

Cross-comparative international, interdisciplinary mixed methods research for development: REACH-WISER Methodology

October 2025

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This report should be referenced as:

Charles, K.*, Hoque, S.*, Korzenevica, M.* et al (2025). Cross-comparative international, interdisciplinary mixed methods research for development: REACH-WISER Methodology. REACH Working Paper 15, University of Oxford, UK. doi: [10.5287/ora-4rr4jbdjk](https://doi.org/10.5287/ora-4rr4jbdjk)

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Executive summary

The ways in which women, men and children experience and influence water security is shaped by their roles and status in their household and community. Across the REACH programme, we have explored water security for vulnerable people, using a risk-based framework to consider the different types of water security outcomes, how water security risks are distributed in society, and how these inequalities are reproduced. WISER – Water InSecurity, Equity and Resilience – was a research collaboration that was designed to consider how risks were distributed down to an individual level, considering intrahousehold dynamics as well as community. Previous research had identified inequalities in intrahousehold decision-making, with examples of these limiting the success of water security interventions.

The research was designed around four central tenets. A cross-comparative approach across countries and the urban-rural gradient supported analysis of the influence of cultural, political and geographic contextual factors, facilitating wider policy relevance. Longitudinal research with repeated engagements across seasons reflected the temporality in water security, grounding the work in an understanding of local climate. Intrahousehold dynamics were at the core of the work, with design ensuring gendered dynamics between spouses were captured. Mixed methods enabled capture of data across scale and depth, and across different times scales.

The three observatory locations, and the water security challenges faced, included: flooding and salinity of drinking water in coastal Bangladesh; industrial growth in agricultural areas near Addis Ababa in Ethiopia; and water scarcity in Turkana County in northwest Kenya.

This paper presents the integrated methodology across these sites and methods. It has been developed to share the design and nuances of methodologies beyond that which can be covered in individual journal papers, including some of the rich methodological discussions held by the authors.

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1. Introduction

Many of the world's vulnerable people have inadequate water security. Between 2.2 billion ([JMP, 2022](#)) and 4.4 billion people ([Greenwood et al., 2024](#)) are estimated to lack access to safely managed drinking water globally. There has been severe stress recorded on the world's water resources over the past five years ([WMO, 2024](#)). Over half the global population are estimated to be exposed to clean water scarcity at least one month per year, which is projected to increase with climate change ([Jones et al., 2024](#)). The intensification of the water cycle with climate change is undermining existing water security, increasing the imperative to improve how we deliver water security to adapt to the changing climate.

Gender inequalities are a barrier to advancing water security. Water security issues relating to gender are commonly reported from the perspectives of women, with women and girls bearing the burden of the work but with limited input into decision-making. In households without water on premises, women and girls collect water in 7 out of 10 households ([WHO/UNICEF, 2023](#)). The assumptions that the sector makes in programming about the roles that women have are increasing the gender divide, such as the heavy reliance on women's time to deliver interventions ([Caruso et al., 2024](#)). While water programmes often target women with their activities at the community-level, and researchers have often focused on reporting women's experiences of inequalities related to water access and use, women remain excluded from many meaningful decision-making processes at all levels ([Coulter et al., 2019](#), [Adams et al., 2018](#)). However, while men may often hold more power in decision-making, these common narratives overlook how and where men are excluded ([Brewis et al., 2024](#)), and assume homogeneity in the grouping of 'men' and 'women'.

Since 2015, the [REACH Programme](#) has advanced interdisciplinary science and supported policies and practice to improve water security for vulnerable people in South Asia and Africa. REACH established core research programmes across eight Water Security Observatories in three countries: Bangladesh, Ethiopia and Kenya. The programme adopted a risk-based approach (Figure 1) with research and impacts aligned to four key themes – climate resilience, inequalities, water quality and institutions ([REACH, 2020](#)).

Figure 1: REACH risk-based framework (REACH, 2020).



The work on inequalities examined how social disparities shape water security risks at multiple scales, revealing how these inequalities are embedded in social practices and political structures. For the urban poor, [Grasham et al. \(2019\)](#) highlighted challenges such as insecure housing rights, lack of access to formal urban water supplies, and reduced water allowances. Among smallholder farmers, [Schreiner and van Koppen \(2020\)](#) argued that post-colonial era governments in Sub-Saharan Africa reinforced water permit systems, effectively criminalising long-standing informal water use. Media analysis by [Fischer \(2019\)](#) showed how political narratives selectively attribute blame for drinking water quality risks, often overlooking vulnerable groups and regions. [Hoque and Hope \(2020\)](#) used daily water diaries to illustrate how seasonal, cultural, and economic factors influence the affordability of drinking water in areas affected by high salinity in coastal Bangladesh.

A cross-cutting dimension of water inequality is gender, particularly the differential ways in which men and women experience water risks and the outcomes of development interventions. The Empowerment in WASH Index, developed by [Dickin et al. \(2021\)](#) and piloted in Burkina Faso, revealed that men were often disempowered in contributing to WASH roles and responsibilities, while women had limited input into decisions regarding WASH expenditures. A similar gender imbalance was identified in Kitui County, Kenya, where women are primarily targeted in WASH education and behaviour change efforts, yet men hold decision-making power within community water management committees and household water expenditure ([Nowicki et al., 2022](#)). As a result, while women undertake most water-related household labour, men determine which water sources are used and what materials are available for ensuring water safety at home. In Kilifi County, Kenya, [Hillesland et al. \(2023b\)](#) found that women's and men's water rights are deeply intertwined with land tenure systems, social relations, and gender norms, with women often relying on complex social networks to negotiate access to water, while men typically hold more robust and complete rights to water sources on household land.

These varying experiences of men and women highlighted how gender roles and norms influence access to resources and information, shaping individuals' and households' response and resilience to water risks in a changing climate. Effectively responding to gendered inequalities requires nuanced understanding of intra-household dynamics of decision-making across diverse geographies and cultures – an area that has been largely understudied despite the increased focus on gender in WASH interventions.

This document details the research design, including methodology, site selection, and fieldwork for data collection. It also reflects on the interdisciplinary collaboration that shaped the study, ensuring a reflective and ethical approach to equity in research and engagement.



2. Research design

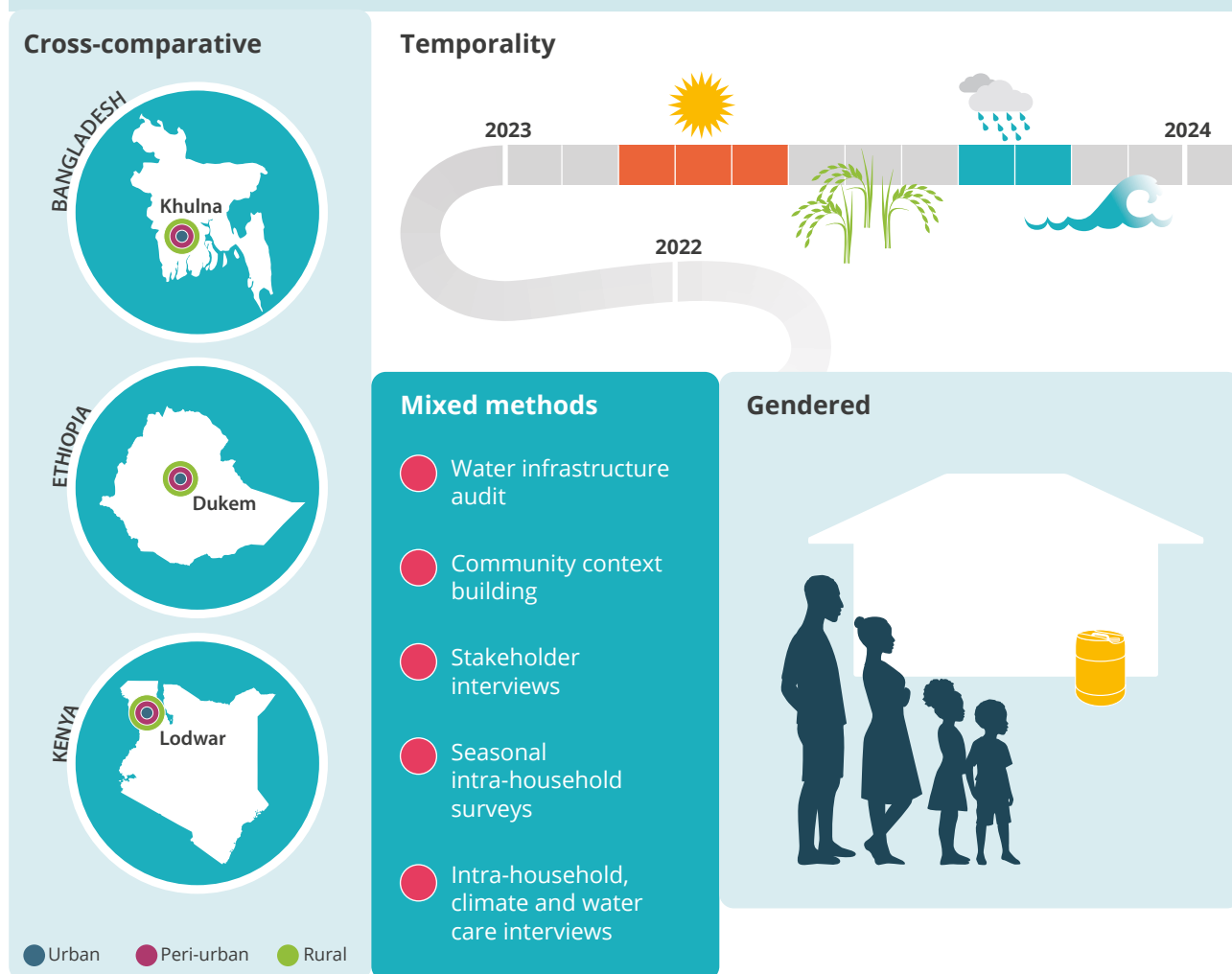
In 2021, the WISER consortium was established within the REACH programme to investigate how power relations and household decision-making impact water security. The WISER study aims to inform policy and practice that address gender inequalities in water risks, examining three research questions.

- How do men's and women's experiences of water insecurity intersect in changing environments?
- How do woman and men navigate environmental challenges, and what are the implications for their livelihoods?
- How do intra-household dynamics and community power relations shape experiences of water security?

The WISER consortium includes researchers from diverse disciplines, including critical geography, economics, international development, anthropology, health sciences, and engineering. Their expertise spans three key areas: water security and stakeholder engagement, leveraging established relationships from previous REACH research; intra-household decision-making and empowerment, using best practices in quantitative gender analysis; and the development of experiential scales to assess water security at both household and individual levels. The consortium researchers were all employed by research institutions over the relevant period for their work. Additional people were recruited for specific components and are referred to by designated titles eg enumerators, translators.

The WISER methodology employs a mixed-methods framework to capture spatial and temporal variations in water security as well as the gendered roles and experiences associated with managing it (Figure 2). While the study was initially planned for Ethiopia, security concerns led to a reduction in study sites in Ethiopia and an expansion to Bangladesh and Kenya. The research design started through workshops in early 2022 and was refined iteratively to reflect diverse geographical and social contexts.

Figure 2: WISER methodology overview.



2.1 Cross-comparative

The WISER study employed a cross-comparative design across the three countries (Bangladesh, Ethiopia, and Kenya) of the REACH Programme, with sites classified as urban, peri-urban, and rural within each country (further details in [Section 3](#) below). This cross-comparative approach facilitated an analysis of contextual factors across varying degrees of urbanisation, considering differing hydroclimatic pressures, infrastructure development, policy landscapes, and demographic profiles that shape distinct experiences of water insecurity. The WISER study was conducted alongside detailed on-going research on the nature of the changing environment, and within established transdisciplinary research partnerships involving researchers, policymakers and practitioners.

In Khulna district of coastal Bangladesh, freshwater availability is severely threatened by high salinity in both surface and groundwater sources. This salinity arises from the natural hydrogeological characteristics of the lower Ganges delta and is further intensified by brackish water shrimp farming and frequent storm surges that overtop embankments, inundating the floodplains ([Hoque and Shamsudduha, 2024](#)). The tropical monsoon climate brings heavy rainfall for four months, replenishing freshwater sources for drinking, domestic use, and irrigation.

In stark contrast to this densely populated mega-delta, Turkana County in northwest Kenya is a sparsely populated, arid landscape traditionally inhabited by nomadic pastoralists. However, rapid population growth in urban centres and refugee camps is placing increasing pressure on groundwater-fed water systems, further strained by the expansion of irrigated agriculture and oil exploration ([Tanui et al., 2020](#)). Droughts and flash floods pose significant risks in these hot climates, where rainfall is both extremely low and highly variable ([Hirpa et al., 2018](#)).

In Ethiopia, Dukem, located on the outskirts of Addis Ababa in the Awash Basin, continues to support traditional rural livelihoods that remain heavily dependent on seasonal rains ([Taye et al., 2018](#)). At the same time, the area is experiencing rapid urbanisation, driven by large industrial developments that have attracted significant in-migration for employment opportunities. These developments have also contributed to increasing pollution challenges in the River Awash ([Abebe et al., 2023](#)), while access to water for domestic use remains a persistent challenge ([Birhanu et al., 2021](#)), with broader implications for equity and water security ([Grasham et al., 2022b](#)).

2.2 Temporality

Water security is inherently variable, shaped by seasonal fluctuations in temperature and rainfall, as well as climatic shocks such as floods and droughts. While seasonality is widely acknowledged in academic and policy discussions, integrating it into global and national monitoring frameworks remains challenging due to data limitations. There is evidence of dry season bias in data collection among major large-scale surveys, as the wet season causes logistical problems for survey implementation ([Wright et al., 2012](#)). Increased workloads during peak agricultural seasons, such as harvest periods, often prevent individuals from engaging in studies, while religious events and festivals further limit the availability of both research teams and participants. Budget constraints often limit research to cross-sectional analysis, while the few longitudinal studies that do capture seasonal variations (e.g. [Broyles et al., 2023](#), [Akinyemi et al., 2022](#)) are typically constrained in scope, measuring a narrow set of indicators that cannot fully reflect the complexities of water security over time. Reliance on longer-term recall to understand seasonal variations in water security will likely over-capture those experiences which have the most immediate impact on an individual but overlook the myriad other experiences that might impact perception of risks and motivation for adaptation.

[Hoque and Hope \(2025\)](#) used water diaries in Kenya and Bangladesh to record household water source choice, expenditures, collection responsibilities and quantities every day for one year, providing nuanced insights into the impact of seasonal water availability, festivals and economic pressures on household water use behaviour. The WISER study expands the investigation into a broader range of study locations, considering both household and intra-household dynamics. The study employed multiple waves of data collection, including three rounds of intra-household surveys in Bangladesh and two in Ethiopia and Kenya, generating a comprehensive panel dataset. By capturing weather-related experiences across different time periods, the research team was able to refine survey questions and develop a deeper understanding of seasonal challenges and adaptation strategies that help to build our understanding of how people might experience the shocks and extremes associated with longer term climate change.

2.3 Gender

Women, men, girls and boys have different roles in decision making, responsibilities and activities to ensure household water security. The responsibility of women to deliver domestic water management is widely reported, and often targeted in programmes related to domestic water such as those designed to increase knowledge of water quality and hygiene ([Dickin and Caretta, 2022](#)). In some cases, research has explored under what conditions men provide support with water collection. In urban Malawi, for example, men typically do not collect water, as it is seen as undermining their masculinity; instead, they provide financial support, discretely fetch water to avoid social stigma, restrict their wives' water collection from other communities, and receive preferential treatment at water points through queue-jumping or designated "bachelor taps" ([Adams, 2024](#)). Research on empowerment and self-efficacy has sought to understand decision-making and drivers of behaviour, demonstrating the importance of education, societal norms, wealth, and urbanicity across areas of agriculture ([Quisumbing et al., 2022](#)) and WASH ([Dickin et al., 2021](#)).

While there is a strong literature on gender issues and water security, prior to the WISER study starting in 2022, there was limited literature on intra-household understanding of water security ([Hillesland et al., 2023a](#), [Hillesland and Doss, 2024](#)). Asymmetries in decision-making power, responsibilities, and access to information within the household may lead to sub-optimal outcomes. In the WISER research design, an intra-household methodology was applied to household surveys and qualitative interviews, based on a feminist epistemology, to capture differences in decision-making, householding, care-giving and care-receiving roles, and responsibilities within a household. The design focused on husband-wife pairs but also included single adult households, and alternative pairings where appropriate. The involvement of children in household water dynamics was included indirectly, from the accounts of adults.

2.4 Mixed methods

To explore the complex issues surrounding intersectional decision-making and lived experiences, a mixed-methods approach was employed, integrating multiple research components, to deepen our understanding of dynamic processes of change (see details in [Section 4](#)). These methods included:

- **Water infrastructure audit:** Water needs for both domestic use and livelihoods are rarely met by a single source in these study sites. The audit identified and mapped the various water sources used, grounding the research in the trade-offs communities make when choosing water sources for different purposes. This method also engaged community leaders and water managers to understand local water management approaches and build relationships that supported access to the communities.
- **Community context building:** Water security challenges are highly contextual. To capture local perspectives, researchers collaborated with community leaders to organise participatory mapping and group discussions, helping to identify key water-related concerns and experiences. This process also strengthened relationships with communities, supporting the continuity of the research.
- **Stakeholder interviews:** Water insecurity is shaped by broader political and economic factors. Interviews with key stakeholders provided insights into the institutional arrangements governing household water supply in the study sites and revealed political barriers to water security.
- **Seasonal intra-household survey:** Panel survey data collection enabled quantitative analysis to explore water security trends across different seasons, providing scalable insights to inform policy-making. The survey captured decision-making processes and household experiences over time.
- **Intra-household, climate and water care interviews:** Interviews with a selection of respondents from the intra-household survey and additional individuals from select communities within the study sites generated rich data on intersectional issues, including care-giving responsibilities and gendered experiences related to water security.

The study sites were selected to align with ongoing transdisciplinary programmes that actively contribute to policy change and impact for local populations. Through stakeholder interviews and knowledge exchange within long-term collaborations, the research connected household experiences with broader policy environments. Additionally, the design facilitated an exploration of empowerment and gender dynamics, examining gender relations through the lens of lived experiences and individual preferences.

3. Observatory locations and study sites

Three research sites were identified from existing REACH water security observatories. Using existing observatories enabled the work to build on detailed on-going research on the nature of water security and the changing environment, as detailed below. It also supported strong partnerships with policymakers and practitioners in the transdisciplinary research, based on relationships established and curated through the REACH programme. The established role within local settings and partnerships with key stakeholders shaped the researchers' positionality. They were conscious of maintaining a research-focused identity, ensuring that communities understood that findings would be shared with government, UNICEF, and NGO partners, while emphasising that their presence was to document experiences rather than to intervene. The observatories were:

- [Coastal Water Security](#), Khulna district, Bangladesh
- [Sustaining growth through water security](#), Awash basin, Ethiopia
- [Small towns in fragile environments](#), Lodwar Kenya

Within the observatories, study sites were selected to reflect key water security challenges across urban, peri-urban, and rural areas. While urban and rural classifications were straightforward, defining peri-urban areas proved more complex. To ensure consistency across countries, the following criteria were adopted to characterise peri-urban areas: (a) weaker connectivity than urban areas; (b) proximity to dense urban centres with challenges in accessing facilities; and (c) lower service levels, where infrastructure and service delivery models remain underdeveloped. Additional desirable factors included mixed rural and urban livelihoods, rapid population growth, and unclear boundaries between city and village, creating a sense of being in a transitional "limbo" space.

Site selection excluded the wealthiest areas and locations deemed too unsafe for fieldwork. Stratification further considered available water sources, particularly the extent of piped water services, ensuring that most respondents relied on multiple water sources. Qualitative and quantitative research teams conducted joint and separate scoping visits to map potential locations. To refine site selection for qualitative methodologies, local researchers engaged in informal discussions and key informant interviews, providing deeper insight into community dynamics.

The qualitative methods focused on a subset of locations, selecting three per country – one urban, one peri-urban, and one rural – to develop a comprehensive contextual understanding and situate the data within the broader waterscape.

Limiting the number of locations enabled researchers to build familiarity with each setting, conduct in-depth observational studies, establish networks with local communities, and enhance personal safety. The sites for qualitative research were chosen based on three key criteria: severe water access challenges, exposure to climate-related hazards, and logistical feasibility for safe interviews. This selection was informed by prior knowledge gained from earlier REACH Programme research and stakeholder engagements.

The sites are detailed in Table 1, with narrative descriptions provided in this section presenting the wider context and the study sites, drawing on published research as well as data collected during research in the individual communities.

Table 1: Names and characteristics of urban, peri-urban and rural sites selected in each country.

Site type	Bangladesh	Ethiopia	Kenya
Urban	3 sites • Wards 1, 21*, 22 in Khulna City Corporation	4 sites • Melka Dukem*, Tsedicha, and Gogicha kebeles in Dukem urban administration	3 sites • California, Napatet, and Kawalase* in Lodwar Township
	Densely populated areas with limited piped water coverage. High reliance on groundwater, but increasing salinity poses challenges. Many residents depend on community tubewells and private deep tubewells. Informal settlements lack piped connections, leading to reliance on NGO-installed tubewells.	Rapidly growing industrial hubs with severe water pollution from industrial and sewage waste. Piped water supply is unreliable, and informal settlements struggle with drainage and flooding. Wealth disparities influence access to water and sanitation services.	Town centre areas with mixed housing types, including permanent structures. Piped water supply exists but is often unreliable. Alternative sources include boreholes, water kiosks, and private vendors. Water quality varies, with contamination concerns from poor sanitation infrastructure.
Peri-urban	3 sites • Chara* and Sanchibunia villages in Jalma union, Batiaghata upazila • Chak Ahsankhali village in Gutudia union, Dumuria upazila	1 site • Koticha* kebele Dukem urban administration	4 sites • Lokaparparei*, Natapar Kakono, and Natoot in Lodwar Township • Ichakun IDP in Kanamkamer ward
	Transitional zones with mixed livelihoods, including agriculture and small businesses. Some areas benefit from infrastructure expansion but still experience water access challenges. Rapid urbanisation is increasing land value and altering economic activities. Water sources include ponds, community tubewells, and private piped schemes.	Areas with planned and unplanned settlements, with some residents having formal land registration and access to piped water, while others rely on communal sources or private vendors. Annual flooding affects poorly constructed houses. Many households depend on industries for water supply.	Low-income settlements with poor infrastructure and high dependency on communal boreholes and private vendors. Some areas receive government-supplied water, but availability is unreliable. Flooding and drought exacerbate water scarcity, with heavy reliance on seasonal rivers and water trucking.

Site type	Bangladesh	Ethiopia	Kenya
Rural	6 sites • Sutarkhali, Nalian, and Kalabogi* villages in Sutarkhali union, Dacope upazila • Katmarchar, Botul Bazar, and Barabari villages in Uttar Bedkashi union, Koyra upazila	22 sites • Abasamuel, Abayi Silto, Abu Achiro, Abu Garbi, Abu Lugna, Abu Serkema, Abusera, Bilbilo*, Bili Silto, Boreta Guji, Dawara Tino, Dengego, Dufa, Echu, Ensilale, Gale Kotich, Gelan Arebsa, Gameda, Gimashe, Koftu, Kombolcha, and Yerer Necho kebeles in Akaki Woreda	4 sites • Nayanae Ang'ikalalio and Kakwanyang in Lodwar Township • Loreng'elup in Kerio Delta ward • Kapua* in Kalokol ward
	Coastal villages vulnerable to cyclones and storm surges. Limited public water infrastructure forces reliance on rainwater harvesting, ponds, and desalination plants. Salinity intrusion affects drinking water quality.	Agricultural communities with unreliable access to piped water. Many rely on communal water points, ponds, and polluted rivers. Flooding from nearby rivers damages crops and affects water availability. Limited road access hinders transportation of goods and services.	Remote pastoralist and farming communities facing extreme water scarcity. Main water sources include boreholes, handpumps, and seasonal rivers, often located several kilometres away. Seasonal migration is common due to grazing and water shortages.
*Sub-set of sites selected for qualitative research			

3.1 Bangladesh

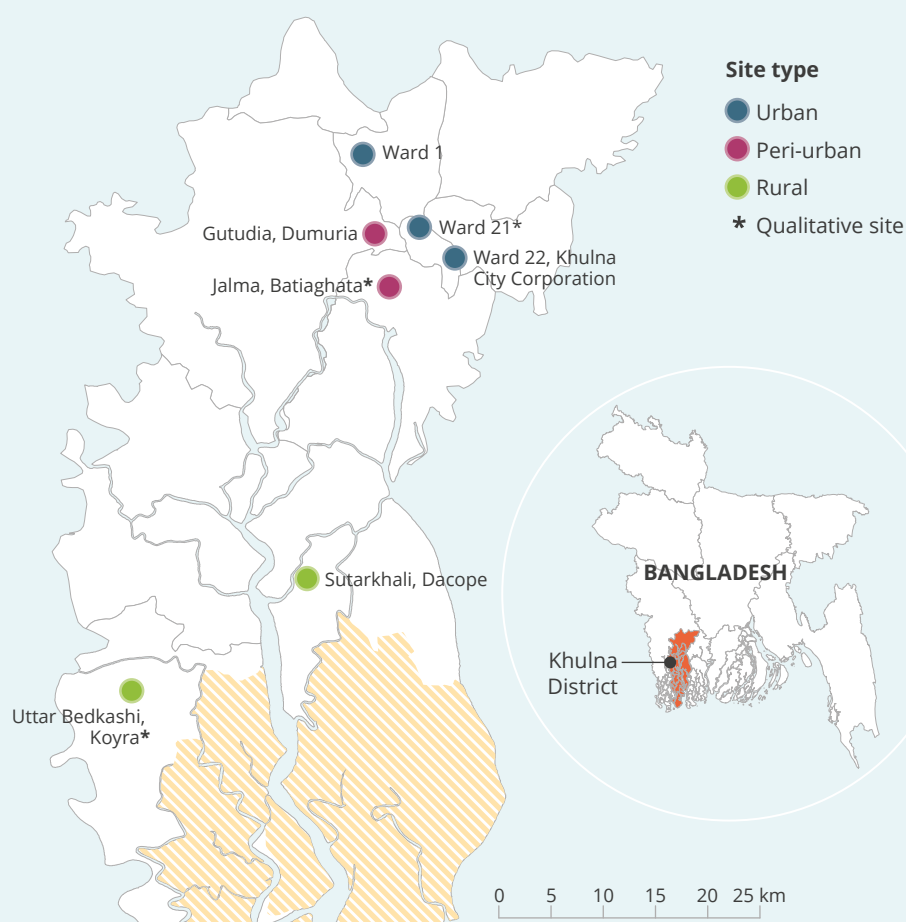
The WISER study in Bangladesh was conducted in Khulna district, which has an urban population of 4.3 million and a rural population of 13.1 million, with a total of 17.4 million people in 4,394 km² (BBS, 2023). Khulna is one of the 64 districts of Bangladesh, located in the southwestern coastal region, and consists of one city corporation with 31 wards and nine upazilas (sub-districts) with 67 unions. The landscape of coastal Bangladesh is criss-crossed by hundreds of tidal rivers and creeks that weave through embanked islands called 'polders', carrying sediment-laden water from the Ganges-Brahmaputra-Meghna catchment into the Bay of Bengal (Paszowski et al., 2021). The region is highly vulnerable to tropical cyclones and storm surges that often overtop or breach the embankments during pre-(May) and post-(November) monsoon periods, inundating rural settlements and agricultural lands with saline sea water (Adnan et al., 2020). Groundwater salinity poses a major threat to drinking water security for the 8 million people living in the 139 polders across the southwestern and southcentral coast. The region has a complex hydrogeology characterised by high spatial and vertical heterogeneity in aquifer availability and water quality (Roman et al., 2021).

Tubewells serve as the dominant source of drinking water, with a four-fold increase in private shallow tubewells (<150m) being observed in the past decade, alongside community deep tubewells (>150m) installed by the government (Hoque et al., 2019, Akhter et al., 2023).

Groundwater salinity generally increases towards the southern sub-districts, where alternative water supply infrastructure such as pond sand filters, rainwater harvesting systems, small piped schemes and desalination plants are prevalent (Hoque et al., 2019). The recent surge in reverse-osmosis based desalination plants has been fuelled by investments by local entrepreneurs, supplying water containers at an average of USD 7 per m³ mainly during the dry season between February and June (Hoque, 2023). Social and spatial inequalities in drinking water security are particularly high in the southern sub-districts where inadequate public provision have shifted the responsibilities to individual households and informal water markets. Those who cannot afford to invest in self-supply through rainwater tanks, or purchase vended water, often rely on poorer quality water or walk longer distances to fetch water, the responsibility for which often lies with women and girls (Hoque and Hope, 2020).

For the WISER study, three wards in Khulna City Corporation (KCC) were selected as the urban sites, three villages in Gutudia union (Dumuria upazila) and Jalma union (Batiaghata upazila) were selected as the peri-urban sites, and six villages in Uttar Bedkashi union (Koyra upazila) and Sutarkhali union (Dacope upazila) were selected as the rural sites. Of these, one in KCC, one village in Jalma and one village in Sutarkhali were selected for qualitative research (Figure 3).

Figure 3: Map of Khulna district in southwestern coastal region of Bangladesh showing locations of study sites.



The selection process began with a scoping visit to 28 potential sites across five upazilas and one city corporation in November 2022. The three upazilas for the peri-urban and rural sites upazilas were purposefully chosen to ensure a representation of the various socio-economic and water security contexts within the district, based on census data on drinking water coverage and insights from the scoping visits. This was followed by random sampling to finalise the specific villages for the study. The three wards for the urban sites were likewise chosen randomly from the nine KCC wards and Paikgachha Pouroshova (municipality) considered during the scoping visit.

3.1.1 Urban sites

The three urban sites include Wards 1, 21 and 22 of KCC (Figure 4), of which Ward 21 was the qualitative research site. Khulna city is the third largest metropolitan city in Bangladesh. Groundwater, the primary drinking water source, has high salinity levels, making it often unsuitable for consumption. Additionally, excessive groundwater withdrawal has increased saline intrusion, and issues with iron and arsenic contamination persist. Khulna Water and Sewerage Authority (KWASA), the city's water utility, provides piped water to only 30 percent of urban households.

Figure 4: Densely packed houses along a narrow street in Ward 22 (urban), Khulna City Corporation, Bangladesh.



Ward 1, also known as Bonik Para, is inhabited by a Catholic Christian community, with most residents being employed in service sectors, blue-collar jobs, or small businesses. While households have piped connection from KWASA, the water quality is poor and mostly used for non-drinking purposes. Deep tubewells, privately installed on premises, are often the primary sources for owners as well as neighbouring households.

Ward 21, known as Greenland Abashon, is an informally occupied area along the Rupsha River within KCC. Due to its status as an illegally occupied settlement, KWASA has not extended any piped water lines to this area. Residents rely entirely on community tubewells equipped with submersible pumps, which have been installed by various NGOs.

Ward 22, which includes the Notun Bazar Char area, has a slightly more formalised urban status. Although some households have piped connections from KWASA, residents rely heavily on a few community water sources, the most notable being the two hand pumped deep tubewells within a woodmill compound. These sources, however, are often out of service due to inadequate maintenance, resulting in frequent periods of water unavailability.

3.1.2 Peri-urban sites

The peri-urban sites include Chara and Sanchibunia villages of Jalma union in Batiaghata upazila, and Chak Ahsankhali village of Gutudia union of Dumuria upazila. Of these, Chara village was selected for the qualitative research.

Given their proximity to KCC, these peri-urban sites have benefited from the recent development initiatives facilitated by the inauguration of the Padma bridge. A rail line goes through the heart of these adjacent villages, significantly elevating land prices and fostering economic opportunities. While residents have begun shifting from exclusive agricultural activities to commuting to nearby urban areas for work, the village's economy still relies heavily on agriculture, particularly paddy cultivation and betel leaf farming. The proximity to water bodies also exposes the village to the risk of flooding during the monsoon, impacting crop yields and livelihoods. While all villages rely on deep tubewells and ponds for their water needs, in Sanchibunia, the recent installation of a private piped scheme with has significantly improved the water supply situation for many nearby households. While Sanchibunia and Chak Ahsankhali are predominantly Muslim, about half of Chara's population are Hindu.

3.1.3 Rural sites

The rural study sites include Sutarkhali, Nalian, and Kalabogi villages in Sutarkhali union of Dacope upazila, and Katmarchar, Botul Bazar, and Barabari villages in Uttar Bedkashi union of Koyra upazila. Among these, qualitative research was conducted in Kalabogi village. These sites are located near the Sundarbans mangrove forest along the southern edge of Khulna district, making them particularly vulnerable to cyclones, storm surges, and increasing salinity levels in both soil and water.

Sutarkhali union is highly vulnerable to cyclones and storm surges and has experienced significant damages during the 2007 cyclone Sidr and 2009 cyclone Aila, making it one of the most researched study sites with years of donor-funded NGO interventions in housing, livelihoods, and water supply infrastructure. Yet it remains one of the most deprived areas in the country owing to its remoteness and adverse hydro-climatic context, which limit agricultural opportunities. In Sutarkhali, Nalian and Kalabogi villages, livelihoods are heavily dependent on brackish water shrimp farming and paddy cultivation. However, the high salinity levels in the soil and water present significant constraints for irrigation, making agriculture increasingly difficult. Many residents have turned to forest-based livelihoods, such as honey collection and woodcutting, to supplement their incomes.

The water supply situation in these villages is precarious, with residents primarily relying on rainwater harvesting and ponds for drinking water. Popular community sources include a pond and associated reverse osmosis plant installed by Heed Bangladesh, and a surface water based solar piped water system installed by the Bondhu Foundation with 20 public water points. The piped system is supposed to provide water twice daily, but maintenance issues often render most of the piped lines non-functional.

Uttar Bedkashi Union was selected to complement Sutarkhali by providing insights into a different set of water security challenges. While Uttar Bedkashi also faces significant salinity issues, it remains more dependent on agricultural activities, particularly paddy cultivation, alongside shrimp farming and fishing. Unlike Sutarkhali, Uttar Bedkashi has seen some success with tubewell installations, providing a critical source of drinking water, which distinguishes it from the complete failure of tubewells in Sutarkhali.

Within Uttar Bedkashi, the villages of Katmarchar, Barabari, and Botul Bazar face critical water security challenges due to increasing soil and water salinity. Katmarchar and Barabari primarily rely on paddy cultivation, with Katmarchar also engaging in aquaculture, while Botul Bazar serves as a local economic hub with small-scale trading and agriculture. All three villages depend on rainwater harvesting and community ponds for drinking water, but these sources often prove insufficient, particularly during the dry season.

3.2 Ethiopia

The WISER study in Ethiopia was conducted in the Awash Valley, in Akaki Woreda (district) and Dukem Urban Administration. This area is characterised by industrial growth and urban expansion, where job creation in urban areas is creating conflicts over water demand and water pollution for rural agricultural areas. The Rift Valley geography creates a localised climate that restricts the utility of global climate models to support climate forecasting ([Taye et al., 2018](#)). Rain-fed agriculture in rural areas is vulnerable to the uncertain climate, with regular floods and droughts ([Grasham et al., 2022a](#)). In the upper Awash Akaki sub-basin, flooding is a common occurrence in the rainy season with the severity changing over time linked to the local drainage infrastructure ([Taye et al., 2024](#)). The areas face water quality challenges, both from extensive geogenic contaminants, such as arsenic and molybdenum ([Abebe et al., 2024](#)), and pollution associated with expanding industry and poor wastewater treatment ([Hailu et al., 2024](#)).

Figure 5: Map of Akaki woreda in Oromia region of Ethiopia showing locations of households surveyed by site type.



The study was initially planned for areas of agricultural expansion in the middle and lower parts of the Awash Valley, specifically in the Fentale (Metehara) and Bosset (Welenchite) districts of the Eastern Shewa Zone in the Oromia Region, however, security concerns restricted the research to an area closer to Addis Ababa.

The selected study sites included four kebeles in Dukem Urban Administration, representing urban and peri-urban areas, while 22 of the 29 rural kebeles in Akaki woreda served as the rural study sites (Figure 5). The selection process was guided by three scoping visits, during which five rural kebeles in Akaki were identified as having security concerns and were therefore excluded. In addition, two kebeles were randomly omitted due to budgetary constraints. Both Akaki and Dukem fall within the Oromia Special Zone Surrounding Finfinne, established in 2008 to foster development and manage Addis Ababa's urban expansion onto Oromia lands, representing an ethnic shift as well as urbanisation. Both Akaki District and Dukem Urban Administration have populations exceeding 100,000 each. However, population estimates remain uncertain, as Ethiopia has not conducted a national population census since 2007.

Dukem, situated 37 km southeast of Addis Ababa along the Addis Ababa-Djibouti railway and highway, has emerged as a major industrial hub. The town is home to the Eastern Industrial Zone, one of Ethiopia's largest industrial parks, attracting both local and international businesses, especially in textiles, garments, and construction materials. However, the discharge of untreated industrial and sewage waste into rivers has significantly degraded water quality. Despite receiving considerable rainfall and having ample surface water, the area suffers from a chronic shortage of clean water, largely due to poor infrastructure and insufficient development efforts. This water crisis is particularly acute in Dukem, which has undergone rapid urbanisation driven by migration and natural population growth.

Despite its rapid development, Dukem retains strong Oromo cultural roots, with local traditions and language central to daily life. The town acts as a bridge between rural Oromia and Addis Ababa's economic activity, playing a crucial role in regional development. Meanwhile, in Akaki Woreda's rural kebeles, agriculture remains the primary livelihood, with farmers cultivating teff, maize, and vegetables for local consumption and markets in the capital. However, flooding is a recurring issue, particularly for farmers downstream of the Akaki River, which overflows during heavy rains, damaging crops and threatening the livelihoods of both rural households and vulnerable communities in Dukem's informal settlements.

3.2.1 Urban sites

Dukem is divided into four kebeles: three urban and one peri-urban. One of the oldest urban kebeles, Melka Dukem, is characterised by diverse economic activities. The central part of the kebele is dominated by small businesses, from tela (local homebrew beer) houses to large restaurants. Many houses in this area are government-owned slum dwellings, which offer poor access to sanitation and water. Residents often face interrupted water supply due to construction-related damage to pipes, and many homes rely on plastic water storage. Women in this area engage in street vending, tela production, small businesses, and sex work, while men work in local businesses or are hired by various organisations. Most of the population in this part of Melka Dukem is indigenous, in contrast to the migrant factory workers who live in newer developments.

The peripheral part of the kebele, characterised by privately owned homes, has better access to water, sanitation, and services. During the rainy season, the slum areas of Melka Dukem are highly vulnerable to flooding, with residents managing their flood risks using local skills and materials due to a lack of government support. Poor drainage systems are a key contributor to the flooding (Taye et al., 2024).

Tsedicha kebele is known for its well-constructed residential houses, made of bricks, cement, and iron, with attractive designs (Figure 6). Tsedicha has few factories and is considered free from pollution, making it a desirable residential area with high land prices. Most residents are newcomers from other regions and ethnic groups, including Addis Ababa and Harar, and are relatively better off compared to other kebeles in Dukem. Water availability is more reliable here, partly due to the proximity of the town's main water storage facility.

Gogicha kebele, located on the outskirts of Dukem, is home to a concentration of factories, which has led to significant air pollution and chemical exposure for the surrounding communities. Many residents work in these factories, with a noticeable gender disparity – factories prefer to hire women because they are perceived to be less likely to demand higher wages. In addition to factory work, residents engage in livestock farming, rainfed and irrigated agriculture, and small-scale entrepreneurship, often supported by government initiatives. However, electricity interruptions are frequent due to high factory consumption, and water supply is also affected by these power outages despite most homes having private water connections.

Figure 6: Overhead water storage tanks at a well-off house in Tsedicha kebele (urban) of Dukem town, Ethiopia.



3.2.2 Peri-urban sites

The peri-urban study site in Dukem town is Koticha kebele, which exhibits significant socio-economic inequalities that are reflected geographically. In some parts of Koticha, houses are well-constructed, planned, and come with land registration certificates. Residents in these areas benefit from better access to services such as electricity, water, and paved roads. Most of the people living here are newcomers from other urban centres in Ethiopia, including Addis Ababa and Harar. Both men and women in these better-served areas generate income through salaried employment and business activities.

In contrast, other areas of Koticha are characterised by illegally constructed, unplanned houses without land registration certificates. These homes have limited access to electricity and water, and many are affected by annual flooding during the rainy season from July to September. The majority of residents in this part of Koticha work in factories, with some also engaging in farming, small businesses, and selling local produce. Women often generate income by selling locally brewed alcohol, injera, and other small-scale goods, while men also participate in farming and various other activities. Many people in these areas rely on water supplied by nearby industries. Additionally, due to the availability of land in Koticha, the government has constructed an IDP site for displaced Oromo people affected by border conflicts with the Somali Region as well as a low-cost housing site for vulnerable people selected from across Dukem town.

The peri-urban area of Koticha kebele is low-lying, and houses that are poorly constructed – mainly made of mud and wood – are particularly vulnerable to flooding (Figure 7). Water scarcity is a significant issue in Koticha. While a few households have private water connections, the majority of residents rely on communal water points provided by nearby factories (Figure 8). Others purchase water from private vendors. The lack of land certification is a major barrier preventing many residents from being connected to the town's formal water system.

Figure 7: Illegally constructed housing with no land registration certificate results in limited connectivity to the water system, Koticha peri-urban kebele, Dukem town, Ethiopia.



Figure 8: Water collection from water points provided by industries for the community freely in Koticha kebele (peri-urban), Dukem town, Ethiopia.



3.2.3 Rural sites

The rural kebeles of Akaki woreda are predominantly agricultural, with men also involved in sand excavation and women selling local produce. Despite their proximity to the capital, the areas lack access to basic services such as electricity, piped water, and clinics. Although many communal water taps have been constructed, they remain non-functional in some areas, such as Bilbilo. As a result, many residents rely on unsafe stagnant pond water for domestic use (Figure 9). The absence of road access to nearby towns hampers the transportation of agricultural goods to market, limiting farmers' economic opportunities. Additionally, land scarcity creates further challenges, particularly for young people unable to find formal employment after completing their education.

Flooding poses a significant threat to farmers, causing economic losses by washing away seedlings and early-stage crops, especially in areas like Dewera Tino and other kebeles. Some kebeles are also exposed to pollution from Addis Ababa's residential, municipal, and industrial waste, which flows into the Akaki River.

Farmers in Gelan Arabsa are affected by residential waste, including toilet waste from nearby condominiums in Addis Ababa, contaminating water used for irrigation – an example of weak rural-urban connections. Similarly, farmers in Dewera Tino and other nearby kebeles suffer from waste discharged by factories and face hazardous flooding from the Akaki River during the rainy seasons and unexpected downpours.

For many years, rural communities along the Akaki River used its water for domestic purposes, but pollution has led to a decline in this practice. However, during extreme water shortages in the dry season, some areas, such as Bilbilo, still resort to using river water for household needs. The river remains a primary source for livestock and irrigation. Due to the lack of safe water in these rural kebeles, residents, especially women and girls, spend considerable time collecting water – often between 6 to 12 hours per day during the dry season – although the time varies by geography and season. Vulnerable groups, such as the poor, elderly, disabled, and weak, face heightened water insecurity across all study sites.

Figure 9: Man filling jerrycans from a pond in Abu Achiro kebele (rural), Akaki woreda, Ethiopia.



3.3 Kenya

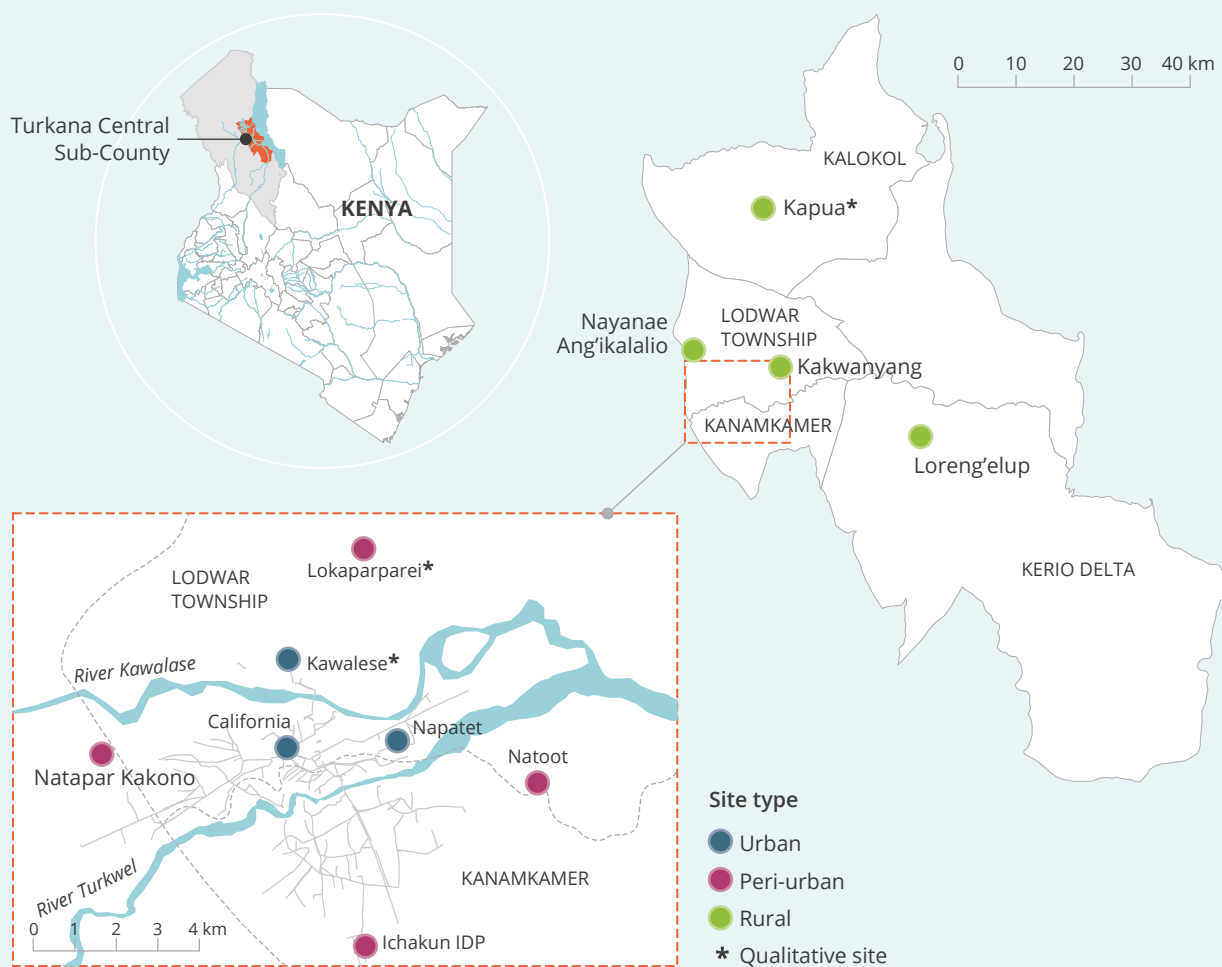
In Kenya, the study was conducted in Turkana Central subcounty of Turkana County in the country's northwest. Turkana County is the second largest of 47 counties, occupying 11.7 percent of the country's land area and only 1.9 percent (927,000 as of 2019) of the total population (47.5 million as of 2019) ([KNBS, 2019a](#)). It is a part of Arid and Semi-arid Lands (ASALs), inhabited largely by nomadic pastoralists; however, in urban areas people employ predominantly sedentary lifestyle. It is the poorest county in Kenya, with an overall poverty rate of 77.7 percent compared to the national rate of 38.6 percent ([KNBS, 2023](#)). One-third of the county's population (35.7 percent) depends on surface water for drinking ([KNBS, 2019b](#)).

Lodwar, the largest town and headquarters of Turkana County, lies between two rivers and is surrounded by black volcanic hills. The Turkwel River, the only perennial river in the county, supplies the town's 83,000 residents through a borehole-fed piped water network, although the supply is often unreliable and unevenly distributed ([Maxwell et al., 2020](#)). The Kawalase River, a seasonal watercourse, is notorious for dangerous flash floods ([Korzenevica et al., 2024](#)), driven by the Turkana Jet ([Munday et al., 2020](#)). The Lodwar Water and Sanitation Company (LOWASCO), rebranded as Turkana Urban Water Company in 2024, has managed the town's water supply since 2007, relying on groundwater from the Lodwar Alluvial Aquifer system. However, this aquifer, recharged by the Turkwel River and local rainfall, is vulnerable to upstream water regulation, droughts, and contamination due to the lack of proper sewage and waste disposal systems. As of 2019, LOWASCO's network covered only 58 percent of the population, with many residents depending on alternative sources like kiosks, neighbours, or wells ([Wanguba et al., 2024](#)). Despite sufficient water from boreholes, distribution remains a challenge, reflecting significant spatial disparities in water access across the town.

Selection of study sites were informed by the extensive contextual knowledge gained through long-term research conducted by the REACH Programme and scoping visits by the team to ten sites in March 2023. During the visits, they engaged with key informants such as area elders, school head teachers, water user association leaders, and community representatives and discussed the socio-economic and environmental challenges faced by residents. Following the visits, the sites were finalised considering their water insecurity risks, road access and safety, population size, proximity to urban centres, and climate vulnerabilities (Figure 10). The urban sites selected are California, Napatet, and Kawalase, while the peri-urban sites are Lokaparparei, Ichakun IDP, Natapar Kakono, and Natoot, all clustered within an area of approximately 80 km² in and around Lodwar. Among the rural sites, Nayanae Ang'ikalalio and Kakwanyang are located 8-10 km northwest and northeast of Lodwar town, respectively. The other rural sites, Loreng'elup and Kapua, are situated about 35-40 km to the north and southeast of Lodwar town.

Livelihoods across the study sites are primarily informal, including sporadic urban jobs, farming, small-scale pastoralism and small-scale trade, including charcoal, firewood sales, and casual labour. Economic opportunities are limited, and most communities face high unemployment and seasonal migration. Climate shocks, including recurrent droughts and extreme heat, impact all locations, with flash floods also affecting some areas. Housing varies from mud and grass-thatched structures to cement and brick homes, with urban centres having more permanent structures. Socio-economic vulnerabilities include hunger, malnutrition, and poor sanitation, particularly in low-income peri-urban settlements.

Figure 10: Map of Turkana Central subcounty, Turkana county in northwest Kenya, showing locations of the households surveyed by site type.



3.3.1 Urban sites

Located centrally within Lodwar Township, most households in California have metered piped water connections from LOWASCO (Figure 11), with some relying on community handpumps and LOWASCO boreholes. Among the commonly used alternative sources are the KAG handpump, the Showground Borehole and Moi Gardens Borehole.

Napetet (approximately 3,500 households), located within Lodwar Township, is a densely populated and well-connected area, where residents typically engage in informal or opportunistic work within the town. However, its proximity to the River Kawalase makes it highly vulnerable to seasonal flash floods and the gradual encroachment of river channels, which have repeatedly caused significant damage to lives and property ([Korzenevica et al., 2024](#)). Fewer than half of the households in Napetet have access to piped water; the rest rely on three handpumps, each charging KES 10 per jerrycan. In Kawalase (about 700 households), residents mainly use the Kawalase River (1 km on average) and boda boda (motorbikes) water delivery services (KES 10 per jerrycan), although river water is often of poor quality, with complaints about smell and taste.

Figure 11: A metered connection from LOWASCO's piped water network in Lodwar town.



3.3.2 Peri-urban sites

In Ichakun IDP (200 households), located in Kanamkamer Ward, most residents rely on LOWASCO water kiosks, paying KES 5–10 per jerrycan using ATM cards. Some households also access piped water from a neighbour's borehole (Napiu tap), at a cost of KES 10 per jerrycan.

Lokaparparae (150 households) is a sparsely populated settlement of migrants, situated far from town and income opportunities, with no electricity, limited access to safe water, and poor-quality schools. Commonly referred to as a 'location of victims', it is home to flood-displaced migrants, as well as those who cannot afford to live in central Lodwar or have fled ethnic violence or poverty from other parts of Turkana ([Korzenevica et al., 2024](#)).

Residents rely on two water tanks – one provided by a private vendor charging KES 30 per jerrycan, and the other by the county government free of charge, though supply is unreliable. In times of shortage, people resort to using water from the Kawalase River, despite its poor quality.

In Natoot (with over 150 households), residents access free water from the borehole at Natoot FGC Primary School (0.6 km away) and a Napuu aquifer tap. Similarly, in Natapar Kakono (2,100 households), the main sources include two handpumps and two boreholes. However, due to concerns over water quality, many opt to collect water from the Kawalase River (1 km away) or purchase vended water from LOWASCO at KES 5 per jerrycan, plus transport costs. Monthly fees for borehole use range from KES 50–100, but poor water quality discourages its use for drinking.

3.3.3 Rural sites

Rural communities in Kakwanyang (700 households), Nayanae Ang'ikalalio (281 households), Loreng'elup (698 households), and Kapua (1,872 households) experience extreme water scarcity, despite the presence of multiple boreholes, rivers, and wells. In Kakwanyang, 80 percent of households rely on the Kakwanyang borehole, located 3.4 km away, paying KES 100 per month for access. Some also use Monti Laga River (0.5–1 km) and Turkwell River (2–3 km) for domestic use. There are two public taps (Lokitoliwo water tap and Kakwanyang Primary tap), but coverage remains limited.

In Nayanae Ang'ikalalio, water sources include boreholes and handpumps such as Eperech Windmill, Eperech handpump, Nabei borehole, and Kainyangalem handpump, which charges KES 200 per month. Additionally, Nayanae Ang'ikalalio and Kawalase rivers are used, though they are not always safe for drinking. Migration to Loima, Pelekech, Oropoi, Kokuro, Song'ot, and Kaikor in search of pasture and water is common, often requiring grazing permits costing KES 3,000, which sometimes leads to conflicts over scarce resources.

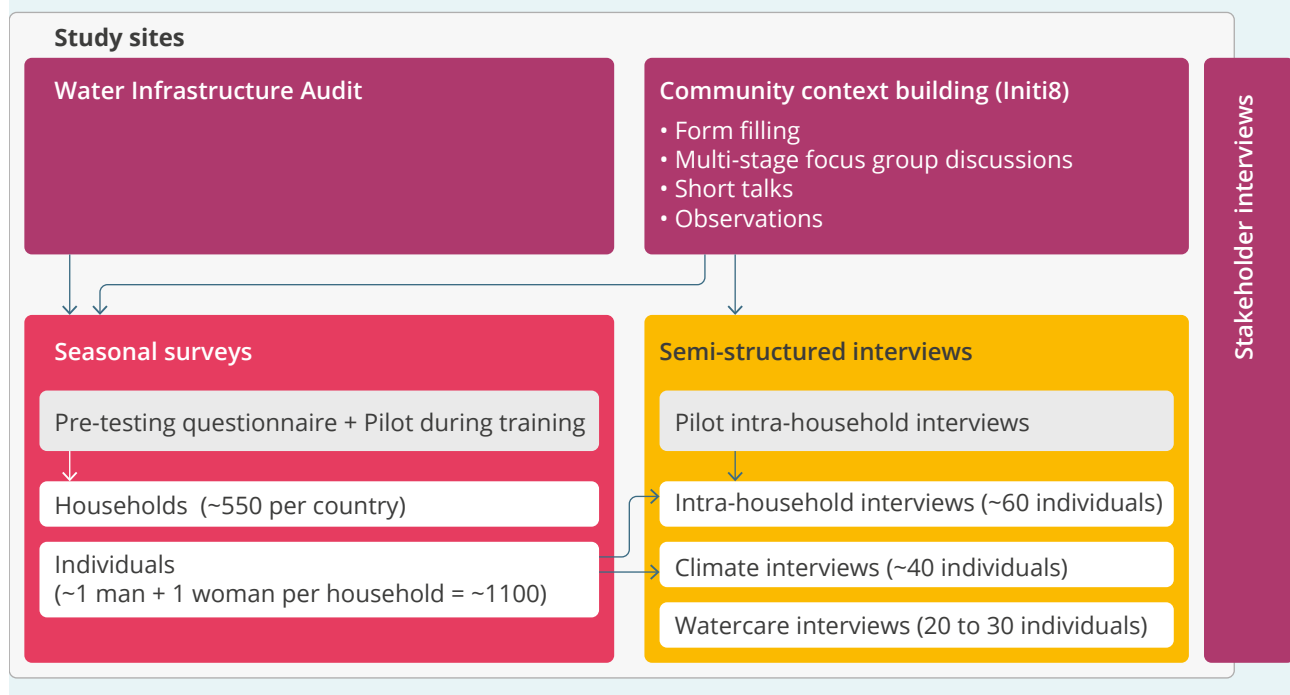
In Loreng'elup, residents depend on three wind-powered boreholes – Kaikol Water Point (0.5 km), Kang'ichok Borehole (1.8 km), and Naang'orchoto Borehole (3.5 km). Two of these boreholes charge a fixed fee of KES 100 per month, but many households also fetch water from Kaekile and Loreng'elup Rivers.

In Kapua, the population lives in clustered villages, with transhumance being a common practice, often leaving women and children at home while men migrate with the herds. The area faces significant challenges, including a lack of adequate social amenities, limited schools with low attendance, the absence of a hospital (with only a local dispensary providing services), few and sparsely distributed water sources, and poor food diversification, all of which contribute to high poverty levels in Kapua. Two-thirds of households use Kapua River (north, 2.5 km) and Kosiya River (south, 1.9 km) or Nakepokan well (on Kosiya River). One-fourth of households depend on two boreholes (Nabiun and Nasurut) and the Nakepookan handpump, all of which are free. However, salinity is a major problem, leading to kidney-related health complications such as kidney stones.

4. Methodological design

The methodology (Figure 12) and the individual tools were developed based on three principles. Firstly, international collaboration across the consortium integrated interdisciplinary knowledge and methods with diverse experiences to develop methods that would enable comparison of drivers and barriers to, and experiences of, water insecurity across diverse contexts. The consortium engaged in the development and review of the tools across multiple methods. The design and timing of implementation employed a mixed methods approach, integrating findings and data between methods to inform development and refinement. This integration was continued in analysis as described in later sections. Secondly, early careers researchers were supported to develop their own research topics within the structure, to have clear research leadership opportunities. Finally, the development was embedded in stakeholder engagement activities to support policy relevance and uptake of findings. This included meetings as part of REACH stakeholder engagement activities, as well as three dedicated webinars with invited national level stakeholders focusing on gender issues. These included presentation of REACH gender research in country to date to engage stakeholders in existing evidence, followed by presentation and discussion of the WISER methodology. Community level engagement is described further below.

Figure 12: WISER research methods administered at community, household and individual scales.



This section provides an overview of the tools developed, and details of how they were implemented, including sampling frameworks.

4.1 Water infrastructure audit

A water infrastructure audit was conducted in each of the study sites before commencing the household surveys. The detailed information in the audit could then be matched with the responses regarding water sources used by surveyed households. The water audit questionnaire, programmed in SurveyCTO, captured details on the location, technical specifications, ownership, funding, management responsibilities, and usage patterns of the water source. All public or community sources and commonly used private sources were included in the audit, regardless of whether they were used for drinking or not (Figure 13). The list of these sources was then included as choices for Modules 8 and 9 of the household questionnaires.

Enumerators, many of whom were local, relied on their contextual knowledge and the snowball method to identify relevant waterpoints. This process included engaging with community gatekeepers, consulting people in marketplaces, and using information from owners or users of one waterpoint to locate others nearby. In Lodwar, data from previous audits conducted under the REACH Programme provided a baseline for the work. In Ethiopia, the enumerators were supported by a local guide and kebele administrators. The questionnaire was answered by the individual waterpoint owners, managers or users, depending on availability.

While the water audits were planned to capture all commonly used sources in the study sites, data from the wave 1 household surveys in Bangladesh and Kenya showed that many of the sources commonly reported by respondents were not captured. This may indicate the very localised knowledge needed, that even relatively local enumerators aren't aware of water sources beyond their locale. These additional sources were listed and audited in a second phase to ensure that a complete dataset was available prior to subsequent survey waves. The resulting dataset comprised 622 waterpoints in Bangladesh, 82 in Kenya and 138 in Ethiopia (of which 64 were linked to the household survey) (Table 2). Linking household survey responses to individual waterpoints enabled identification of commonly used sources, seasonal shifts in source use, and spatial analysis of household choices relative to the sources used (Figure 14).

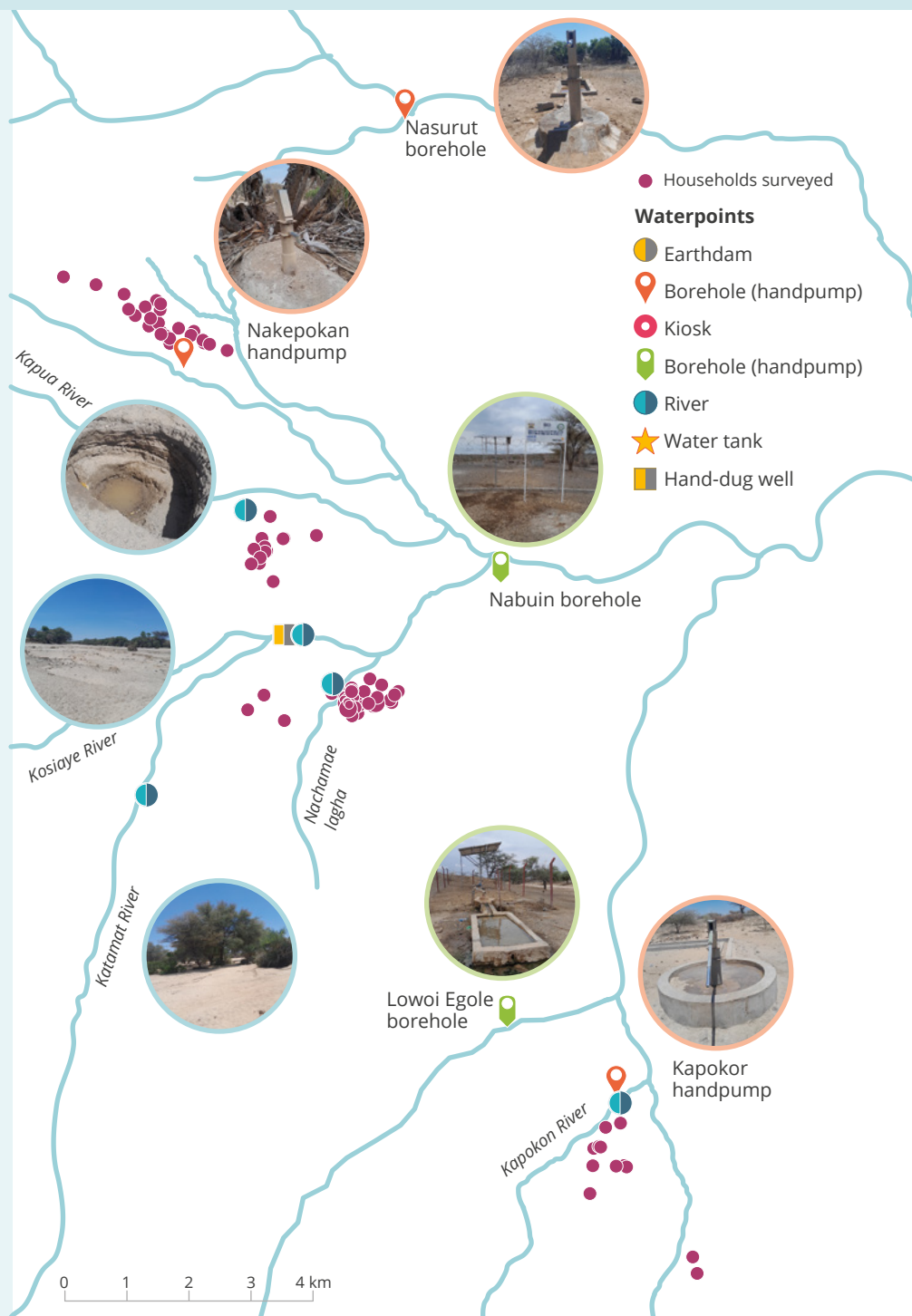
Table 2: Types and numbers of water sources audited in the three study countries.

BANGLADESH Phase 1 (n=286) 18 to 23 December 2022 Phase 2 (n=339) 12 to 20 April 2023		ETHIOPIA (n=138) 24 to 28 November, 12 to 15 December 2022		KENYA Phase 1 (n=41) 20 March to 23 April 2023 Phase 2 (n=41) 21 to 24 August 2023	
Deep tubewell (Handpump)	182	Public tap from a piped scheme	62	Borehole with handpump	21
Shallow tubewell (Handpump)	127	Borehole or dug well with handpump	8	Borehole with motorised pump	26
Motorised borehole	82	Natural spring	7	Kiosk	10
Public tap from a piped scheme	27	Surface water	59	Public tap from a piped scheme	6
Pond Sand Filter	3	Water tank	2	Earthdam (unequipped)	2
Reverse Osmosis (RO)	4			River	11
Rainwater harvesting System	23			Unprotected hand dug well	3
Surface Water	174			Water tank	3
Total	622	Total	138	Total	82

Figure 13: One of the handpumps at a water source included in the audit in Bangladesh



Figure 14: Map of Kapua (rural site) in Kenya showing the locations of households surveyed and the water sources identified in the water infrastructure audit.



4.2 Community context building – INITI8

Recognising the absence of early-stage exploratory methodologies for building contextual knowledge, INITI8 was developed as a structured research approach in Bangladesh, Ethiopia, and Kenya ([Korzenevica et al., 2025](#)). Researchers from these countries, in collaboration with UK-based partners, refined the methodology through iterative testing from late 2022 to May 2023. The primary objective was to gather local contextual knowledge to inform subsequent methods, gain insights into community challenges related to water access and governance, and examine power dynamics influencing water resource management. The INITI8 method builds upon Community-Based Participatory Observation (CBPO) ([Roque et al., 2024](#)), where community members provide field notes and insights, further enhanced through structured multi-step focus group discussions (FGDs) to facilitate systematic context-building. The method integrates principles of feminist, decolonial, and slow scholarships.

The INITI8 method consists of eight key steps, structured to maintain consistency while allowing for flexibility according to community availability. Prior to implementation, researchers agreed on the tools, schedule, and questionnaire. The initial piloting of INITI8 in Ethiopia led to two key adjustments. Firstly, literacy challenges emerged as a barrier, necessitating a revised approach where participants were encouraged to seek assistance from same-gender community members. Women, for instance, often enlisted their daughters for support. Secondly, the original questionnaire, which contained multiple simple questions, produced vague responses. To address this, a revised version featured one broad question per topic, enabling participants to elaborate on relevant aspects based on their lived experiences.

Step 1: Identifying and training participant leaders

Leaders were identified as individuals who had lived in the community for at least ten years, possessed extensive knowledge of the area, held some authority within the community, and had a high level of literacy. These leaders played a crucial role in guiding the research process within their communities and were trained in the INITI8 methodology. Their insights were vital in supporting subsequent steps.

Step 2: Selecting participants

Researchers and participant leaders (separately for men and women) selected participants, aiming for individuals knowledgeable about the community and, where possible, literate. Participant selection followed three key guidelines: (1) a balanced 50/50 gender split for gender-separated FGDs, (2) participants with substantial community knowledge, and (3) literate individuals where possible. This process was collaborative, incorporating informal discussions within the community.

Step 3: Community mapping

At this stage, participants and leaders collaborated to create a community map, identifying geographical features, services, and challenges (Figure 15). This exercise provided an opportunity to discuss socio-geographical marginalisation and other vulnerabilities within the community. Participants valued this process, as it enabled them to reflect on issues that were often overlooked due to time constraints. The mapping exercise also served as a foundation for FGDs, helping participants structure their thoughts and develop relevant insights based on grassroots realities.

Figure 15: Woman drawing a community map in Ward 21 (urban site), Khulna district, Bangladesh.



Step 4: Participant training and completion of take-home survey forms

Participants were trained in completing take-home survey forms, which initiated the next step of the methodology. They were given several days to a week to complete these forms and were encouraged to seek support from same-gender community members if literacy posed a challenge. Participant leaders and researchers also provided assistance, including transcribing dictated responses when necessary. In total, 21 completed forms were received across qualitative sites in Bangladesh, 30 in Ethiopia and 41 in Kenya.

Step 5: Reviewing the forms

Completed survey forms were collected and analysed, with the pre-prepared FGD schedule modified accordingly. Adjustments included: (1) further exploration of questions that had been insufficiently answered, (2) follow-up on intriguing topics that had emerged, and (3) the removal of questions that were deemed irrelevant to the local context.

Step 6: Group discussions

Participants engaged in gender-separated FGDs, where discussions focused on refining survey responses and further exploring significant topics. The sessions began with the key questions: What questions did you find most interesting? Which did you consider unimportant? This ensured that discussions aligned with community interests. Survey questions that lacked contextual relevance were omitted from these discussions. A total of six FGDs were held in Bangladesh, nine in Ethiopia and 11 in Kenya.

Step 7: Individual engagement with marginalised groups

Steps 3 to 6 were repeated on a one-to-one basis with marginalised community members identified during the earlier mapping phase and FGDs. Since group dynamics were not feasible in these cases, the discussions took the form of semi-structured interviews. However, the principles of multi-step engagement and open-topic discussions were maintained.

Step 8: Data analysis

Survey forms and FGD recordings were translated, transcribed, coded, and analysed to extract meaningful insights.

Each research team adapted the INITI8 approach to align with local needs:

- **Kenya:** INITI8 leaders were typically village heads or local administrators, as this respected community hierarchies. Some leaders opted out due to literacy concerns, requiring researchers to identify alternative facilitators. Forms were translated into Swahili and Ng'aturukana, with participants preferring Swahili for FGDs. Marginalisation was found to be situational, with newcomers facing social exclusion and limited access to resources due to unfamiliarity with established networks.
- **Ethiopia:** INITI8 leaders were initially schoolteachers, but in some areas, community elders were preferred due to their deeper local knowledge. FGDs were initially mixed-gender, but this led to lower female participation. Consequently, separate FGDs were introduced to encourage more inclusive discussions. Literacy support was provided through family members, ensuring all participants could engage effectively.
- **Bangladesh:** INITI8 was first conducted in Ward 21 (Greenland Abashon), where high NGO engagement facilitated participant selection. The approach was later adapted to peri-urban and rural areas, where community mobilisation was more challenging. Participants were encouraged to seek assistance from literate family members, and additional guidance was provided to INITI8 leaders unfamiliar with water governance issues. The advance distribution of survey forms led to more in-depth discussions during FGDs.

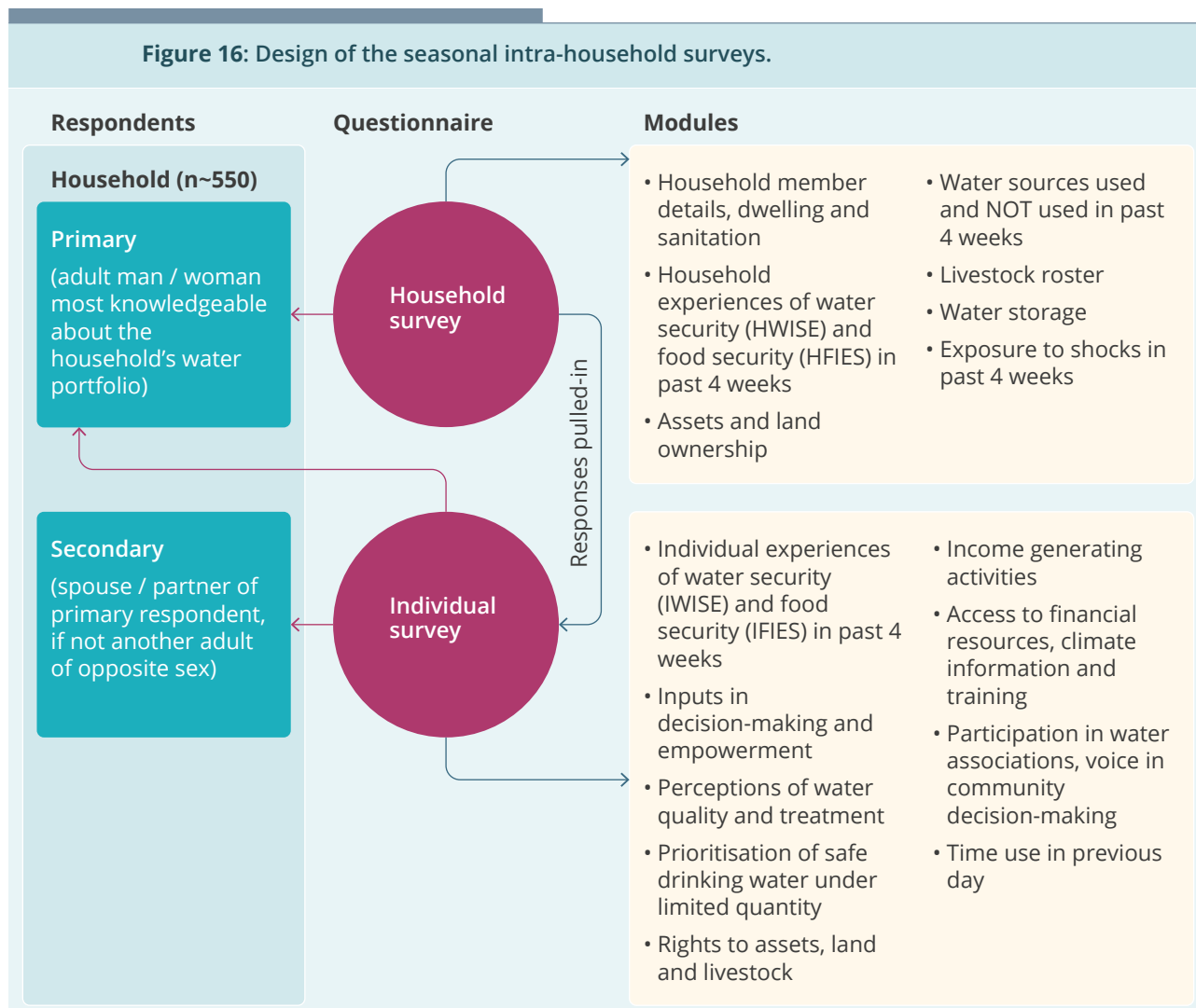
4.3 Seasonal intra-household survey

The survey methodology was designed to capture seasonal variations in water insecurities, equity and resilience at household and intra-household levels across urban, peri-urban and rural areas in each of the study countries. Standardised survey questions were used where appropriate to increase comparability with studies internationally. This included integration of the Empowerment in WASH Index (EWI) (Dickin et al., 2021), Household and Individual Water InSecurity Experiences (HWISE and IWISE) scales (Young et al., 2019), Washington Group Short Set disability questions (WGSS) (Amilon et al., 2021), and the Food Insecurity Experience Scale (FIES) (Ballard et al., 2013). The scales are described in more detail in the Quantitative metrics in Section 5.2. A 4-week recall period was used to capture experiences relevant to the season, for comparison between 2 to 3 waves of data collection in different seasons as outlined in the sampling strategy.

4.3.1 Survey tools

The survey was composed of two parts – the household-level questionnaire and the individual questionnaire (Figure 16).

Figure 16: Design of the seasonal intra-household surveys.



Within each household, a primary respondent was identified – an individual who was 18 years or older and was well informed about the household's assets and the water collection activities (such as where to get water, who collects the water, how much is collected) of all household members, and makes decisions about the household's water portfolio, including the choice of water sources. The primary respondent provided the information needed for the household-level questionnaire and was one of the two respondents who answered the individual questionnaire. The second respondent who completed the individual questionnaire (referred to as the 'secondary respondent') was the spouse or partner of the primary respondent. If the primary respondent did not have a spouse or partner, another adult of the opposite sex was interviewed. In some households, there was no secondary respondent, and the household was included as a single-headed household.

The household-level and individual questionnaires were slightly modified for each survey wave, such that questions without seasonal implications were only asked in wave 1. The household questionnaire comprised 14 modules in wave 1, reduced to 10 modules in subsequent waves. The individual survey questionnaire comprised 24 modules in wave 1, of which 16 and 12 modules were retained in waves 2 and 3.

Household survey

Following introduction and consent in **Module 1**, **Module 2** of the questionnaire records the household members' profiles, including their names, relationship with primary respondent, sex, age and educational attainment. **Module 3** captures data on dwelling and sanitation, including housing structures, number of rooms, type and location of toilets and handwashing facilities.

Module 4 captures the household's subjective experiences of water insecurities in the past 4 weeks, using the 12-item Household Water Insecurity Experiences (HWISE) scale to quantify the household's subjective experiences of water-related problems, with each item being scored on a 4-point Likert scale indicating the frequency at which the problem has been experienced in the past four weeks. These items include aspects of psychosocial distress such as worry, anger and shame, challenges due to limited quantity for washing body, clothes, and hands, measures of unreliability such as need to change plans and interruption of main source, and questions on extreme scarcity such as no water at all, going to sleep thirsty, and not having enough to drink. In addition to these standard 12 items, we added four more items to measure affordability – inability to pay for a desired source, access as much quantity as desired, sacrifice other essential and non-essential items.

Module 5 uses the 8-item Food Insecurity Experience Scale (FIES), developed by the Food and Agricultural Organisation (FAO), to capture the household experience of food insecurity. It focuses on self-reported food-related behaviours and experiences. The questions reflect increasing difficulties in accessing food due to resource constraints in the past four weeks, starting from being worried about not having enough food to not eating an entire day, with Yes or No as responses.

Modules 6 – 9 capture the household's water portfolio, which consists of the multiple sources of water that the household has access to for domestic and productive uses and the factors that influence which sources are used. These include the household's water-related assets (**Module 6**), such as stoves and filters that can be used for boiling or treat the water, modes of transportation that can reduce the time and alleviate the physical burden of carrying water, and tanks and pumps that help to draw and store water easily. The household's ownership and access to land (**Module 7**) can greatly affect their water choices ([Hillesland and Doss, 2024](#)), with water sources on or adjacent to dwelling, for example, allowing the household to use more water without spending time in collection.

Finally, the water supply infrastructure in the community, whether publicly or privately owned, shapes the household's choice set. To better understand household source choices and outcomes, the questionnaire asked about the water sources used by the household in the past four weeks (**Module 8**), as well as those listed in its land roster (**Module 6**) and water infrastructure audit but not used by the household (**Module 9**). For each of the sources mentioned in Modules 8 and 9, further details were collected on the location, technology type, availability, use, perception of quality, costs, likelihood of conflict, collection route, frequency and time, and person(s) involved in collection.

Module 10 is about the livestock and poultry owned by the household, either exclusively or jointly, and their numbers. It includes information on which household members are responsible for grazing and watering the animals. **Module 11** asks about the water storage practices, to identify the type of containers, duration, and amount of drinking water stored the household. **Module 12** focuses on shocks experienced by the household in the past four weeks, where a shock is defined as “an event that led to a serious reduction in asset holdings, caused the household income to fall substantially or resulted in a significant reduction in consumption”. This is followed by **Module 13** collecting data on disabilities affecting each of the household members listed in Module 2 using WGSS. These include difficulties in vision, hearing, speech, communication, mobility, and cognition. Finally, the survey concludes with **Module 14** recording the respondent's contact details, photo of the house, and GPS coordinates.

Of these, Modules 3 (Dwelling and sanitation), Module 6 (Assets), Module 13 (Disability) and Module 14 (Contact details) were excluded in waves 2 and 3.

Individual survey

The individual survey was administered to both the primary respondent and the additional respondent. It starts off with key aspects of the respondent's identity (**Module 1**), including education, religion, language and ethnicity. **Module 2** then collects data regarding the respondent's involvement in water collection activities in the past 4 weeks and their concerns regarding incidences of harassment or violence during water collection, for themselves and their family members. The survey then moves on to the individual respondent's experiences of water (IWSE) (**Module 4**) and food insecurities (IFIES) (**Module 5**) using the same 12-item and 8-item scales as the household survey, respectively, based on 4-week recall.

Module 6 collects information on individual's roles in decision-making within the household related to the Empowerment in WASH Index, regarding choice of water source, water collection responsibilities, water-related expenditures, allocation of water for different uses, water treatment, sanitation expenditures, toilet cleaning, and purchase of assets, as well their roles in community water planning activities. Structured as nine sub-sections, each of these topics follows the same pattern of questions. The respondent is first asked to identify the household members who make(s) the decision on each topic, selecting a maximum of three members. If the respondent indicates that he/she is the only decision-maker, the follow-up questions were skipped. If there are multiple decision-makers, the next question addresses level of input of the respondent, from input in a few decisions to input into most or all decisions. Depending on their response, the following question asks if the respondent would like to have more or less say in the decision-making process.

Module 7 continues about the individual's roles in decision-making but focuses on consequences of participation and backlash if their decisions are different from other members. This module is divided into two sub-sections relating to empowerment – one on large household purchases and the second on decisions to use own earnings.

Module 8 identifies the individual's preferences in terms of allocation of water for different uses given quantity constraints, ranking top three source choices given the availability restrictions during that season, and the top three criteria determining source choice for drinking. This then leads to **Module 9** on perceptions of the safety of drinking water used over the past 4 weeks, including perceived impacts on the health of the respondent and other household members. **Module 10** focuses on how the needs of individual household members and livestock are prioritised when adequate quantities of good quality drinking water are unavailable.

Module 11 draws on the list of water-related assets owned by the household, as recorded in Module 5 of the household survey. For each asset, the enumerator asks three key questions: whether the asset is used for farming, livestock, or business activities by the respondent; whether the respondent owns the asset exclusively or jointly; and how many of that asset type the respondent owns.

Module 12 focuses on the respondent's rights concerning land, water, and agriculture. It collects data on decision-making for harvests, formal land ownership, and water access. The module addresses each plot of land and associated water sources individually, linking back to the household's land roster listed in Module 6 of the household survey. Key questions cover who decides what crops to grow, how the harvest is managed, and who handles the sale and use of earnings from agricultural products. It also explores land rights, including ownership, the ability to sell or bequeath land, and whether the respondent's name appears on legal documents. For water rights, the module asks about usage rights, purposes of water use, access during scarcity, and the ability to regulate or improve water infrastructure. Responses include details on whether these decisions are made alone or jointly, and who else is involved, with up to three IDs provided for those who share these responsibilities.

Module 13 focuses on livestock assets owned by the household at the time of the survey, linked to Module 10 of the household survey. It covers ownership, management, care, and financial decisions related to each type of livestock. After confirming ownership, the module explores who makes decisions about selling livestock, managing health treatments, and handling daily care, including feeding and watering. It also examines decisions about selling livestock products and the use of earnings. For each question, respondents can provide up to three IDs for those involved, whether household or non-household members, with attention to specifying the gender of non-household members. The module systematically addresses all aspects of livestock management and economic decisions to capture a comprehensive picture of the household's involvement with their livestock assets.

Module 14 examines the respondent's wage employment, self-employment, and non-agricultural income activities. It differentiates between wage employment – where payment is fixed and not directly tied to the employer's revenue – and self-employment, which encompasses various income-generating activities, including small businesses and agricultural work intended for sale. The module begins by asking if the respondent engaged in wage employment in the last 12 months, followed by details of the types of work, how the respondent was remunerated, and how they became aware of the employment opportunity.

For self-employment, questions explore the nature of the business, whether it was run jointly, the respondent's share, and contributions to family labour. The questionnaire also addresses unpaid work in family businesses, the type of employment (e.g., seasonal, fixed-term, or permanent), and work hours. Additionally, it investigates the industry sector, location of work, and the use of water resources in business activities. This includes identifying water sources, who makes decisions about water use, and who collects it.

Module 15 focuses on the respondent's access to financial resources, particularly in relation to water services. It first inquires whether the respondent could obtain a loan if needed and the potential sources of such a loan (e.g., banks, NGOs, informal lenders, or relatives). It then asks if the respondent has taken a loan in the past 12 months and from which source. The section also explores whether any loan was used for water or sanitation services or to recover from floods or droughts.

Module 16 explores whether the respondent has travelled to a market in the past four weeks and the location of these markets. It then gathers details on the frequency of visits to a specific market, the mode of transportation used, and the travel time in minutes. Additionally, it inquires whether the respondent drinks water during these trips and if the water consumed is sealed bottled water.

Module 17 focuses on the respondent's involvement in community groups, both formal and informal. It asks about the presence of various types of groups in the community, including water associations, credit and savings groups, agricultural or trade groups, flood rescue teams, neighbourhood committees, and women's groups. The module then gathers details about the specific groups the respondent is involved in, including the type of group, and whether the respondent feels they can influence decisions within these groups.

Module 18 focuses on the respondent's access to WASH information and whether they shared it with others. It asks about the types of information received in the past 12 months, including topics like safe water practices, sanitation, citizen rights regarding water, duties of local water service providers, and how to file complaints. If the respondent received information on any of these topics, further questions are asked about the source of the information (e.g., radio, friends, NGOs) and whether the respondent shared this information with other household members.

Module 19 examines the respondent's access to climate information in the past 4 weeks. The first sub-section focuses on official weather forecasts, such as seasonal or monthly updates from the meteorological department or county government. The second enquires about alerts or warnings related to extreme rainfall or flooding. The third section explores the use of traditional weather forecasting methods. For each of these topics, further questions are asked to identify the sources of this information, whether the respondent shared it with others, and whether it influenced any decisions.

Module 20 on participation and voice evaluates the respondent's comfort level in addressing water or sanitation issues within their community, particularly in public forums or directly with leaders and service providers. Questions explore the respondent's ease in speaking up during the implementation of water and sanitation projects, such as deciding on the type, price, or location of new services. It also asks about their comfort in publicly complaining or raising concerns about issues like service breakdowns or inadequate service, either in community meetings or directly to leaders. Additionally, it examines the respondent's willingness to join others in collective actions like petitions or demonstrations to address water service problems.

Module 21 investigates social norms related to family and community expectations, without focusing on the respondent's personal experiences. It seeks to understand the respondent's views on issues like whether men should be responsible for fixing broken water points. The questions are designed to capture immediate, instinctual responses with quick yes/no answers, aiming to gauge the respondent's perception of common social norms in their community.

Module 22 collects detailed information on how respondents spent their time in the past 24 hours, focusing on gender differences in daily activities. The enumerator guides the respondent through a detailed time diary, starting from when they woke up yesterday to when they went to bed. The aim is to capture every activity, including paid and unpaid work, personal care, social activities, domestic tasks, childcare, leisure activities and particularly water-related tasks such as collection and management.

Activities are recorded in 15-minute intervals, with the enumerator rounding to the nearest quarter-hour. If the respondent engaged in water collection, additional questions ask about childcare responsibilities during this time. This process continues until all activities up to bedtime are recorded, providing a comprehensive view of daily time use.

Module 23 assesses the respondent's recent work levels and personal satisfaction. It begins by asking whether the respondent worked more, the same, or less than usual in the last 24 hours, considering both domestic and income-generating work. Following this, the respondent is asked to rate their satisfaction with the amount of personal time they have for activities they enjoy, using a scale from 1 (not satisfied) to 10 (very satisfied).

Finally, **Module 24** includes questions for the enumerator to ensure the integrity of the interview process. It asks if both respondents were interviewed simultaneously, if the household questionnaire was conducted with both present, whether the individual questionnaire was completed separately from the other respondent, and if anyone else was present during the individual interview. If someone else was present, the enumerator must specify who it was.

The individual survey questionnaire was significantly shortened for subsequent waves, with modules 1 (Education), 2 (Water collection), 7 (Water-related assets), 11 (Empowerment), 15 (Access to financial resources), 17 (Involvement in community groups), 18 (Access to WASH information), 20 (Participation and voice), and 21 (Social norms) being excluded and modules 6, 8, and 12 being shortened.

4.3.2 Programming the questionnaire in digital platform

Programming the household and individual survey tools in SurveyCTO was a complex task due to the length of the questionnaire, the need for multiple nested groups drawing data from parent groups, intricate skip and relevance logics, and the necessity of automating the process as much as possible to minimise human errors during data collection.

SurveyCTO was selected as the digital data collection platform after considering various factors, including subscription costs, the ability to manage different levels of access across team members, integration of data from separate forms submitted to the server, support for multiple languages, and its capability to incorporate complex logics within the questionnaire. Separate projects were created for each country, with the quantitative work package lead and the data manager having full access to all projects. Country quantitative team leads were granted editing permissions specific to their respective countries. Enumerators were only permitted to submit data, while relevant team members were given view-only access to monitor progress as required.

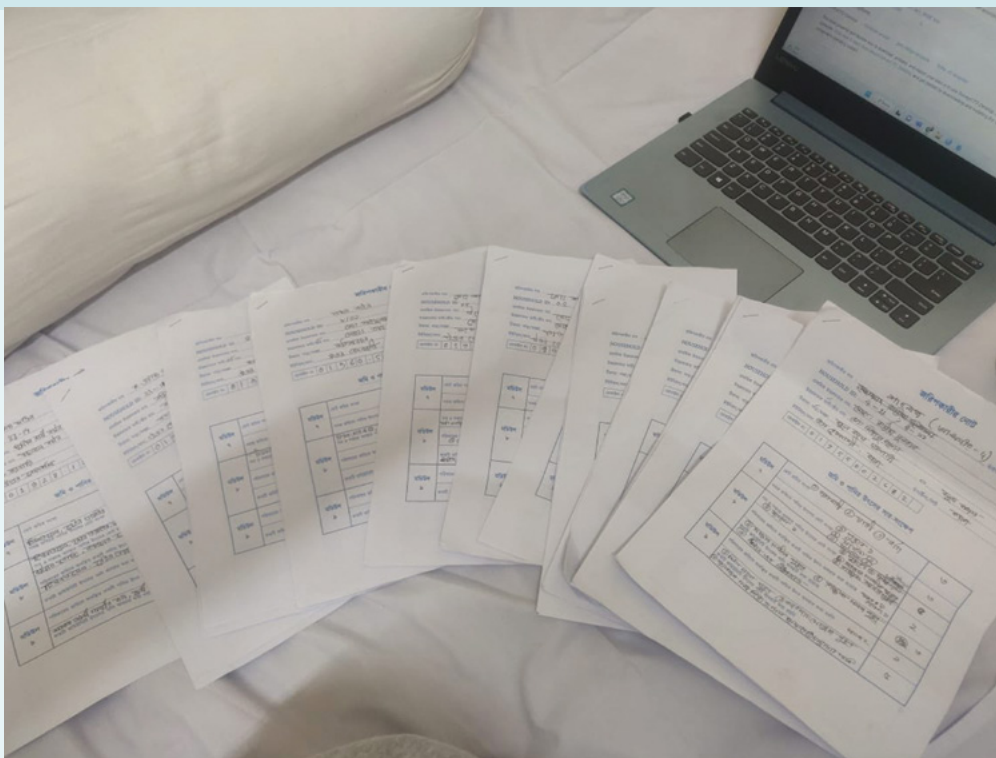
Errors in coding, identified during training and piloting, were communicated with the data manager and rectified on the same day. Where further errors were identified in the data cleaning they are outlined later in the document, with revisions being made between waves.

The questionnaires were designed to minimise enumerator entry errors as much as possible. Compared to paper-based methods, digital tools incorporate built-in constraints that restrict out-of-range responses. Additionally, the 'required' options ensure that enumerators cannot proceed to the next question without answering the previous one. However, in modules involving repeat groups, digital tools limit the ability of enumerators to visualise responses in a traditional table format, making it difficult to track responses, particularly in groups with a large number of questions (Modules 7-9). To reduce errors, summary notes were incorporated at the end of different sections in the digital form, and enumerators were provided with printed tables for specific questions, which could be cross-checked later (Figure 17).

In a proportion of households, the questionnaire coding was reviewed in subsequent waves to recheck data submitted in the first wave. This included clearly identifying the primary and secondary respondents, rechecking the list of household members to track additions or dropouts, and reviewing the list of land parcels and their water sources to capture changes that would affect response to subsequent questions.

All questionnaires were initially programmed in English and then translated into local languages – Amharic and Oromia in Ethiopia, Bangla in Bangladesh, and Swahili in Kenya, with on-the-spot verbal translation into Turkana where necessary.

Figure 17: Enumerator notes (in Bangla) being cross-checked with survey data for each household submitted to SurveyCTO.



4.3.3 Training and piloting

The training of enumerators and piloting of the questionnaires was led by the quantitative research leads in the respective countries prior to the first waves of the intra-household surveys, with shorter refresher trainings being conducted prior to subsequent waves with the same set of enumerators. In Bangladesh, the data collection was led by two male researchers from the Bangladesh University of Engineering and Technology (BUET) with a team of 32 enumerators (20 males and 12 females) of whom 12 were designated as field supervisors for each of the wards or villages within the study sites (Figure 18). In Kenya, the household and individual surveys were conducted by the consultancy firm Amrec with consultants leading a team of 25 enumerators (16 males and 9 females) (Figure 19). Researchers from the Universities of Oxford and Nairobi supervised the training and pilot process. The data collection in Ethiopia was led by a male researcher from the Water and Land Resource Centre (WLRC), 22 enumerators (18 males and 4 females) organised into four groups. Each group was assigned six kebeles, with all teams collaborating in two kebeles.

While the structure and duration of the training varied by country due to research needs and logistical constraints, the key focus areas remained consistent. The training began with an introduction to the project, outlining the objectives of WISER, the data collection timeline, study sites, survey structure, and team management. Enumerators were trained in research ethics, including informed consent, voluntary participation, data confidentiality, and appropriate enumerator behaviour. Each enumerator signed an agreement in line with REACH policies before being introduced to the SurveyCTO platform. They downloaded the SurveyCTO Collect app, configured user accounts, and were granted access to the questionnaire. Enumerators were trained on form navigation, built-in skips and constraints, repeat groups, and response types within SurveyCTO.

The survey plan was then introduced, detailing sample sizes, household recruitment, team organisation, and survey locations. This was followed by a detailed introduction to the survey questionnaires, with each module carefully explained using training materials and hands-on practice with the digital form. A training manual, originally developed for Ethiopia, was translated and adapted to support training in other countries, with key sections used to create presentation slides. Modules on land and water use (Modules 7-9) were supported by video and slide-based training materials prepared by the research team. Enumerators learned to categorise land parcels, identify water sources, and differentiate between source types. They were also trained on how to link water sources in Module 8 to prior land-use responses in Module 7 and external water audit data. Enumerators engaged in group exercises and mock surveys, using either tablets or smartphones to familiarise themselves with the process.

Following the training workshops, enumerators conducted pilot surveys in nearby areas that were not included in the main study. This served three key purposes: firstly, it provided enumerators with real-world experience in conducting surveys; secondly, it allowed for the piloting of questionnaires within the country-specific context, helping to refine response options and wording based on respondents' interpretations; and thirdly, it enabled the identification of technical challenges, such as programming issues, internet connectivity problems, and GPS-related difficulties.

Enumerators shared their experiences in feedback sessions, allowing for the discussion of challenges and best practices (Figure 20). Simultaneously, pilot data was checked by researchers to ensure accuracy and consistency. Following this, enumerators were debriefed on key findings and areas for improvement before proceeding with the main survey.

Although the original plan was to use tablets encrypted by the University of Oxford's IT team, this proved unfeasible. In Ethiopia, Amazon Fire tablets purchased and encrypted by IT were provided; however, it became apparent during the survey that these devices could not detect GPS without an internet connection – unlike other devices. As a result, enumerators used their personal phones for data collection.

Similarly, in Kenya and Bangladesh, although locally purchased tablets were available, enumerators preferred their own smartphones due to their portability, superior technical performance for running survey forms, and reliable internet access via mobile data. To avoid such logistical issues in future studies, higher-specification tablets with SIM capability would be required, though these would come at significantly higher cost.

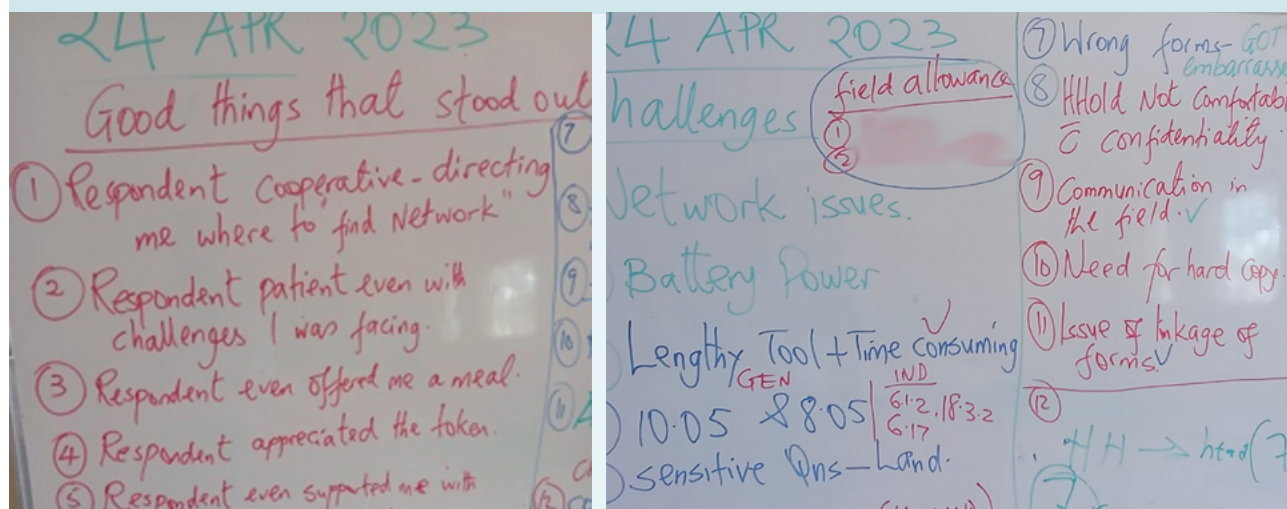
Figure 18: Enumerator training for Intra-household survey in Bangladesh (June, 2023).



Figure 19: Enumerator training for Intra-household survey in Kenya (April, 2023).



Figure 20: Feedback from enumerators after first day of piloting the survey in Lodwar, Kenya.



4.3.4 Sampling strategy

The household survey sample size was calculated to be 550 households per country, with an additional 10 percent included to account for potential dropouts in subsequent waves. Within each household, the individual questionnaire was administered to two adult respondents, preferably a man and a woman in a marital or equivalent relationship, resulting in a target of approximately 1,100 individuals per country.

Waves of data collection were timed to start in drier conditions to minimise transport disruptions, with subsequent waves timed to capture contrasting conditions in terms of weather, based on the assumption this would also capture differences in water security (Figure 21).

Figure 21: Timing and sample size of seasonal intra-household surveys in 2023.



This sample size was designed to support robust analysis of intra-household dynamics, including who makes decisions affecting water security at both household and individual levels. It was also sufficient to explore differences between sites and examine intersectional factors such as urban-rural residence, household wealth, size, and individual identity.

Households were defined as people living together and sharing basic resources such as food and water. Efforts were made to include multi-generational households to enable comparison across generations for specific research questions. Eligibility criteria required at least one competent adult (aged 18 or over) likely to be available across all survey waves (Figure 22). To ensure diversity while maintaining representativeness, households with only one adult were capped at 10 percent per site. This was particularly important in Kenya, where national data suggest such households comprise 21 percent, compared to 2 percent in Bangladesh and 7.5 percent in Ethiopia.

Households were selected using stratified random sampling, with areas classified as urban, peri-urban, or rural. Approximate sample sizes were allocated to each village or kebele (the lowest administrative tier). As no complete household lists were available, local leaders provided only rough estimates of household numbers. Enumerators employed a ‘random route/walk sampling’ method, selecting households at regular intervals based on estimated household counts, target sample sizes, and local settlement patterns. The spatial distribution of selected households was regularly reviewed using SurveyCTO maps to ensure coverage across the study area.

Although surveys with both household and individual respondents were ideally to be conducted on the same day, this was often impractical due to time constraints or the unavailability of the secondary respondent. In such cases, enumerators scheduled return visits – up to three times. If the survey could not be completed after three attempts, the household was dropped from the sample.

Individuals unable to give informed consent – including children, individuals with intellectual disabilities or special needs, those under the influence of substances, or anyone flagged by local informants as vulnerable – were excluded, unless their vulnerability did not impair their autonomy (e.g. physical disability).

Table 3 summarises the number of households and individuals surveyed by site type and wave in each country. In Bangladesh and Kenya, 250–300 households were sampled from rural areas, and 100–150 each from peri-urban and urban areas. In Ethiopia, oversampling occurred in Wave 1, as it was the first site surveyed and there was a risk that some data might need to be discarded. Given the small size of urban and peri-urban sites, most households were sampled from rural areas, and urban and peri-urban data were later combined for analysis.

In Bangladesh, only two single-mother households were identified during Wave 1, highlighting the need for a more targeted strategy in subsequent rounds. As a result, Waves 2 and 3 included 12 newly identified single-headed households – four each from the urban (Ward 21), peri-urban (Chara), and rural (Sutarkhali) areas – recruited through snowball sampling. This approach helped ensure the inclusion of a typically hard-to-reach group and allowed the study to better capture the unique challenges faced by single-headed households across different settings.

Table 3: Number of households and individuals surveyed in the three countries.

Survey Wave	Site Type	No. of Households	No. of Individuals		
			Primary respondent	Secondary respondent	Total
Bangladesh					
Wave 1	Urban	100	100	100	200
05 February to 27 February 2023	Peri-urban	150	150	150	300
	Rural	305	305	305	610
	Total	555	555	555	1110
Wave 2	Urban	99	99	99	198
11 May to 6 June 2023	Peri-urban	149	149	148	297
	Rural	304	304	303	607
	Total	552	552	550	1102
Wave 3	Urban	99	99	98	197
28 August to 30 September 2023	Peri-urban	144	142	140	282
	Rural	303	302	302	604
	Total	546	543	540	1083
Ethiopia					
Wave 1	Urban	72	70	55	125
26 January to 3 February 2023	Peri-urban	24	24	22	46
	Rural	524	511	485	996
	Total	620	605	562	1167
Wave 2	Urban	61	58	54	112
8 September to 5 October 2023	Peri-urban	24	22	22	44
	Rural	473	450	442	892
	Total	558	530	518	1048
Kenya					
Wave 1	Urban	140	112	140	252
8 May to 26 May 2023	Peri-urban	160	160		316
	Rural	252	212	252	464
	Total	552	484	548	1032
Wave 2	Urban	124	108	94	202
4 September to 24 September 2023	Peri-urban	140	122	105	227
	Rural	228	204	159	363
	Total	492	434	358	792

Figure 22: Enumerator conducting a household survey in Kapua (rural site), Kenya.



4.4 Semi-structured interviews

Qualitative interviews were designed with different streams and objectives. Intrahousehold interviews closely followed the sampling of quantitative surveys, with researchers using survey data to understand respondents' basic socio-economic situations. Water care interviews were conducted independently of survey sampling or results, although in Bangladesh some participants took part in both the survey and interviews. Climate interviews were piloted both jointly and separately from the main qualitative interviews, after which each country adopted a tailored approach. Table 4 presents an overview of the methods and numbers by country, while Figure 23 illustrates the timeline.

The data collection process faced several challenges. In Kenya, the general elections in August 2022 heightened risks of insecurity particularly for some ethnic groups. In Bangladesh, staff turnover disrupted continuity, while in Ethiopia civil unrest caused repeated interruptions and limited the ability to complete interviews in certain areas.

To maintain consistency, every data collection activity – including short conversations and observations – was documented using SurveyCTO. A short tracking form was developed to log all team activities. For interviews, respondents were also asked a few basic socio-economic questions, and researchers linked participants to their corresponding quantitative survey IDs where applicable. Depending on the method, this survey lasted between 1–10 minutes. This systematic approach not only safeguarded data integrity despite multiple rounds of translation and transcription, but also allowed researchers to track progress, manage time effectively, and clean and verify data, especially respondent IDs.

Figure 23: Timeline of qualitative data collection.

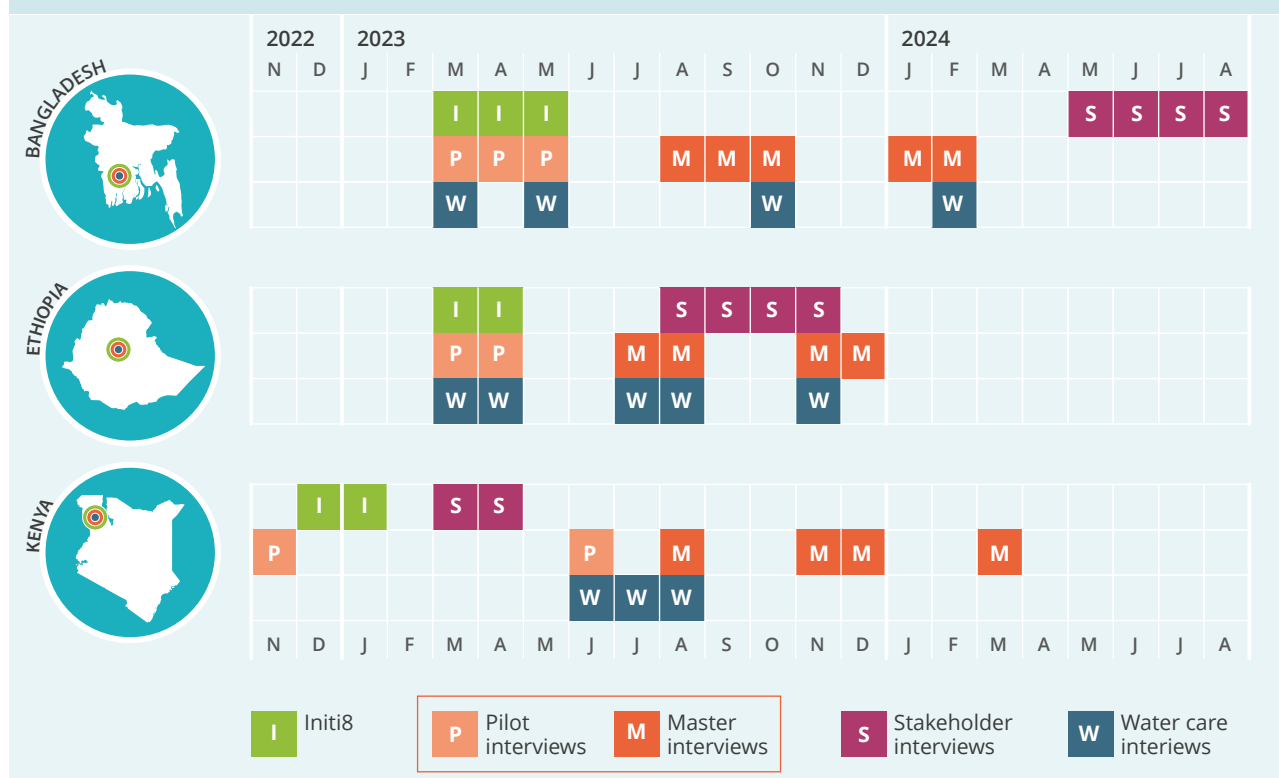


Table 4: Summary of sample sizes for qualitative methods applies across the three study countries.

Type	Description	Bangladesh	Ethiopia	Kenya
Pilot and supplementary methods	Pilot interviews	17	13	16
	Short talks and observations to create contextual understanding	7	30	19
Intra-household interviews	Interviews with the selected dyads (man and woman) from Household surveys on water quality, water access and gender norms	69	40	48
Climate interviews	Interviews with the selected respondents from Household surveys on access and use of climate information	41	Included in intra-household interviews	42
Water care interviews	Interviews with the most vulnerable people in the community on their dependency on water care from others	28	18	29

4.4.1 Intra-household interviews

The interview guide was developed to address the research interests of multiple members within the team. Semi-structured interviews were conducted with the primary and secondary respondents from a sub-set of the surveyed households. The primary objective was a deeper exploration of intra-household gender dynamics in relation to water and climate issues. Pilot studies were conducted to test the interview guides across all locations. The final guide consisted of three central modules. The first module focused on gender norms and gender policing in water responsibilities, particularly examining how these responsibilities shift during periods of disruption, such as the most challenging water access periods in the past five years. The second module investigated perceptions, behaviours, and gendered roles in relation to drinking water safety. The third module explored individual perceptions of climate information, including its accessibility and usefulness. In addition to these three core modules, contextual questions were included to situate households and individuals socio-economically. These modules covered topics such as aspirations, challenges, and wealth indicators. They were positioned at the end of the interview to prevent influencing respondents' earlier answers about water-related issues and to allow for the discussion of any additional topics the interviewees found important.

All pilot interviews were regularly checked for quality by the qualitative research lead. This informed discussions on contextual and linguistic nuances, as well as additional training for field researchers. Several modifications were made to the guide, such as adjustments to wording for better clarity, the addition of more specific prompts, and refinement of contextual questions. These changes were centrally documented in a single file used across all countries. To ensure consistency in data collection, the modifications were developed and agreed through bilateral and weekly group discussions between the qualitative research lead and all researchers who contributed to the development of the guide, including all who conducted the interviews.

Sampling

The sampling frame was restricted to households that had participated in the first wave of the household surveys. Ten households were selected for each of the nine qualitative study locations (the selection of these locations is explained in [Section 3](#)). Sampling was structured based on household water insecurity experiences (HWISE) scores and wealth index scores calculated from the survey data within each locality. Households were categorised using a two-by-two matrix, classifying them as either above or below the median HWISE score and within upper or lower wealth quartiles.

The general approach was to include four households from the most vulnerable group (low wealth and high water insecurity) and two from each of the remaining three groups. However, in some locations, deviations were necessary due to unusual distributions of the wealth index and HWISE scores. For the Koticha site, 42 percent of surveyed households were classified as higher wealth and water insecure, whereas only 8 percent were classified as low wealth and water insecure. Consequently, the selection was adjusted to five water-secure households (three lower and two higher wealth) and five water-insecure households (two lower and three higher wealth quartiles). A similar approach was used for the Ward 21 site, where one-third of households were high wealth but water insecure, while only 10 percent were low wealth and water insecure. The adjusted selection ensured a balance between different security and wealth classifications.

Households were randomly selected within each category of the security-wealth matrix. The selected respondents were then reviewed to check for diversity in age and household composition and the selections were purposively changed to improve diversity in a few cases. Wherever possible, researchers aimed to include at least one single female-headed household and one single male-headed household. Here, "single" referred to the relationship status of the primary household decision-maker, though these households might still include other adult decision-makers, usually children of the household head.

Fieldwork in the rural locality of Ethiopia had to be discontinued due to escalating security concerns. In the remaining study locations across the three countries, research teams followed the initial selection lists but faced challenges in interviewing both spouses in some households. In cases where only one spouse was available, in some instances, another adult member of the household was interviewed instead. Where this was not feasible, researchers selected a replacement household with a similar HWISE score, wealth index, and household composition from the survey list.

4.4.2 Water care interviews

The primary objective of the water care interviews was to explore various aspects of care and dependency in relation to water access. Its analysis was informed primarily by two strands of literature: 1) water sharing and the role of social capital in securing access to water ([Brewis et al., 2019](#), [Wutich et al., 2018](#)), and 2) disability and water access ([Dosu and Hanrahan, 2021](#), [Groce et al., 2011](#), [Wilbur et al., 2024](#)). The study sought to identify the principles, conditions, and challenges shaping care for neighbours, with specific attention to seasonality, hazards, and gender. In particular, it aimed to unpack gendered notions of deservingness ([Faas and Jones, 2017](#), [Zhang, 2016](#)), overlapping seasonal vulnerabilities, and the socio-spatial geographies of interdependence ([Milligan and Wiles, 2010](#)). The analysis foregrounded both the moral frameworks of communities and the lived perspectives of carers. Finally, it addressed the role of children as caregivers, interrogating emerging social norms around their paid and unpaid contributions within the community.

The interview guide was deliberately kept concise to respect the time and energy levels of respondents. Semi-structured interviews were chosen as they allow for comparative analysis across countries, while also being non-intrusive and relatively short. However, with this particular group of respondents, the interviews often lasted longer than expected. While this approach allowed for contextual adaptation of questions to each respondent's unique situation, challenges arose due to respondents frequently being tired, weak, or forgetful. Researchers had to remain flexible, adjusting their questioning and triangulating responses throughout the conversation to ensure accuracy and sensitivity.

The concept of care evolved beyond a research theme into an act of praxis ([Middleton and Samanani, 2021](#)), as respondents shared deeply personal accounts of physical and emotional suffering. Researchers, in turn, assumed the role of carers in that moment – listening attentively, providing comfort, and offering empathetic reassurance. Interviews concerning illness and death were particularly challenging, eliciting unanticipated emotional responses from both respondents and researchers. While these emotions were expected, the depth and intensity of the experiences shared were profound. Many of these difficult interviews were later discussed in group debriefings, where researchers reflected on ethical considerations, sensitivity, and emotional boundaries. It was crucial that researchers remained attuned to the well-being of interviewees, knowing when to gently conclude discussions to avoid causing further distress ([Varpio and McCarthy, 2018](#)).

Sampling

Identifying particularly vulnerable individuals within communities was often challenging, as they were frequently invisible to the wider public. Many of the most at-risk individuals were known only to a small network of neighbours or caregivers. This reality underscored the localised nature of care networks, where a single household would often assume the responsibility of assisting a vulnerable individual. Given these complexities, researchers employed a multi-step identification strategy. Initially, they leveraged existing rapport with respondents from other research activities and engaged in informal discussions on the topic. This was followed by community scoping visits and conversations in public gathering spaces. Finally, snowball sampling was used, whereby researchers asked key informants to identify individuals who faced consistent difficulties in accessing water and depended on others for water collection – not necessarily continuously, but beyond seasonal fluctuations or short-term crises, such as cyclones in Bangladesh. Upon identifying a potential respondent, researchers typically conducted a brief conversation to verify the accuracy of their reported vulnerability.

In Kenya, particularly in urban and peri-urban areas, respondents frequently stated that “everyone is vulnerable”, making it difficult to assess varying degrees of water insecurity. However, certain groups were more commonly identified as water-dependent. These included persons living with disabilities (PLWDs), the elderly (especially those living alone or whose relatives worked long hours), and individuals with chronic illnesses such as Tuberculosis, HIV, and Polio. In rural areas, the primary vulnerable groups were PLWDs and the elderly.

In Ethiopia, researchers engaged with town water utility experts to refine the sampling approach. Partially aligning with the government's definition of vulnerable populations in need of subsidised housing, the sample included elderly individuals, low-income groups, people with chronic illnesses, military veterans, and PLWDs. Additionally, through informal discussions in public spaces, researchers expanded the scope to include elderly men and women, PLWDs, and women with serious health conditions (e.g., HIV and kidney disease), particularly among indigenous communities and internally displaced persons (IDPs).

Beyond direct interviews with vulnerable individuals, researchers sought to engage carers – those who provided regular assistance in water collection. However, these conversations were not always possible, as carers were often occupied with their responsibilities. When accessible, their perspectives provided valuable insights into the challenges of caregiving in the context of water insecurity.

To ensure comprehensive coverage, the geographical scope of the study was expanded to include neighbouring communities where needed. The water care sample was defined based on regular dependency on others for water collection, with additional criteria including frequency of water access, physical ability to collect water independently, unique barriers to water access, and the quantity of water typically received daily. However, the diversity of vulnerable individuals made it difficult to establish strict quantitative inclusion and exclusion criteria. When researchers encountered uncertainty, they documented their observations and discussed them in team meetings to ensure consistency in sampling decisions.

4.4.3 Climate information interviews

Individual interviews exploring the provision and uptake of climate information and services were also conducted across the study sites. Participants were asked whether they received any form of climate information, such as seasonal forecasts or traditional/indigenous forecasts. Those who did were further asked how they used this information, how they negotiated its use within their households or communities, and how the information could be improved. Those who did not receive any were asked whether and how such information might support their decision-making, and why they believed they were not receiving it. These interviews aimed to complement the quantitative survey data, which indicated the proportion of the sampled community that had access to climate information. The populations sampled for this study represent the 'last mile' in climate services delivery. Unlike studies focused on specific user groups, such as farmers, this community cross-section offered a more representative picture. The qualitative interviews were designed to provide a deeper understanding of whether climate information is regarded as a priority within communities, and how best to ensure that relevant and actionable information reaches those who could benefit from it.

Sampling

The sampling strategy for the climate information interviews varied across study sites, which limits the potential for direct comparison of results across locations for practical applications. However, the findings do allow for the identification of cross-cutting themes that may inform future research. In Ethiopia, climate information interviews were conducted as part of the main intra-household interviews and therefore followed the same sampling approach, including the limitations imposed by the country's security situation at the time. In Bangladesh, 42 interviews were carried out, and in Kenya, 41 interviews were conducted. In both countries, participants were selected from among those who had taken part in the quantitative survey, with some overlap with individuals who participated in the intra-household interviews outlined in [Section 4.3.1](#). The sample in both contexts was distributed across urban, peri-urban, and rural sites, and included both male and female respondents. Importantly, efforts were made to ensure a mix of individuals who had and had not received climate information, based on responses in the quantitative survey. The proportion of participants who had received such information was higher, reflecting the broad range of information sources captured in the quantitative data.

4.5 Stakeholder interviews

To gain deeper insights into water insecurity at household, community, and regional levels, stakeholder interviews were conducted with policy-makers and practitioners. These interviews provided a broader political and institutional perspective on water governance, highlighting the challenges and inequities in water access. They explored how institutional arrangements and infrastructure functionality contribute to persistent disparities in water security across the study sites. Additionally, the interviews helped triangulate findings from other research methods, ensuring a more comprehensive understanding of the barriers to water access.

The research team had prior knowledge of organisations working on water security challenges, owing to the REACH Programme's long-term engagement with government officials and sector professionals in each of the three countries. Key informants were selected from both government agencies and international/local non-governmental organisations actively engaged in water access, infrastructure development, and policy implementation. An iterative approach was used, beginning with the organisations known to be active in water security efforts, with additional stakeholders were identified through community recommendations and snowball sampling. In total, 13 stakeholder interviews were conducted in Ethiopia (March to April 2024), 14 in Kenya (August 2023), and 12 in Bangladesh (August to October 2024). The interviews were conducted by the respective researchers in the three countries – one female in Ethiopia, one male in Kenya, and one female and two males in Bangladesh.

In Ethiopia, stakeholders included representatives from woreda and federal government offices, such as water, energy, agriculture, health, and environmental authorities, alongside utility officials (e.g. Dukem Town Drinking Water and Sewerage Utility, Akaki Woreda Water and Energy Office, Ministry of Water and Energy). In Kenya, interviews engaged a mix of county-level government officers, international and local NGOs, faith-based organisations, and multilateral actors (e.g. Turkana County Water Office, AMREF/USAID, Diocese of Lodwar, UNICEF). In Bangladesh, stakeholders spanned government ministries, international organisations, NGOs, and community-based organisations working in WASH governance, service delivery, and programme implementation (e.g. Local Government Division, UNDP, UNICEF, BRAC, WaterAid, Heed Bangladesh).

The interviews followed a structured interview guide, consisting of one core module and several thematic modules tailored to each organisation's role in the water sector. The core module, asked to all participants, focused on lived experiences of water-related inequalities, structural barriers to water security, governance challenges, and institutional responsibilities. Additionally, interviewees provided insights on seasonal variations in water insecurity, the impact of climate shocks, and how organisations are working to build climate resilience through water interventions. Thematic modules covered topics such as community participation, water quality and safety, urbanisation, water infrastructure, and climate adaptation strategies.

5. Data management and analysis

A shared cloud storage was set up on the University of Oxford's SharePoint for data management. All consortium authors could access non-confidential folders such as management, communications, research tools, and site information. Access to qualitative and quantitative data folders was restricted to relevant sub-groups.

Qualitative data included audio recordings, translated transcripts of group discussions and interviews, and associated structured survey forms. Transcripts were anonymised using ID codes, with personal identifiers stored separately. Quantitative data included water audits, all waves of seasonal intra-household data, and photos of houses and water points. Personal identifiers, such as names and contact details, were only accessible to each country's respective quantitative team. Access to specific dataset sections was granted by the qualitative and quantitative leads upon request.

5.1 Cleaning quantitative data

The data cleaning process began with downloading and organising the data using the SurveyCTO desktop app. The data were stored in folders with restricted access permissions to ensure data security. For the water infrastructure audit, each source was given a 15-character identification number (Waterpoint_ID) combining codes for the site type, the administrative boundaries, the serial number and the waterpoint type (e.g. R_AK_ABS_059_SW referring to a surface water body in Abasamuel kebele of Akaki woreda in rural Ethiopia). All associated photos were downloaded and renamed as per the Waterpoint_ID using a code in R.

The household and individual survey datasets were downloaded in both wide and long formats as Excel files, with consistent file names (e.g. Bd_HH_survey_w1_Long). The long format contained separate sheets for each repeat and nested repeat group, linked to the Main sheet via the parent key. Column names corresponded to the codes representing each question, while sheet names referred to the section or repeat group code (e.g. Module02_HH_roster, Module08_water_sources_details_rpt). Unique identifiers were assigned to each household and individual to ensure consistency across the dataset. These included serial number (SL_No), site type (Site_type), administrative boundaries (adm1, adm2), and household identification number (Site_HH_ID) for households and individual identification numbers (Site_HH_Ind_ID) for individuals within each household. The Site_HH_ID was a 12-character identifier combining codes for the site type, the administrative boundaries, and the serial number.

Data cleaning in the first wave identified concerns on accuracy in identification of primary and secondary respondents, allowing data to be rechecked in the second wave (see section 5.3.1). Among the common minor errors was the use of the 'Other' category when predefined response options were available. Enumerators sometimes selected 'Others' and provided written explanations that closely matched existing response options. In such cases, responses were recoded under the correct category, and if no appropriate option existed, the explanation was rewritten in proper English for clarity. Where responses were logically inconsistent, inconsistencies were reviewed and corrected to align with logical expectations. For example, when enumerators selected 'Yes' to show something occurred, but then recorded '0' in the numerical field, it was recoded as 'No'.

Care was taken in merging and validating water-related data across Modules 7, 8, and 9. Identification numbers were assigned to each of the land parcels owned or accessed by the household (Site_HH_Land_ID) and the water sources in those land parcels (Site_HH_Land_water_ID) in Module 7. Each of the sources reportedly used by the household in the past four weeks (Module 8) were linked either to the water sources listed in the land parcels (Module 7), or community water sources listed in the water infrastructure audit. If neither of these applied, further details were collected on the source. During data cleaning, new columns were created merging these data sources on water source location (WS_location_coded with values being 01_dwelling_land, 02_non_dwelling_land, 03_community_source, 04_other_private_source), water source type (WS_type_coded), and waterpoint identification number (integrating Waterpoint_ID and Site_HH_Land_water_ID).

For each water source used, household members responsible for collection were identified in the dataset using serial numbers corresponding to their position in the household roster. During data cleaning, these were matched with the relevant Site_HH_Land_ID to merge in additional details such as the collectors' age and gender, facilitating further analysis.

For household and land rosters, data from Wave 1 was combined with rechecked data from Wave 2, as previously noted, to produce clean lists of household members, land parcels owned or accessed by the household, and water sources. Further cleaning of individual modules was not undertaken by the core team but left to individual researchers, with support provided as needed.

Across such a large and complex survey, coding errors are inevitable. Two coding errors that limited analysis of first wave data were:

- In the first waves of the Ethiopia and Bangladesh household surveys, a `select_one` option was used instead of `select_multiple` for `WS_collectors` (i.e. household members who collected water from each source identified in Module 8), meaning that data was collected for only one water collector per source rather than multiple. Additionally, an incorrect relevance condition for `WS_freq` (i.e. frequency of visits for each source) resulted in subsequent omissions in the `WS_day` (i.e. number of visits per day) and `WS_week` (i.e. number of visits per week) responses for certain types of sources. This limited the analysis of seasonal variations in water collection responsibilities by gender or age. This was corrected in later waves, including the Kenya first wave.
- The time-use diary (Module 22) in the Individual Survey necessitated changes in coding in subsequent waves to reduce enumerator errors. Some enumerators recorded multiple activities throughout the day, while others simply selected 'sleeping/resting' for the entire day, omitting essential activities such as 'eating/drinking' and 'using sanitation facilities'. To improve accuracy in the second wave, modifications were introduced to constrain time options for activities based on the available awake time, reducing the margin for error. A maximum of eight hours was allowed for any single activity. For example, if someone reported working for ten hours, this had to be broken up into smaller segments, as they would naturally take breaks for eating and using the toilet. The minimum time for recording an activity was set at fifteen minutes. This was further supported by training.

5.2 Quantitative metrics

Several quantitative metrics, including water and food insecurity scores, the household wealth index, and the empowerment index, were calculated and integrated into the respective datasets to prevent duplication of effort among team members.

5.2.1 Household and Individual Experiences of Water Insecurity (HWISE and IWISE) Scores

The HWISE and IWISE scores ranged from 0 to 36, with higher score representing higher water insecurity. The score is the summation of the 12-items – the responses to which were graded as never (0 times), rarely (1–2 times), sometimes (3–10 times), often (11–20 times), always (more than 20 times), don't know and not applicable, whereby 'never' is scored as 0, 'rarely' is scored as 1, 'sometimes' is scored as 2 and 'often/always' are scored as 3. If the response to any of the items is 'don't know' or 'not applicable', the household or individual is not given any WISE score and hence, discarded from related analysis. Households or individuals were subsequently categorised into four water insecurity categories, described as 'No to marginal', 'Low', 'Moderate' and 'High', with scores of 0-2, 3-11, 12-23, and 24-36 respectively. This four-part categorisation, suggested by [Frongillo et al. \(2024\)](#) provides a more nuanced differentiation of water insecurities than the original two-part categorisation of 'water secure' (0-11) and 'water insecure' (12 to 36) developed by [Young et al. \(2019\)](#).

5.2.2 Household and Individual Experiences of Food Insecurity (HFIES and IFIES) Score

The HFIES and IFIES score, developed by the Food and Agriculture Organization (FAO) ([Ballard et al., 2013](#)), was calculated to assess the level of food insecurity experienced by households over the last 4 weeks. The scores ranged from 0 to 8, with higher scores indicating higher levels of food insecurity. These scores were calculated based on responses to eight standardised yes/no questions, with each affirmative response contributing to the total score. The raw scores were then processed using the Rasch model, which transformed them into interval-level measurements that are comparable across different contexts. The final scores were used to categorise households into different levels of food insecurity, which allowed for a detailed analysis of the prevalence and severity of food insecurity across the urban, peri-urban, and rural sites included in the study.

5.2.3 Wealth index

The household wealth indices were calculated in SPSS 29 using principal component analysis (PCA) – a commonly used multi-dimensional poverty assessment method ([Filmer and Pritchett, 2001](#), [Vyas and Kumaranayake, 2006](#)). PCA reduces multiple variables into uncorrelated principal components, with the first principal component (PC1) capturing the most variance and serving as the raw wealth index. PCA was conducted with 16 indicators from household survey data, including educational attainment, housing materials, asset ownership (e.g., radio, TV, bicycle, motorbike), and sanitation facilities. Households were then classified into four quartiles based on PC1 scores.

To account for urban-rural differences in asset portfolios and housing structures, two PCA iterations were conducted for each country: one using all households ('all' dataset) and another with households grouped by urban, peri-urban, and rural sites ('combined' dataset). This approach addressed contextual disparities, ensuring a more accurate wealth classification. The Kaiser-Meyer-Olkin (KMO) statistic was used to assess sampling adequacy, with values above 0.70 considered appropriate. Eigenvalues greater than 1 determined the number of extracted components, balancing explanatory power and dimensionality reduction. Table 5 shows the mean asset ownership by wealth class in Bangladesh, as an example, and Table 6 presents the distribution of households by wealth across urban, peri-urban and rural areas in the three countries.

Table 5: Mean ownership of assets/variables by wealth quartiles calculated using principal component analysis in Bangladesh.

Mean ownership of assets/ variables used in wealth assessment	1 (Poorest)	2	3	4 (Wealthiest)	Weightage (Factor loading PC1)
No. of households	139	138	139	139	
Urban	44	41	13	2	
Peri-urban	31	30	36	53	
Rural	64	67	90	84	
Percentage of HH members (>18 years) completed at least primary education	35%	40%	45%	52%	0.293
Floor material 0 = Earth/ mud; 1 = Brick/ cement	0.01	0.17	0.52	0.93	0.719
Wall material 0 = Earth/ mud; 1 = Tin/ brick/ cement	0.07	0.45	0.65	0.94	0.619
Roof material 0 = Leaves/straw; 1 = Tin/ brick/ cement	0.84	0.96	1.00	1.00	0.283
Cooking fuel 0 = Dung/straw/wood; 1 = Gas/ electricity	0.07	0.02	0.04	0.11	0.095
Toilet 0 = Unimproved (Open defecation, Pit latrines without a slab, Hanging latrines, Bucket latrines) 1 = Improved (Flush, Pit latrine with slab, Composting toilet)	0.88	0.89	0.86	0.85	-0.011
Solar device	0.50	0.43	0.26	0.14	0.394
Water pump	0.05	0.12	0.12	0.26	-0.270
Stove	0.72	0.91	0.99	1.00	0.244
Bicycle	0.09	0.18	0.25	0.34	0.235
Motorcycle / Car	0.05	0.20	0.35	0.50	0.418
Refrigerator	0.01	0.07	0.41	0.83	0.701
Smart Mobile phone	0.29	0.48	0.58	0.88	0.445
Simple Mobile phone	0.71	0.93	0.91	0.88	0.198
Television	0.00	0.15	0.52	0.86	0.683
Number of rooms used for sleeping	1.60	1.86	2.01	2.42	0.442
Kaiser-Meyer-Olkin Measure of Sampling Adequacy					0.718
Components with eigenvalue>1					5
Total variance explained					52.56%

Table 6: Wealth distribution of households across the three countries by site type [1 = Poorest, 4 = Wealthiest; * Urban and peri-urban are merged for Ethiopia].

	Wealth Quartile	Urban	Peri-urban	Rural	Total
PCA on all households combined					
Bangladesh	1	44 (44%)	31 (20.7%)	64 (21%)	139 (25%)
	2	41 (41%)	30 (20%)	67 (22%)	138 (24.9%)
	3	13 (13%)	36 (24%)	90 (29.5%)	139 (25%)
	4	2 (2%)	53 (35.3%)	84 (27.5%)	139 (25%)
	Total	100 (100%)	150 (100%)	305 (100%)	555 (100%)
Ethiopia*	1	3 (3.1%)		151 (28.8%)	154 (24.8%)
	2	3 (3.1%)		153 (29.2%)	156 (25.2%)
	3	10 (10.4%)		144 (27.5%)	154 (24.8%)
	4	80 (83.3%)		76 (14.5%)	156 (25.2%)
	Total	96 (100%)		524 (100%)	620 (100%)
Kenya	1	13 (9.3%)	14 (8.8%)	109 (43.3%)	136 (24.6%)
	2	17 (12.1%)	24 (15%)	99 (39.3%)	140 (25.4%)
	3	48 (34.3%)	59 (36.9%)	31 (12.3%)	138 (25%)
	4	62 (44.3%)	63 (39.4%)	13 (5.2%)	138 (25%)
	Total	140 (100%)	160 (100%)	252 (100%)	552 (100%)

5.2.4 Empowerment in WASH index

The Empowerment in WASH Index (EWI) was developed as part of a partnership grant in the REACH research programme, and is a novel tool to measure women's empowerment in the context of household water and sanitation security ([Dickin et al., 2021](#)). The tool can be used for diagnostics and research purposes, as well as monitoring and evaluation of gender outcomes of water security programmes. It was adapted to a household water and sanitation security context based on the Women's Empowerment in Agriculture Index (WEAI) ([Malapit et al., 2019](#)), and previous work on measuring multi-dimensional poverty ([Alkire and Foster, 2011](#)). The EWI is comprised of twelve indicators that capture domains of agency and resources across individual, household and community levels that can support a process of empowerment to achieve a range water-related development and health outcomes (Table 7), drawing on the conceptual work of [Kabeer \(1999\)](#) (Figure 24). To calculate the EWI, data are collected from a pair of men and women respondents who self-identify as the main decision-makers in their household on water and other social and economic issues. To calculate the index an individual achievement score is generated for all respondents based on pre-determined thresholds for each indicator (See [Dickin et al. \(2021\)](#) for details).

Once calculated, the achievement score is used to identify respondents who achieve 75 percent of the EWI indicators, which is generally used as the threshold for empowerment, and results in an empowerment ratio for the sample. These results are used to calculate the overall EWI score for the sample, adopting the following formula:

$$\text{EWI} = \text{Empowerment Ratio} + (\text{Disempowerment Ratio} \times \text{Average achievement score})$$

Additionally, an intra-household empowerment gap is calculated using both respondents' achievement scores to investigate gender parity within households. The achievement score, or achievement of particular indicators of interest, are also used to assess associations with other outcomes of interest, such as characteristics of WASH access as well as household and individual water (in)security experience scores (HWISE/IWISE).

Figure 24: Empowerment in WASH index

Wider social, economic, environmental and political contexts and structures

Empowerment in WASH Index (EWI)

RESOURCES

- Control over household assets and access to loans
- Time for water collection
- Work balance
- Information access and sharing on WASH practice information
- Information access and sharing on WASH rights information
- Group membership
- Other resources not measured in the EWI

AGENCY

Individual

- WASH gender attitudes

Household

- Input into decisions about:
- WASH roles and responsibilities
 - WASH expenditures
 - Representing the household in community WASH activities

Community

- Comfort in speaking up in:
- WASH implementation
 - WASH accountability

Purchase of or access to WASH services that meet needs

WASH providers improve services

Societal and water specific norms and sanctions

Intermediate outcomes

Enabling benefits from WASH

- Reallocation to more equal burden of unpaid work
- Use of water source that is nearby and reliable
- Use of nearby sanitation facility
- Use of safe water source free from contamination
- Use of safe sanitation facility with menstrual hygiene facilities

Women's health

- Reduced water carrying injuries
- Reduced GBV linked to accessing WASH
- Reduced psychosocial distress
- Improved menstrual health and maternal health outcomes

Child health

- Reduced undernutrition
- Reduced diarrheal disease
- Reduced neglected tropical diseases

Economic outcomes

- Time for designed income generation, training, or education activities
- More livelihood activities possible using water

Long term societal outcomes

- Reduced poverty, improved household income, and improved livelihoods
- Women's subjective wellbeing
- School attendance and attainment
- Child cognitive and physical development, reduced mortality
- Women's status and participation in public life and government

Table 7: EWI indicators by levels of empowerment.

	Level	Indicator	WISER individual questionnaire module
1	Individual	Individual WASH and gender attitudes	Module 21
2	Household	Decisions on WASH roles and responsibilities	Module 6
3		Decisions on WASH expenditures	Module 6
4		Decision on who can represent the household in community WASH activities	Module 6
5		Control over household assets and access to loans	Modules 11 and 15
6		Work balance	Modules 22 and 23
7		Time for water collection	Modules 22 and 23
8		Access to and sharing of WASH practice information	Module 18
9		Access to and sharing of WASH rights information	Module 18
10	Community	Group membership	Module 17
11		Comfort in speaking up in WASH implementation activities	Module 20
12		Comfort in speaking up in WASH accountability (e.g. resolving service problems)	Module 20

5.3 Qualitative coding in NVIVO

A multi-staged analytical process was pursued using NVivo Release 1.7.1 (2022 release of NVivo 2020, retroactively labelled as NVivo 13). Collaboration was established as the initial step, facilitated using the NVivo Collaboration Cloud service. The NVivo license version was not updated with new releases because team members in Kenya, Ethiopia, and Bangladesh accessed the software using perpetual academic licenses purchased in January 2023. Team members in the UK accessed the software through the University of Oxford licensing scheme but did not update to new release versions to maintain compatibility for collaborative coding across the team. A commitment to joint training, shared learning, shared coding tasks, ongoing discussions, and continuous support was required. Given the collaborative nature of the analysis, multiple diverse interests in data, and its cross-comparative scope, it was recognised that a combination of constructivist grounded theory and thematic analysis would best serve the research objectives. A deductive approach was consciously avoided at this stage, as the focus was on conducting an in-depth exploration of the data, enriched by multiple perspectives. This approach also provided a solid foundation upon which subsequent theoretically informed analyses could be built, aligning with individual research priorities.

Grounded theory has been acknowledged for its responsiveness to contextual nuances and evolving research topics ([Glaser and Strauss, 1967](#)). Although a full application of the method was not feasible (e.g., allowing research topics to evolve continuously), core principles were adhered to, including simultaneous data collection and analysis, comparative analysis, and a focus on meanings and processes. Importantly, objectivism, as originally proposed by [Glaser and Strauss \(1967\)](#), was rejected, and instead, principles of critical inquiry and constructivism were followed ([Charmaz, 2008](#), [Charmaz, 2005](#), [Clarke, 2007](#)).

The analysis was structured into multiple stages using thematic analysis, a method involving hermeneutic content analysis through pattern recognition and the development of thematic categories ([Roberts et al., 2019](#)). The process was guided by Braun and Clarke's five-step thematic analysis framework ([Braun and Clarke, 2006](#), [Braun and Clarke, 2021](#)) and the code creation and testing process outlined by [Roberts et al. \(2019\)](#).

Step-by-Step thematic analysis process

1. Exploring initial code sources

At this stage, preliminary data rather than theoretical frameworks were prioritised, although the research design and initial study questions inevitably shaped the dataset.

- Reflections from pilot-stage fieldwork were shared, transcripts from INITI8 focus group discussions and pilot interviews were reviewed, and early results from the first round of quantitative surveys were analysed.
- Individual reflection and group discussion facilitated the identification of points of interest within the preliminary data.

2. Initial code development

This stage involved the generation of themes from the data, resembling the "open coding" phase in grounded theory. However, rather than breaking down points of interest into highly specific details, broader codes were initially employed.

- Work in NVivo was initiated, utilising its collaboration cloud feature for shared access to a central project file.
- Initial broad codes were derived from interview guides, which had been informed by the study's key research questions (e.g., climate information and resilience, water safety perception and practice, intrahousehold negotiation and gendered water management roles, and vulnerability identification).
- Further sub-codes were developed inductively. Initially, three pilot transcripts were coded individually before merging and discussing the codes collaboratively.

3. Codebook development

This phase involved the review and consolidation of the preliminary themes.

- Multiple in-person and online meetings were conducted to refine and negotiate a standardised set of codes that could be applied by all team members.
- Codes were defined with clear qualifications and exclusions, based on examples drawn from pilot transcripts.

4. Codebook application and refinement

- Inter-rater reliability tests were undertaken to compare coding consistency across different team members.
- Based on these tests, steps 2 and 3 were revisited, leading to refinements in codes, the splitting of large categories, and the clarification of definitions.
- The process continued iteratively until a final round of coding revealed no further need for modifications.

5. Group coding

- The full qualitative dataset was divided among team members, with each individual coding their assigned data using the agreed-upon codebook.
- Multiple merge events were conducted in NVivo to integrate all coding into a central project file, followed by further refinements for clarity.

By adopting this structured and collaborative approach, transparency, coherence, and the inclusion of diverse research perspectives were ensured. Further individual or smaller group analyses were conducted in subsequent stages, allowing for more specialised and theoretically driven inquiries.

6. Research Integrity

6.1 Ethical considerations

Ethical approval for the study was obtained through the University of Oxford's Central University Research Ethics Committee (CUREC) under the School of Geography and the Environment's (SOGE) ethics review process (SOGE-1A-2021-042). This approval was deemed sufficient for project partners based in the United States and Sweden. In addition, country-specific ethical approvals were sought where necessary. For Ethiopia, the research protocol and translated survey instruments were submitted for review by the Ethiopian Society of Sociologists, Social Workers, and Anthropologists. In Bangladesh, no additional in-country ethical review was required for this type of research. In Kenya, the study operated under the existing REACH National Commission for Science, Technology and Innovation (NACOSTI) research permit, meaning no further local ethical approval was necessary.

6.1.1 Consent and confidentiality

Participants were provided with detailed information about the study's purpose, their involvement, and their rights before they were asked to provide informed consent. Given that literacy levels varied across the study sites, consent was obtained verbally where necessary and recorded appropriately. Separate consent was sought for audio or video recordings and for any household observations. Participants had the right to withdraw from the study at any time without consequence, and this was explicitly communicated at the outset.

Confidentiality was prioritised throughout the research process. Identifiable information, such as names and contact details, was stored separately from research data in secure, password-protected systems. Any publicly shared findings, including academic publications, reports, or presentations, were anonymised to prevent the identification of individuals or households. GPS coordinates were collected for spatial analysis but were handled with care to ensure privacy. The research team was committed to data security and followed established protocols for encryption, storage, and restricted access.

6.1.2 Compensation

Compensation for participants was carefully designed to be appropriate and fair within each country's context, ensuring that involvement in the study did not create undue financial burdens. Participants in household surveys, key informant interviews, and focus group discussions received modest compensation in the form of mobile phone credit, cash, food packages, or other locally relevant incentives. These compensation structures were developed in consultation with local teams to align with cultural norms and ethical guidelines, as well as considering the administrative burden. Local cultural norms were affected by the presence of NGOs, increasing expectations of cash payments in some areas.

In Bangladesh, each household participating in the intra-household survey was given coupons worth BDT 500 (USD 6) in each wave that could be redeemed at a local grocery store to obtain selected household essentials like rice, pulses, cooking oil, and soap (Figure 25). The coupon was given in two parts – the primary respondent who completed the household and one individual survey was provided BDT 200, while the secondary respondent was given BDT 300 upon completion of the second individual survey. Where needed, the enumerators transported these bags of goodies instead of handing out the monetary compensation. In Ethiopia, respondents were paid ETB 100 per survey form, totally to ETB 300 (USD 2) per household. In Kenya, households were paid KSH 500 (~USD 3.8).

Figure 25: Bags of groceries being transported by enumerators in Bangladesh to be handed to respondents as compensation for their participation.



6.1.3 Rapport building and positionality

Ethical considerations also extended to community engagement and stakeholder involvement. Prior to data collection, visits were made to local leaders, including community elders, local government representatives, and other key stakeholders, to ensure transparency and respect for local governance structures. The study upheld a participatory approach, ensuring that communities were actively involved in shaping the research agenda and that findings were shared in accessible formats with relevant stakeholders.

The initial scoping visits, contextual engagement, and interaction with community gatekeepers played a crucial role in building trust. In Kenya, researchers were frequently referred to as “our friends”, reflecting the acceptance gained through visits to water sources, mobilisation for household interviews, and the INITI8 process. Enumerators who were previously involved in the water infrastructure audit often facilitated introductions to households, making the transition into interviews smoother.

Despite being native to their respective countries, researchers encountered positionality challenges. The socio-economic gap between highly educated researchers and the communities they engaged with was evident. In Ethiopia, ethnic differences added further complexity. The lead researcher, who was not from the majority ethnic group, attempted to incorporate Afan Oromo phrases before transitioning to her native Amharic, which helped ease interactions. In Kenya, the primary researcher was non-Turkana, but a Turkana research assistant provided continuity and familiarity. This led to the researcher being perceived as someone “bringing aid”, while the assistant was referred to as “our child” or “a bearer of change”. However, locals also questioned why the assistant needed to ask about issues such as drought impacts, which he already understood firsthand. In Bangladesh, researchers from Dhaka were welcomed with curiosity, and a female researcher was often asked about her ability to travel independently as a married woman, which was viewed as a privilege.

6.1.4 Safeguarding measures

Safeguarding measures included ensuring that participants were never pressured into participation, that interviews and surveys were conducted in private where appropriate, and that data collection processes did not put individuals at risk.

The atmosphere of the intra-household interviews varied significantly. Respondents were often welcoming, but interview fatigue was evident in some cases. Discussions on water responsibilities in Ethiopia frequently became emotional for women, while in Bangladesh, conversations on gender roles and expectations sometimes led to laughter. However, at times, emotions became overwhelming. In Bangladesh, researchers occasionally had to pause interviews when respondents became too distressed, allowing them time to recover before continuing with renewed consent.

Research teams were not continuously stationed in research locations but instead made multiple visits. This approach provided opportunities to adjust strategies and reflect on evolving community dynamics. However, working in socio-economically disadvantaged regions came with additional challenges. Alcoholism in Kenya and domestic violence across all sites were prevalent concerns. Witnessing or being aware of violence against women was distressing, and researchers frequently discussed appropriate responses.

Security risks also posed difficulties. In Kenya, some communities were hostile to outsiders, leading to verbal aggression. Researchers were at times required to park vehicles away from villages and walk in to avoid drawing attention. In Ethiopia, unrest and the risk of kidnappings made reaching rural study sites particularly challenging, with information on security threats often obtained from unofficial sources, complicating decision-making.

The long history of NGO and research involvement in all locations influenced community expectations. Many communities had frequent interactions with aid organisations, making remuneration for participation a sensitive issue. In Kenya, participants worried about neighbourhood tensions arising from who was selected and compensated. In Ethiopia and Kenya, research fatigue was apparent, with respondents questioning what tangible changes the study would bring. In contrast, in Bangladesh, this sentiment was less pronounced, possibly due to a greater number of visible development projects in the area, fostering acceptance of data collection as a step towards long-term improvements.

Another challenge was ensuring privacy during interviews. Family members and neighbours often interrupted or attempted to listen in, making it difficult to maintain a one-on-one setting. This was particularly challenging in densely populated informal settlements in Bangladesh, where limited space made privacy nearly impossible.

Despite these difficulties, researchers navigated the challenges with adaptability and sensitivity, ensuring that ethical standards were upheld, prioritising the comfort of respondents and working to convey appreciation for their engagement throughout the process.

6.2 Collaboration within the consortium

The consortium includes researchers with a diversity of disciplinary expertise and contextual experiences (Figure 26). The leadership was dominated by women, with gender considered in recruitment to new positions created to help ensure balance in country teams. Collaborative working arrangements were adopted to ensure the diversity of voices were heard and individuals supported in their research and career development. This also sought to promote interdisciplinary working to support mixed methods, and ensure research was locally contextualised. The design of the methods included space for each researcher to study their own topic within the broader project. Consortium management approaches were designed based on those developed by the HWISE Consortium.

Collaborative working was supported by a mix of in-person and online meetings, study visits and mentoring partnerships. A series of in-person meetings were held for the team to develop their collaborative relationships including through design and development of methods, sharing preliminary results, harmonising analysis and identifying common interests to support develop of outputs. Researchers developed sub-group collaborations to implement different steps of the methodology in quantitative and qualitative workstreams (e.g. developing data collection instruments, fieldwork training and logistics, data cleaning and management, coding interview transcripts, or calculating indices) and to explore different focal topics and epistemological approaches (e.g. use of climate information, water safety perceptions and practices, water care, water justice, water and food security nexus etc.), and through mentoring partnerships to support early career researchers to develop their skills.

Consortium meetings were hosted in Oxford and Nairobi (02/2022, 03/2023, 09/2023, 09/2024). Consortium members visited teams in other countries, including field visit sites during data collection, and study visits to Oxford. Weekly online team meetings (using Zoom) provided updates on management aspects, from field teams, and from quantitative and qualitative methodological aspects. This provided a regular platform for researchers to present their work and obtain feedback, and to develop targeted training were requested from members with more expertise or experience in one area. Dedicated separate meetings of project sub-groups supported quality assurance and further developed collaboration and capacity building. These collaborations were supported with WhatsApp group communications, emails, and a collaborative SharePoint site for information and file sharing. SharePoint provided multi-level secure platforms used for data sharing and collaborative development of tools, analysis and papers, however access inequities were an issue due to computing functionality and network connectivity. WhatsApp was the most readily accessible and inclusive platform and was used for short communications.

The implementation of research in the study sites was led by researchers in the consortium, and were supported by enumerators and field assistants recruited for specific roles during intensive data collection periods, and for transcription and translation. For each team, including these additional roles, the gendered composition of field research teams was considered to ensure as much as possible that women were interviewed by women and men were interviewed by men. In all sites, field workers included team members who spoke local languages.

In a collaborative approach it is important to recognise the contributions made across the consortium members to the methodological development through design, data collection, and analysis. The contributions of consortium members are provided at the end of the document.

Figure 26: REACH-WISER workshop in Oxford (September, 2023).





7. Conclusion

Water security and its intersection with other societal crises, including gender inequalities and climate change, present complex research challenges that necessitate diverse methodological approaches. The intricacy of these overlapping issues demands methodological plurality – a key reflection from the WISER process – as there is no single way to study or measure water security. The survey-based approaches in this study capture broader patterns and impacts, including the often-overlooked intra-household dynamics. Quantitative tools offer comparable metrics that enable cross-cultural comparisons, while qualitative methods provide insight into lived experiences, contextual meanings, and critically examine the role of the researcher. This pluralistic approach helps to overcome the limitations inherent in any single epidemiological perspective or methodology.

In addition to employing innovative research methods, WISER embodies a collaborative research ethos, grounded in collegiality, kindness, and a commitment to addressing power imbalances within academia. Navigating these dynamics and fostering an environment where novel insights can emerge required creating space for multiple voices and facilitating the open sharing of data, methods, feedback, and reflections across disciplinary boundaries. By embracing rather than simplifying methodological complexity, the team was able to promote collaborative knowledge production, advancing global water security research that integrates both scientific rigour and principles of equity.

8. Acknowledgements

8.1 Funding

This document is an output from the REACH Programme funded by UK Aid from the UK Foreign, Commonwealth and Development Office (FCDO) for the benefit of developing countries (Programme Code 201880). However, the views expressed and information contained in it are not necessarily those of or endorsed by FCDO, which can accept no responsibility for such views or information or for any reliance placed on them.

Support was also received from the UK Research and Innovation through the GCRF Water Security and Sustainable Development Hub. Work applying the Empowerment in WASH Index was also supported by funding from Formas (the Swedish research council for Sustainable Development, PI Sarah Dickin).

Data availability statement: All data will be anonymised and shared via the REACH website (reachwater.uk/datasets/) and ORA portal (to be added) after publication of the relevant research papers.

8.2 Author contributions

The author contributions below are based on CRediT (Contributor Roles Taxonomy). They represent their contribution to the research design and data collection for the project, including to data analyses not presented in this methodological working paper. Writing credits are solely for this working paper. Conceptualisation reflects that for the overarching WISER approach, although individual researchers have contributed to conceptualisation of their own research aims. Authors with a particular focus on either qualitative or quantitative methods are indicated, but all worked collaboratively across both qualitative and quantitative.

Consortium authors	Work package		CRediT roles													
	Quantitative	Qualitative	Conceptualisation	Methodology	Software	Validation	Formal Analysis	Investigation	Resources	Data Curation	Writing – Original Draft	Writing – Review & Editing	Visualization	Supervision	Project administration	Funding acquisition
Prof Katrina Charles																
Dr Sonia Hoque																
Dr Marina Korzenevica-Proud																
Dr Saskia Nowicki																
Dr Catherine Grasham																
Dr Marya Hillesland																
Dr Ellen Dyer																
Prof Cheryl Doss																
Dr Khonker Taskin Anmol																
Ms Fahreen Hossain																
Mr Md Rajibul Islam																
Dr Mahfuz Islam																
Dr Sara Nowreen																
Mr Sharif Helal																
Prof Salome Bukachi																
Mr Cheruiyot Buses																
Mr Daniel Esukuku Ekai																
Dr Dalmas Ochieng																
Mr Dennis Ongech																
Ms Mercy Mbithe Musyoka																
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Dr Sarah Dickin																
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Prof Alex Brewis																
Prof Wendy Jepson																
Prof Justin Stoler																

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About REACH

REACH was a global research programme to improve water security for the poor by delivering world-class science that transforms policy and practice. The REACH programme ran from 2015–2025 and was led by Oxford University with international consortium of partners and funded with UK Aid from the UK Government's Foreign, Commonwealth & Development Office. Project code 201880.

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