el Desarrollo Sustentable
Flor Garcia-Becerra	Parakata RSR and Universidad Autónoma Metropolitana in México City
Francesca O'Hanlon	Blue Tap/University of Cambridge
Greg Allgood	World Vision
Gustavo de Almedia	University of Southampton
Hans Komakech	Water and sanitation specialist
Harry Chaplin	SEED Madagascar
Heather Price	University of Stirling



60 participants



Based in
17 countries

Name	Organisation
Helena I. Gomes	University of Nottingham
Ifeoluwa Akinwumi	Obafemi Awolowo University Teaching Hospitals Complex
Ilan Adler	University College London/EcoNomad Solutions
Joanne Beale	Independent consultant
Joanne Rose	University of York
Juan Durán-Álvarez	Universidad Nacional Autónoma de México
Kaveh Madani	Imperial College London
Kemi Adeyeye	University of Bath/Water Efficiency Network
Kemi Akinola	United Utilities
Kevin Gacheru	Mobi-Water
Kristin Ravndal	Cranfield University
Krizia Delgado	British Embassy – Newton Fund
Luis Carlos Rosa	SEIP 7
Luisa Orsini	University of Birmingham
May Sule	Imperial College London
Megan Farrish	Kohler
Oriana Landa Cansigno	University College London
Rachel Cardone	Stanford University
Ramón Colmenares-Quintero	Universidad Cooperativa de Colombia
Rebecca Sindall	University of KwaZulu-Natal
Sasha Kramer	SOIL
Saurav Goel	Cranfield University
Sneha Krishnan	London School of Hygiene and Tropical Medicine
Stephanie Connelly	University of Glasgow
Tanvi Nagpal	School of Advanced International Studies, Johns Hopkins University
Thomas Fudge	WASE/Brunel University London
Tracy Morse	University of Strathclyde
Urvaksh Patel	Green Climate Fund
Yi Wei	International Development Enterprises

Event feedback

In the post-event survey, completed by 29 respondents, 100% of respondents said they would recommend attending a Frontiers of Engineering for Development event. 86% rated the overall event 'excellent' and the remaining 14% rated it 'good'.

"This was one of the most impactful conferences I have been to in years."

"All depends on having a thoughtful, diverse group of people in the room, and that happened here. Thank you."

"I have expanded my scope of network by considerable magnitude."

"It was my first experience like this, and it was absolutely fruitful. Regarding networking, it was great to have the opportunity to interact with so many people from different backgrounds."

"Excellently organised, very friendly team and interesting event overall."

"Fantastic event! So happy to have been part of it."

"Great quality of discussion and a very interesting heterogeneous group."





Royal Academy
of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

Our 2025 ambition

Talent & diversity

We'll grow talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession – with an aim to help over 7,500 professionals to enhance their leadership skills.

We'll develop skills for the future by identifying the challenges of an ever-changing world and developing the skills and ideas we need to build a resilient and diverse engineering profession. We've set ourselves a target to work with over 500 engineering businesses and organisations to champion diversity and inclusion in the workplace.

Innovation

We'll drive innovation by investing in some of the UK's most creative and exciting engineering ideas and businesses. In partnership with industry, entrepreneurs and academia, we're on course to support the growth of more than 500 companies through our Enterprise Hub.

We'll build global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to address the greatest global challenges of our age. As a leading voice in engineering and technology, we're working to build networks and partnerships in over 40 countries, across six continents.

Policy & engagement

We'll influence policy through the National Engineering Policy Centre – providing independent and expert guidance to government, drawing on the expertise and creativity of over 450,000 engineers. In our 2020-25 strategy we've committed to working with over 1,000 policymakers in the UK and internationally to improve people's lives.

We'll engage the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers. Through campaigns like This is Engineering, we're changing perceptions of the profession and by 2025, we'll have helped a million young people – from every background in the UK – to explore a career in engineering.



For more information, including eligibility,
please visit raeng.org.uk/frontiers and follow [@RAEngGlobal](https://twitter.com/RAEngGlobal)

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