REACH

Improving water security for the poor

REACH Global Strategy 2020-2024

October 2020

Who we are

REACH is a global research programme funded by the Foreign, Commonwealth & Development Office (FCDO) to improve water security for the poor by delivering world-class science that improves policy and practice. REACH is led by the University of Oxford in partnership with a global network of collaborators:

- UNICEF

- Bangladesh University of Engineering and Technology
- University of Nairobi
- Water and Land Resource Centre, Addis Ababa University

- International Centre for Diarrhoeal Disease Research, Bangladesh
- International Food Policy Research Institute
- International Water Association
- IRC International Water and Sanitation Centre
- Skat Foundation hosting the Rural Water Supply Network
- University of Dhaka

Cover image: Tobin Jones

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Credit: Alice Chautard

IMPROVING WATER SECURITY, REDUCING POVERTY

Water security is an elusive and enduring sustainable development challenge. Improving water security is essential to achieve environmental protection, economic growth, poverty reduction, and improvements in public health.

Decision-making in this context is often difficult due to the multiple risks that need to be considered, requiring trade-offs in complex and dynamic systems with uncertain trajectories for climate and population. Floods, droughts, pollution and resource competition commonly dominate water security headlines, but without sufficiently addressing the implications and impacts for the poor, whose lives and livelihoods are most at risk.

Water security is often presented as a technical challenge, but the decisions that define it are deeply political. REACH recognises that the risks to the poor are often neither identified nor addressed.

Improving water security requires managing complex and competing water-related risks in order to deliver sustainable and equitable outcomes for all. For our work, it is essential to consider the water system beyond hydrology and infrastructure, to include the social and political drivers that influence institutions and governance.

REACH aims to improve water security for 10 million poor people in Africa and Asia by 2024 through new thinking, models, policies and technologies which can potentially benefit many millions more.

The COVID-19 pandemic has starkly illustrated how multiple water security risks affect billions of people across Africa and Asia. For example, the pandemic has compounded the severity of the impacts resulting from water-related climate hazards, such as floods, droughts and cyclones. Ensuring water infrastructure functions with affordable, reliable and safe services in these complex environments in times of crisis is critical to protect vulnerable individuals, communities, schools and healthcare facilities. Building water secure institutions reduces the need for and the cost of emergency funding to avoid unnecessary hardship on the most vulnerable, and increases resilience to future risks and shocks.

Climate change will affect the reliability and availability of water, and the frequency of hazards, increasing uncertainty.

Unreliable or intermittent services restrict opportunities for small businesses to grow, and make access difficult and more costly for those who work outside the home.

Decisions to allocate water resources to industry, agriculture or towns, can reduce the availability and quality of water for marginalised users, like pastoralists, or for ecosystems.

Decisions within the household limit the choices and ability of individuals to access water and participate in management, affecting how they benefit from water security interventions.

Changes in land management to support livelihoods can impact groundwater recharge and flood risk, affecting who is exposed and how.

Groundwater provides storage near where water is needed, but access is constrained by wealth, unreliable infrastructure and contamination.

The complex trade-offs of water security

REACH works across scales from the individual, to the institutional and the environmental levels, integrating interdisciplinary work to improve sustainability of water security for the poor.

This document outlines REACH's research and impact strategy for 2020-2024.

REACH collaborates across disciplines, and engages across different geographic and time scales to base our work on long-term, science-practitioner partnerships. These partnerships build evidence and trust in strengthening, adapting or designing policy and practice to benefit the poor.

This strategy has been developed in collaboration with our partners, and based on our research to date to provide focus and direction for the delivery of the second phase of work. It is supported by a growing collection of scientific papers (see reference list on p. 42) and active collaborations with research partners and practitioners.

First, we provide an overview of how the programme is designed to deliver novel and collaborative science that supports the tools and knowledge to strengthen the policies and practices that benefit the poor.

Second, we explain how risk provides a common language that communicates interdisciplinary research to multiple stakeholders, to support effective and sustainable water security outcomes. Risk has been a core component to how the programme has developed and operates, and we expand on our risk-based framework.

Third, we present four key research themes for REACH's work until 2024. These themes build on our global work to date to advance world-class, interdisciplinary science.

DELIVERING IMPACT

In order to improve water security for 10 million poor people in Africa and Asia, we must ensure that our work is responsive to the priorities of the poor and actionable by practitioners.

Many actors are working beyond academia to improve water security for the poor, either directly, or indirectly through health, agriculture, education or other programmes. REACH's science-practitioner partnerships recognise the existing expertise, tools, networks and impactful work led by many of these actors at local, national and global scales.

Our aim is to continue to support and complement their work by advancing new data, approaches and technologies that can be used to influence policies and practices. To achieve this, we have designed our programme around three pillars:

1. Water Security Observatories

2. Strategic Partnerships Across Scales

3. Capacity Building.

1. Water Security Observatories

REACH builds interdisciplinary and science-practitioner collaborations, targeted at user needs, through our Water Security Observatories. The long-term, instrumented and interdisciplinary observatories allow us to advance our understanding of the individuals, institutions and environment within the water system. In this way, we can support the needs of practitioners and decision makers, through research that addresses the complexity of the water system, to

deliver the knowledge and tools that promote better outcomes for the most vulnerable.

The infographic on the following page illustrates the concept of an Observatory using REACH's Coastal Observatory, in Khulna, Bangladesh, as an example.

Science-practitioner partnerships

Collaboration through long-term, interdisciplinary and instrumented research
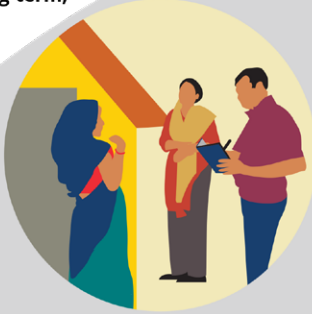
Qualitative and quantitative social research

Modelling and measurement of multiple hazards

Monitoring water sources

Polder 29, Khulna district, Coastal Bangladesh

2. Strategic Partnerships Across Scales

REACH has established science-practitioner partnerships with government, private sector and civil society stakeholders in long-term, instrumented and interdisciplinary observatories to understand and influence the most significant but uncertain risks.

Supporting and influencing wider global initiatives is a key aspect of our work through our partnership with UNICEF in Bangladesh, Ethiopia and Kenya, and our contributions to regional and global programming.

REACH has commissioned complementary work with 22 partners in 12 countries. We also are engaging with international programmes led by the African Ministers' Council on Water (AMCOW), the International Water Management Institute (IWMI), the Swedish International Development Cooperation Agency (Sida), the UK Global Challenges Research Fund, UK Space Agency, UN-Habitat, USAID, and the World Health Organization (WHO) to support a global community of practice working to deliver water security sustainably at scale.

Since the start of the programme, we have engaged with partners through consultations and collaborations to identify research gaps and thus guide the research, ensuring we align with local, national and global priorities. As the programme progresses, we will continue

The Cabinet Secretary for the Ministry of Water and Irrigation, Hon. Eugene Wamalwa, joins the REACH conference in Oxford as the first Patron of the Kenya REACH programme. Credit: John Cairns

In Bangladesh, REACH is working with the Prime Minister's Office's Principal Coordinator for SDG Affairs which has included his leadership in high-level events in Oxford in 2017 and 2019, and Dhaka in 2018. Credit: Alice Chautard

to collaborate with key stakeholders to adapt to evolving priorities, and to promote the use of REACH methodologies, findings and messages. Critically, these partnerships are active at different scales:

• **Local actors help us to understand risks, share data, as well as design and test relevant water security solutions**. In our Kitui Observatory, in Kenya, engagement with county governments, schools, water user groups, local water providers and the private sector has ensured our research balances the needs of multiple users in this water scarce environment.

• **Collaboration with basin and national level actors contributes to informing overarching policy, institutional and investments constraints.** In our Awash

Observatory, in Ethiopia, engagement with the Awash Basin Development Office has ensured our research supports the water allocation decisions they are making. Engagement with national actors enables issues outside the Basin Development Office's remit to be addressed.

• **Collaboration with global actors allows us to shape international agendas around water security.** Through our engagement with global development actors, including UNICEF, FCDO, WHO and USAID, we are translating research into sector-wide tools, such as developing new methods and metrics to design service delivery models promoting more affordable, safe and sustainable services.

3. Capacity Building

Translating research into policy and practice requires collaborative engagement with our partners from governments and UNICEF, to civil society organisations and global networks, like the Rural Water Supply Network. Capacity building is a key priority to support the design and uptake of research and to ensure the impact of our work is sustained beyond the lifetime of the programme. It includes approaches to target researchers, policy makers and practitioners:

- With academic partners in Africa and Asia, we work to build capacity to conduct interdisciplinary water security and poverty research, allowing collective progress to further their global reputation for research excellence.

- We support the development of PhD students and early career researchers, by providing training and enhancing their visibility in research and communication activities, to build capacity globally for future water security research, policy and practice.

- With policy-makers and practitioners, we use collaboration and training to build technical capacity to monitor and understand risks, and to plan and implement water security interventions.

Our capacity building specifically targets the differentiated needs of women, in line with our Gender Strategy. Throughout the programme, we actively seek to increase opportunities for women, early career researchers, and researchers from Africa and Asia to lead in our events and communications, underpinned by our Best Practice Guide to Developing Inclusive Conferences.

In November 2018 REACH led capacity building workshops around climate, hydrology and water quality with the Awash Basin Development Office. Credit: Alice Chautard

RISK: A COMMON LANGUAGE FOR WATER SECURITY

The concept of risk provides a common language and focus for academics and practitioners to address the multiple dimensions of water security. There is no unifying theory or model for determining or managing risk, but rather a range of theories, models, and technologies that can help us to improve our understanding of the trade-offs that exist in responding to risk. These range across disciplines, including politics, climate science, hydrology, economics, public health, law and policy, anthropology, and engineering. REACH's work has been designed based on a risk-based framework, drawing from these diverse approaches.

Our risk-based framework has been developed on three pillars (see infographic on the following page):

Firstly, it focuses on water security outcomes, considering the trade-offs between different and interrelated outcomes in water resource systems and water services.

Secondly, it uses a distributional analysis to evaluate and address inequalities embedded in social practices or generated by ill-conceived interventions.

Thirdly, it recognises the intersection of water security and inequalities through the different processes and practices by which water security is managed and realised.

We characterise three water security outcomes, and identify the interactions and trade-offs between them:

- Resource sustainability: water is managed and conserved to ensure quality and availability are maintained, considering the impacts of climate variability and extremes on surface water and groundwater systems.

- Inclusive services: different users (people, industry, agriculture) are able to access safe, reliable, sufficient and affordable water, and to dispose of wastewater safely.

- Sustainable growth: changing water needs and threats, linked to job creation, productivity and standards of living, are managed as countries develop.

Resource sustainability

Individuals

Sustainable growth

Inclusive services

Places

Groups

WHAT

Water security outcomes

Water security is an acceptable level of water services for all users and acceptable water-related risks. Improving water security requires consideration of the politics of water security trade-offs.

WHO

Risk exposure

Water security risks are experienced differently, varying based on the individual, group and place. Explicitly recognising inequalities based on gender, ethnicity, and wealth identifies how benefits and risks are distributed.

Individual choice

System modelling

HOW

Processes and scales

Water security risks are managed at different scales through multiple processes that determine which risks are addressed and for whom. Understanding these processes is critical to ensuring water security inequalities can be addressed.

Planning and allocation

Politics and institutions

Examples from our ongoing work in Water Security Observatories illustrate these trade-offs:

Water security for an urban river, Bangladesh

In Dhaka, a mega-city of 18 million people, trade-offs between resource sustainability and sustainable growth outcomes are evidenced in the pollution of its river systems from multiple sources. Ambitious industrial growth targets aim to provide jobs, but expose the poor who fish, bathe, wash, play and work on or near the river to health problems. Improving water security requires timely and credible evidence to challenge policy and practice to identify and mitigate pollution from multiple sources.
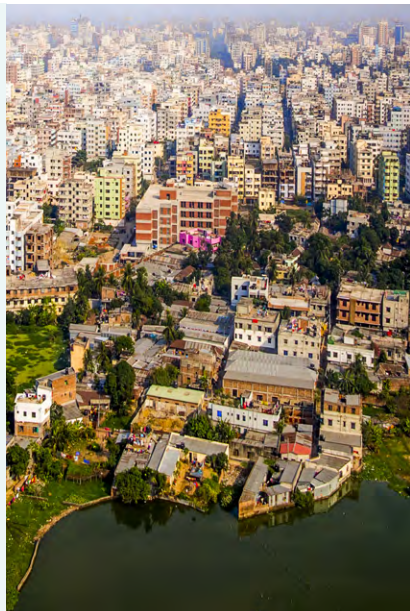


Building water secure institutions, Kenya

In Kitui County, 9 in 10 people live in rural areas, depending on shared water supplies for community, school and clinic water needs. Investment in infrastructure has increased access for domestic needs and livelihoods, but has failed to deliver safe, reliable and affordable services in the absence of effective institutions and regulation. This has left people vulnerable in long dry spells, with women and children sourcing water of uncertain quality. Improving water security requires challenging policy and practice which are being actively developed through national and sub-national partnerships.

Sustaining growth through water security, Ethiopia

In the Awash River Basin, exposure to water related risks is inherently unequal due to spatial variability in rainfall and access to surface and groundwater resources. Competing water security outcomes, aiming to promote growth and support food security, need coordinated management to support the poor. Urban and industrial areas are expanding faster than the capacity to treat their waste. Irrigation schemes are essential to increase food security, but inefficient practices further threaten water quality. Water treatment works cannot adapt rapidly enough to the changing water quality, placing those in communities that rely on the river at risk. Subsistence farmers, pastoralists and agro-pastoralists remain vulnerable to climate shocks. Improving water security requires challenging policy and practice to recognise and reduce inequalities in allocation decisions to benefit more vulnerable groups.
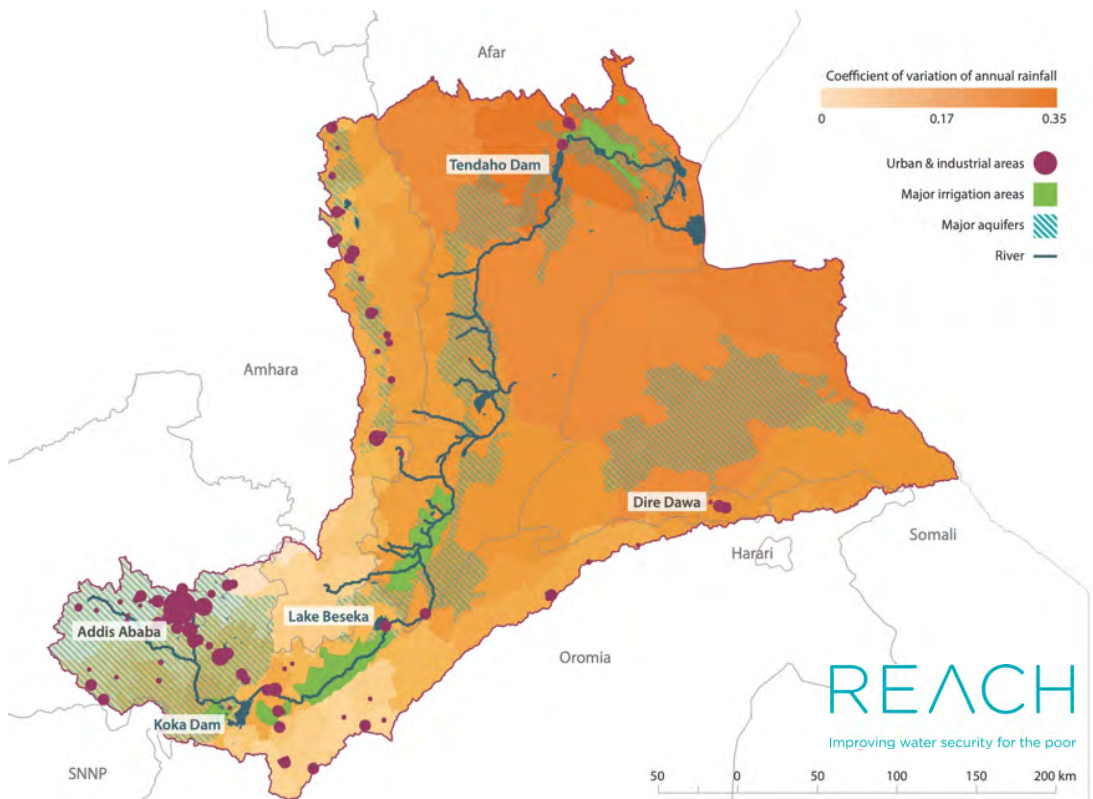
Competing water security outcomes in the Awash River Basin require management of distributional risks and benefits.

The way water security risks are managed varies across spatial and temporal scales, often creating unequal outcomes. Decision-making is influenced by local, national and global processes that change over time. Structural inequalities in how decisions are made, and by whom, often mean that the poor are not represented, or, in an absence of data on their lives and livelihoods, it is assumed that they collectively share the same concerns. Political narratives and powerful vested interests can impose solutions and priorities in the name of the poor, who may be characterised as a homogenous, apolitical and passive group.

Explicitly incorporating the processes by which water security is managed - including modelling to planning, and allocation to individual choice processes - we tackle the multiple scales needed to understand the success and distributional outcomes of water security investments. This integration of equity, processes and outcomes helps to shape priorities and actions to improve water security for the poor.

Using this risk-based framework, REACH's research is guided by the following questions to identify the impact of investments and policies on water security risks:

1. *Has evaluation of this investment or policy considered the interrelated hydrological, social and political systems, and the people who use and manage the water?* Understanding this interaction of people and resources is vital.

2. *How does this investment or policy contribute to the mitigation of multiple water risks?* The poor face multiple risks related to the variability, quality and affordability of water.

3. *How does this investment or policy redistribute risk between different groups?* The redistribution of risks, such as through flood embankments or pollution, is often overlooked as externalities, and the impact on the poor requires explicit consideration.

4. *For how long will this investment or policy mitigate risks?* The sustainability of an intervention relies on how operation and maintenance requirements are met, as well as how the risks might change due to climate, demographic changes and other processes.

REACH PROGRAMME THEMES

In this section, we outline REACH's research and impact themes and activities to 2024. These themes have been developed in collaboration with our partners, and based on our research to date. They seek to deliver novel science and to support the tools and knowledge relevant to the design of effective practices and policies.

Inequalities | Addressing the inequalities across scales from within the household to community, town, city, basin and region, that define current and emerging water security experiences. This includes the gendered impacts of water security interventions.
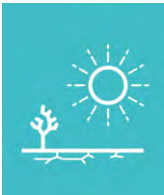
Climate resilience | Preparing for the threat from climate change through advancing understanding of regional climate and climate change, and through building capacity to integrate climate in water policy and practice.

Water quality | Designing and demonstrating new approaches that can be adapted at scale in service delivery models for drinking water, as well as managing and conserving surface water and groundwater.

Institutions | Supporting law, policy and regulation to design, monitor and fund new institutional models for the delivery of universal, safe and affordable drinking water services and ensuring water resources are protected, managed and allocated effectively and sustainably.

For each of these themes we expand on the challenges, key research areas, and how we will continue to ensure impact that benefits the poor. These will continue to be delivered in line with our risk-based framework, working across our Water Security Observatories, and collaborating across themes.

REDUCING INEQUALITIES IN WATER SECURITY

Aim: to support the development of inclusive water security outcomes

Inequalities in water security are often difficult to identify. They have structural and historical roots that formally or informally normalise inequalities for individuals at different scales, from the household, to the community, town, river basin or the region. Water security interventions that redistribute risks can lead to positive outcomes. However many interventions reproduce or entrench these inequalities.

Our work to date has highlighted how inequalities are embedded in contextual social practices and political structures. For the urban poor, Grasham et al. (2019) demonstrate that common challenges include lack of legal rights to housing, lack of connections to the formal urban water supply and smaller water allowance. For smallholder farmers, Schreiner and van Koppen (2019) argue how post-colonial governments in several countries in Sub-Saharan Africa reinforced and expanded permit systems, obliging smallholder farmers to apply for permits. This

effectively made established, but informal, water use practices of millions of smallholder farmers illegal.

Fischer's (2019) textual analysis of the allocation of blame and responsibility during political debates from multi-decadal media coverage of drinking water quality risks, reveals how vulnerable social groups and geographies can be selectively identified or ignored. The use of daily water diaries by Hoque and Hope (2019) demonstrates how seasonal, cultural and economic factors influence inequalities in the affordability of drinking water in environments with high salinity and other water risks.

One cross-cutting area of water inequality relates to gender, and the differential experiences of water security, and impacts of interventions, for women and men, girls and boys. Our work has highlighted how the gendered roles for domestic water supply, where women are often recognised as the water managers,

remain unchanged when women start taking on responsibilities traditionally considered to be men's (e.g. becoming breadwinners and working outside the home; Korzenevica, 2019).

REACH's analysis of inequalities, including gender-related ones, across scales, supports the development of tools that can interrupt the reproduction of these inequalities. At the household level, where women are often the water managers, understanding the influence of intra-household dynamics in constraining choices over water and related expenditures allows targeted interventions. At the national scale, assessing the cumulative impact of water security policies on women, such as the impact of employment outside the home on water security, can inform how water is considered in development interventions.

2020-2024 Planned activities

Inclusive planning tools for water allocation. Scarcity of safe water is increasing as water demand and pollution increase. Drinking water may be, in many cases, the first priority for allocation, but our research has identified that tools to support this prioritisation are limited, based on rudimentary evaluations of demand. Small water users, such as smallholder farmers or small businesses, have difficulty engaging in the decision-making processes to influence the outcomes that could support their livelihoods. Ecological needs are often poorly understood.

REACH will work with basin managers to support the development of decision-making tools that are inclusive and support their needs. To do this, we will combine the perspectives and priorities of water users, from large industry to marginalised groups, based on social field research, with basin-scale climate and hydrological modelling.

Gendered implications of water development decisions. The outcomes of water allocation and infrastructure investment can create opportunities for livelihoods and employment - but they can also entrench inequalities. For example, when women gain employment, they are paid lower wages than men. Gendered impacts are often not taken into account in cost and benefit analyses.

We will analyse the intersectional gendered implications of water

development decisions, including water allocation, planning or infrastructure development. This work will build on REACH's research on gendered experiences of water security, across the three countries, developing strategies to reduce the negative impacts of these gendered gaps.

Intra-household decision-making: bargaining for productive and domestic water security. Individual water security is affected by social inclusion at household and community levels. Households make complex decisions around water use for domestic and productive uses. Studies have demonstrated that it is inappropriate to model the household as a single decision-making unit. Bargaining models provide insights into the factors that affect the outcomes of household decisions, including income generating opportunities, ownership of assets and access to other resources, education levels, and laws and social norms.

This new research will look at household decisions around water use, particularly for productive and domestic uses (including sanitation and hygiene). We will develop a model of intra-household decision-making that incorporates individual preferences and control over

Focus group discussion with women in Polder 29, exploring their concerns on drinking water security and vulnerability to natural hazards. Credit: REACH Field Officer.

income, taking into account the quality, cost, and convenience of water from different sources, for different purposes.

Quantifying change. Water security is often measured by the allocation of resources, either in terms of water or infrastructure, without considering the distribution of impacts.

REACH will adopt the novel household water insecurity experiences (HWISE) tool that uses psychosocial indicators to measure the water security experience, rather than focusing on infrastructure. We will integrate this scale, in collaboration with HWISE, in household surveys to test the assumptions that underpin water security programming about inequalities in experiences of water security interventions. It will also be used for monitoring and evaluation purposes across relevant areas of the programme to help us measure our impact.

Ensuring impact, engendering change

Influencing change on inequalities is invariably complex as it requires breaking down entrenched, and often invisible, norms and biases. However, the focus of the Sustainable Development Goals on equity, and the key commitments of many of our partners to support this target, provides an opportunity now that is greater than ever.

The FCDO is committed to tackling challenges, deep-rooted social norms and unequal power relations that maintain gender inequality, as well as prioritising people who are most excluded. UNICEF harnesses its global presence and partners to help further gender equality. Working in collaboration with these advocates for change enables us to generate evidence to inform high-level decisions by stakeholders open to challenging established norms.

REACH is committed to ensuring that consideration and communication of inequalities are included in our management and at every scale of the research: from individual, to national and to international levels. We will develop and use interdisciplinary methods to measure and communicate inequities in outcomes, challenging our understanding of what is best practice.

BUILDING CAPACITY FOR
CLIMATE RESILIENCE

Aim: to increase the capacity of decision-makers at all scales to incorporate awareness of climate risks in their programming.

Climate change is a global and local risk to the delivery of the SDGs, and to sustaining the gains that have been made under the MDGs and SDGs. Impacts will be far reaching geographically and across societies, affecting migration, health, agricultural productivity, and economic and social development through damage to infrastructure and reduced returns on investments. Ensuring that there is adaptive capacity in water management systems to absorb the impacts of climate-related events and adapt to changing events, is key to climate resilience.

In the Horn of Africa, our research highlights large decreases in streamflow (Hirpa et al., 2019), and a projected reduction in water availability in the Awash River Basin in Ethiopia (Taye et al., 2018). Similarly, in Lodwar, Kenya, climate change is projected to make it increasingly difficult to

meet water demand from surface water, highlighting the importance of protecting groundwater resources in arid and semi-arid lands (Hirpa et al. 2018; Olago, 2018). In the Ethiopian highlands, Edwards et al. (2019) have demonstrated how sustainable land management approaches can contribute to reducing the negative impacts of climate variability on ecosystems and societies, increasing groundwater recharge, reducing water stress for communities and enabling increases in agricultural productivity.

Cyclonic storms in coastal Bangladesh create storm surges that can breach and break flood protections causing damage to crops, economic losses and major disruptions to drinking water supplies. Multi-decadal modelling of flood protection in rural and coastal Bangladesh indicates some but limited benefits to lives and livelihoods (Manandhar et al. 2020). Coastal

embankments reduce storm surge breaches, but at the cost of higher pluvial flooding. New thinking is thus required to increase climate resilience beyond building more infrastructure (Adnan et al., 2019).

Integrating biophysical and social research, we document how rainfall influences water use behaviour, and the impact on water security. For example, water diaries demonstrate how the use of different water sources, and payment behaviours, change with water availability (Hoque & Hope, 2020). This understanding has emerged through better monitoring technologies and by aligning social and biophysical data.

The challenge is to use these data to help plan, monitor and manage water systems to build resilience. For example, the supply and demand for rural and urban water supplies is under enormous financial and affordability pressures due to COVID19 with climate patterns affecting the severity and occurrence of impacts.

National policy makers and sub-national practitioners will be at the forefront of improving climate resilience. However, there are multiple barriers to their ability to deliver change. Decision-makers managing water resources or water supplies need access to meaningful information on these
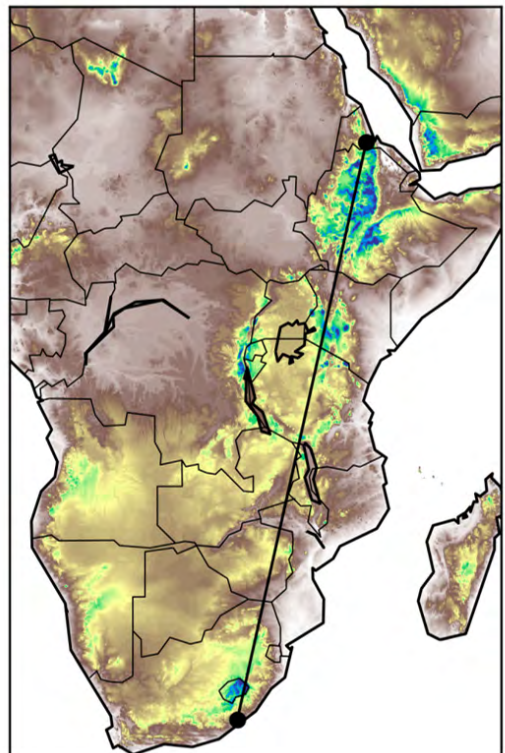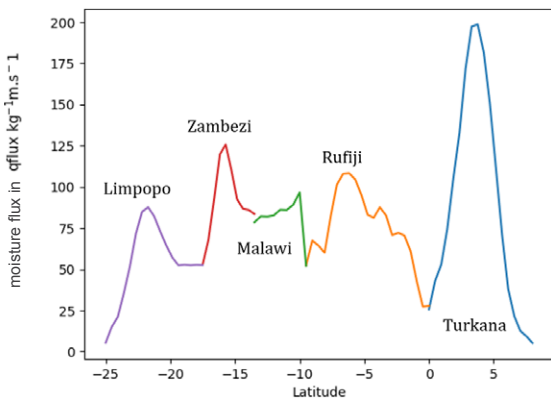
The provision of water vapor is key to understanding rainfall in Africa. In East Africa water vapour transport is dominated by the Turkana Jet (low-level jet stream which present in northwest Kenya). The Turkana Jet accounts for close to 30% of the total water vapour transport from eastern to central Africa across the line shown in right figure (Dr Callum Munday).

complex interactions, and options for managing them. This requires science that is tailored to their needs and that is communicated effectively, as well as the confidence to use and challenge the data. Recognition of the political nature of these data and decisions is also critical (Haines et al., 2017).

Uncertainty in future climate projections presents challenges to getting decision makers to engage with climate research and embed climate in their work. Ensemble approaches to Global Climate Models (GCMs) help to provide more robust global estimates. However, they are not the best tools for decision making at the basin scale, where identifying individual GCMs that best reflect the climate of the local area can create more reliable data for water managers (Dyer et al., 2019).

REACH will continue delivering targeted climate tools and research to advance understanding of regional climate and climate change, working with stakeholders across a range of scales, from small urban utilities to national governments, to increase access to reliable information, helping them to apply it in their work and decision making.

2020-2024 Planned activities

Integrated approaches to climate resilience for water supplies. A lack of integration between water supply and water resource management sectors results in water supplies that are developed and managed without an understanding of the changes in water availability and allocation, and without preparedness for the impact that droughts and floods can have on their service delivery. The resulting unreliability of water services has implications for financial sustainability, health and poverty alleviation. This is illustrated with the COVID19 pandemic where an acute, but not unique, public health crisis intersects with climate shocks and weak institutional structures.

This research will improve coordination between water supply and water resources sectors through engagement on climate resilient water safety plans, aligning with current investments by the FCDO, governments, UNICEF and NGOs.

Climate communication. Water managers in government and non-government organisations have developed deep expertise relevant for their roles through study, training

and experience. However, these do not always include opportunities to integrate an understanding of climate and the likely impacts on the water systems they manage. Furthermore, barriers to the uptake of climate data and forecasts can vary from political restrictions on data use to presentation of data on scales and timeframes that do not match those required by the water manager.

This research will seek to understand the needs of stakeholders in relation to climate data, forecasts and their application to their work. We will assess demand, barriers and incentives, considering modalities preferred for capacity building and communication that can increase climate capacity in a sustained manner for stakeholders across water management institutions.

Ensuring impact, sustaining progress

The threat of climate change to water security is widely understood, creating broad demand for applied research. However, the challenge here is in communicating and targeting research appropriately to drive change. At a local level, impact will be achieved through partnerships with water managers, such as Basin Development Offices, and water utilities, targeted at embedding climate resilience in their planning, individually and through collaboration across sectors.

Aligning this work with existing investments supports communication to investors, such as the FCDO, WHO and UNICEF. This process will also be used to inform global partners, UNICEF and WHO, on barriers and opportunities for capacity development in climate resilience. Resources and tools will be shared through a collaborative initiative to create a new website on climate resilience for water security.

Credit: Andrew Dansie

IMPROVING WATER QUALITY MANAGEMENT

Aim: *to design and demonstrate new models to deliver safe drinking water supplies, and reduce environmental pollution.*

Progress towards the SDG target for safe drinking water is greatly off track. Globally, the JMP estimate that 29% of the population lack access to drinking water that is "free from contamination", i.e. compliant with standards for faecal contamination (E. coli) and priority chemical contamination (arsenic and fluoride). In practice, data are scarce, especially in developing contexts. In Sub-Saharan Africa only 10 of 51 countries have estimates of safe drinking water, with major information gaps for water quality in schools and healthcare facilities. Furthermore, this definition of 'safe' water is narrow, excluding many other key contaminants that affect health (such as salinity, manganese, chromium, pesticides, etc) and therefore underrepresents the risk to exposed populations.

Novel monitoring technologies, such as the molecular biosensor (Rampley et al., 2019), offer new ways to measure

risk, but improving water quality goes beyond the technical challenge,. The water quality that people are exposed to, for drinking or for other purposes, is a result of many interrelated of factors, including the occurrence of natural contaminants and pollution sources, the design and management of water access and treatment infrastructure, and hygiene behaviours. Improving water quality requires understanding science, politics, behaviour and planning.

REACH's work to date has identified a number of challenges to improving water quality. Appropriate, reliable water quality data are not readily available to decision makers in a timely manner, from lay-managers through to basin managers (Peletz et al., 2020). Where data are available, action is still infrequent as there are many barriers to sharing information amongst stakeholders, understanding when and where changes are needed

Mary Musenya Sammy, FundiFix water quality officer, preparing a sample for E. coli analysis in the field lab in Kyuso, Kitui. Credit: Saskia Nowicki

and being able to implement and afford them (Nowicki et al. 2020). Roles and responsibilities affect how water quality hazards are assessed and managed, especially in rural water systems. Water quality research and management often focuses on a single contaminant, e.g. arsenic free programmes, or disinfection focused solutions, ignoring the multiple hazards.

In Bangladesh, monitoring and modelling of river water quality (Whitehead et al. 2018) has encouraged the government to invest in more

sustained monitoring. In Kenya, a rural water quality laboratory has been established to monitor drinking water quality and provide information to local managers. To help achieve safe water for all, REACH will work to accelerate action to improve water quality through innovations in measurement, monitoring and management. Working together with stakeholders, from the community to the national level, we will develop and refine risk-based methods for managing water quality risks.

2020-2024 Planned activities

Access to safe water in multiple hazard systems. The priorities for drinking water quality management are typically based on faecal contamination, measured by E. coli, and priority chemicals such as fluoride and arsenic. Many more hazards that can affect health or deter people from using water - such as manganese, salinity, iron, and agricultural and industrial chemicals - are often ignored. Perceived responsibilities for managing water quality vary depending on the hazard between the user, supplier or the government. Thus multiple actors are required to achieve safe water where multiple water quality hazards exist.

This research will explore approaches to delivering safe drinking water that address multiple hazards and the political and behavioural challenges that they constitute.

Risk-based approaches to water safety at scale. Rural drinking water management approaches focus on individual supplies, with government having responsibility potentially for thousands of systems. In this context, with limited resources, management becomes reactive, and the response to water quality testing, if conducted, is often inadequate.

This research will build on a risk-based approaches (water safety planning) to prioritise water safety monitoring at scale for governments. It will be based on an assessment of the similarities in risks across systems and dedicated monitoring of a subset of systems, and will be cognizant of climate impacts. Working with partners in government, UNICEF and the private sector, monitoring and action plans will be tailored to make effective use of resources.

Decoupling of urban and industrial growth from environmental pollution. Expanding urban growth and industrial development are a growing threat to the provision of safe drinking water, and to ecosystems. Water managers often struggle with a lack of information on water quality hazards, due to limited resources for monitoring the range of potential threats.

In this research, we will expand river, groundwater and wastewater monitoring. We will use the results to inform modelling, highlighting sources of contamination and impact pathways to guide targeted policy and regulatory responses at different scales. Analyses will use biosensors to detect toxicity developed in the first phase of research.

The work will address the catchment scale (Awash River Basin, Ethiopia), city scale (Dhaka, Bangladesh), and town scale (Lodwar, Kenya).

Ensuring impact, improving quality

Drinking water quality has been explicitly included as a measured indicator for SDG 6.1. However, ensuring safety requires management as well as measurement. Improved tools to deliver safe water for the poor are essential to expand access, and are of key interest to WHO and UNICEF, as well as to government partners trying to meet their SDG targets. Additionally, tools that allow monitoring of improvements can demonstrate potential new ways to monitor post-SDG goals.

Pollution is covered by SDG 6.3. Partnering with UN-Habitat has helped to design the research to deliver case studies that can inform pathways to manage trade-offs between resource sustainability and sustainable growth. Pollution, especially industrial pollution, is rarely linked to drinking water quality in developing contexts. However, our partners have made us aware of the challenge from industrial pollution in our observatories, with major new infrastructure needed to tap new water sources where treatment of surface water is no longer feasible. Linking drinking water quality and pollution will help to highlight the emerging challenge and the resources being diverted to address it.

Children bathing in the Turag River, Dhaka, Bangladesh. Credit: Alice Chautard.

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The installation of this Water ATM and repair and maintenance works
at Ivonangya Water Project Kiosk in June 2019, was supported by:

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STRENGTHENING INSTITUTIONS FOR WATER SECURITY

Aim: *to strengthen institutional design through allocating risks and responsibilities between the state, market and community.*

Strong institutions are recognised by SDG 16 as a necessary condition to support sustainable development, protect vulnerable people and promote prosperity. Institutions govern how decisions, information, incentives and behaviour can promote or constrain water security outcomes for the poor. Without inclusive governance, reflecting the priorities of the poor, progress may remain inequitable in how water resources and services are managed, monitored, and allocated between competing demands by industry, agriculture, domestic water and ecosystems.

For many developing countries, achieving and sustaining economic growth requires recognising and regulating governance systems, addressing not only the production of goods (jobs, income) but also mitigation of the production of bads (pollution, scarcity, illness). Mega-cities, small towns and neglected rural populations in Africa and Asia, face climate and environmental risks where limited institutional capacity and regulation of risks leaves people living with water quality hazards from polluted rivers or contaminated groundwater. Theoretical work by Koehler et al (2018) and Fischer et al (2020) articulates how socio-cultural and political processes allocate responsibility between individuals and collective decision-making structures, and between the state, market, and individuals.

REACH is exploring how governments and researchers can collaborate to support institutional change in policy and practice. This includes the gap in providing safe water to schools and clinics, reducing river health hazards for riparian communities in cities, or the growth in the self-supply of water of uncertain quality in rural villages. Structural barriers and
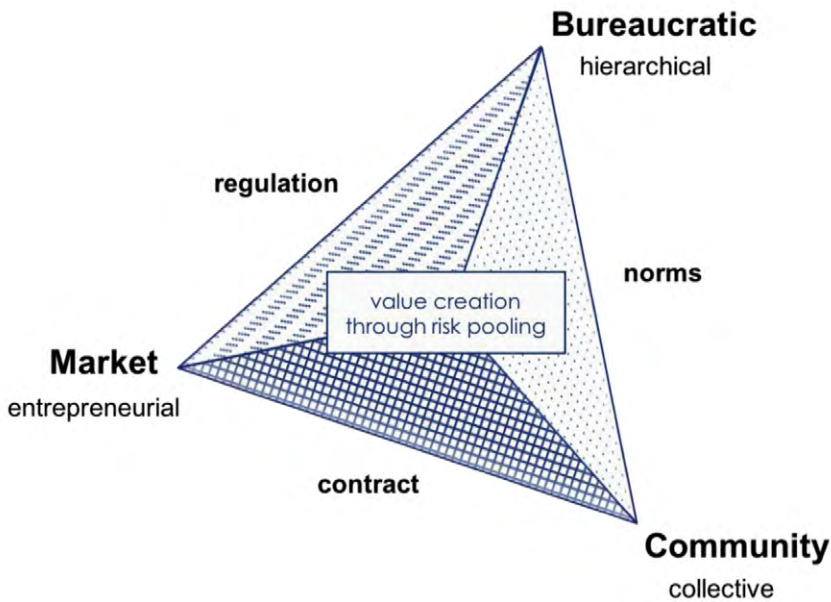
A pluralist institutional network to recognise and promote cooperative management cultures (Koehler et al. 2018)

institutional separation can fail to clarify responsibilities and allocate risks fairly. Information disclosure is inevitably political in where, how and when resources and blame can be allocated, until an acceptable solution emerges or the status quo is re-established. Understanding and supporting partnerships in building institutions will remain a key part of our work in future years.

We also recognise that a critical constituency of individuals, households or communities, who are unwilling or unable to engage in formal institutional models, can be easily ignored or forgotten. What influences or constrains the behaviours and choices of a minority left behind, excluded or disinterested, is of particular concern in ensuring institutions are inclusive in action and outcomes as well as in spirit and intent (Hoque and Hope, 2019; Koehler et al., 2018; Korzenevica, 2019)

REACH has offered new thinking around institutions to build water security sustainably at scale. In Kenya, we have examined new opportunities to pool risks for rural water security through re-allocating responsibilities between the state, market and communities. Advances in remote monitoring of rural water infrastructure has provided information flows to inform institutional design and performance.

This is illustrated in the FundiFix model, where risks and responsibilities can be shared more fairly, leading to major improvements in water service reliability in contexts of highly variable rainfall (Koehler et al., 2018; Thomson et al., 2019) and during the COVID19 pandemic where services continue to flow without the need for emergency funds.. In turn, the institutional work is informing new funding models where non-traditional finance can be secured to support more sustainable solutions at scale (Hope et al., 2020). Through a wider partnership, this work is contributing to performance-based models with reliable water services for one million rural people today, and a goal of 100 million people by 2030 (McNicholl et al., 2019). REACH aims to expand this work with a focus on water quality in the next phase.

2020-2024 Planned activities

Performance-based, service delivery models at scale. Delivering and maintaining reliable, affordable and safe water in rural communities, clinics and schools requires new institutional approaches. Performance-based models with guaranteed service delivery, are challenging the traditional separation between the state, private sector and communities (Koehler et al., 2018). User payment behaviours, which are contingent on a higher and regulated service level, promote new approaches to blend finance from government, donors and users (Hope et al., 2020). Sustainable finance through trust funds, development impact bonds or other funding vehicles, is critical to meet national and global funding gaps. The often over-looked challenge of providing safe drinking water is central to this work.

REACH will build on established work in Kenya, where climate risks, groundwater quality and high-levels of inequality challenge delivery models, and new work will be advanced in coastal Bangladesh to adapt and pilot a model appropriate for this vulnerable context. Institutional coordination and cooperation are foundational aspects of this work, where sustainable financial models, applicable at scale, will need to be recognised in revised policy, planning and regulatory approaches.

Water security policy and regulation.
Institutional design and performance are guided by the legal, policy and regulatory context. Interventions operating outside political mandates are unlikely to be sustainable.

This work will support partnerships with national and local governments in reviewing and reforming relevant aspects of Water Bills and Policy as well as regulatory norms for monitoring and enforcement. The focus will be on the intersections between water resource systems and water service delivery, in the context of how decentralisation in Kenya is reforming national water law, influencing county water bills and policy. In Bangladesh and Ethiopia, the focus will be on national water policy with associated discussions on environmental regulation and enforcement, and the processes of decentralisation and recentralisation of authority and responsibility for water services at local levels.

Over 420,000 school children in 1,874 Primary and Secondary schools in Kitui County need drinking water within school premises to enhance academic productivity. Fundifix offers new institutional approaches to delivering and maintaining reliable, affordable and safe water in rural communitie, schools and clinics. Credit: Cliff Nyaga.

Ensuring impact, building institutions

REACH's research and long-term engagement with policy makers and practitioners have informed and influenced investments at national levels. We will build on these successes to accelerate the uptake of our research, ensuring continued collaboration with those working to improve water security for the poor.

The research here, and across all themes, is developed with stakeholders, to address the decisions they are making. For example, institutional models for service delivery have been co-designed with UNICEF to inform their future investments in water supplies, with significant support from government partners. On-going engagement with stakeholders in industry and government seeking to meet SDG 6.3, to reduce untreated wastewater discharges, continues to inform a strong understanding of the delicate balance between trade-offs.

This work will engage with the inequalities' theme recognising that institutions are often designed to represent and protect the interests of the more powerful. Understanding bargaining solutions in households or the daily choices and practices of individuals will help identify where vulnerability, exclusion or marginalisation may be addressed in alternative governance arrangements.

Andrew Trevett, UNICEF Kenya's Chief of Water, Sanitation and Hygiene (WASH), at the Turkwel River, as part of a REACH-UNICEF field visit in Turkana County. Credit: Rob Hope

DELIVERING VALUE, SUSTAINING IMPACTS

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REACH recognises the continuous need to reflect on how value can be created for all our stakeholders, ensuring sustainable impacts that benefit the poor at scale.

Translating our research into meaningful action will continue to improve the value of our work. National and sub-national stakeholder forums provide regular and critical feedback to challenge and improve the quality and focus of our work. The healthy tension between academic scholarship and practitioner accountability drives our work to focus on impacts of demonstrable value to multiple stakeholders. This strategy reflects the core components, across the global programme, of the most significant water security challenges where REACH can make a difference.

We hold ourselves accountable for creating value for money through metrics of economy, efficiency, effectiveness and equity as well as a wider programme of monitoring and sharing our work. Demand and uptake are critical and are reflected in the many established partnerships with governments but equally, the role of

the private sector from multinational companies to incubating new social enterprises, like FundiFix in Kenya, is recognised.

Rapid and unpredictable public health hazards and climate shocks reveal deep inequalities in water insecurity outcomes where the poorest who bear no responsibility, are most at risk but are least able to cope. Sustaining impacts means the poorest need to benefit most, and those benefits must be maintained over time. REACH will invest more in understanding the daily practices and risks faced by the water insecure poor in the next phase of work. We recognise the need for and value of collaboration and invite our partners and wider networks of practice to join us in advancing this critical work.

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