Climate Resilient Water Supply in Kenya

Strategy Brief

May 2019

Centre for Humanitarian Change | What Works

Strategy Overview and Recommendations

Devolved government in Kenya has resulted in a huge increase in investment in water infrastructure in ASAL counties in Kenya since 2014. However, the country faced another drought emergency in 2016/17 which resulted in over 800,000 people facing acute water shortage. This burden falls largely on women and impacts on child malnutrition as well as maternal and child health. Lessons learnt from the 2011 food security crisis and the 2016/17 drought indicate a weakness in the water sector in Kenya to address the underlying causes of drought and seasonal water stress. Successive local water departments have initiated water trucking as a first response measure instead of a last resort. The resilience of households in ASAL areas depends on the reliability of their water supplies and there is a need to strengthen water service systems to i) develop resilient water supply technologies and ii) contribute to strengthening household resilience to drought.

UNICEF Kenya commissioned this review and strategy development as part of its support to the water sector, specifically county governments and the Ministry of Water and Sanitation (MoWS), to strengthen risk assessment and planning and to provide a clear direction for building water resilience in the ASALS. The review identifies a number of lessons learnt from the 2016/2017 drought in the region with respect to water resilience and highlights some promising developments and innovations. Outcomes from the risk assessment exercises carried out in three counties (Kitui, Garissa and Turkana) and the National Workshop on Climate Resilience WASH are combined with findings from the review to develop a strategy for UNICEF. The recommended strategy for UNICEF WASH follows a three-part approach of i) foundational – risk informed development (i.e. DRR), ii) Reliability – Sustainable water supply systems and iii) Response capacity – Shock responsive systems ('Surge models' - services that expand and contract to meet demand).

Contents

List of Acronyms

AOR	Area of Responsibility
ASAL	Arid and Semi-Arid Lands
CG	County Government
CHEW	Community Health Extension Worker
CHV	Community Health Worker
CIDP	Community Integrated Development Plan
CLTS	County-Led Total Sanitation
CMAM	Community-based Management of Acute Malnutrition
DFID	Department of International Development (British Government)
DRR	Disaster Risk Reduction
EDE	Ending Drought Emergencies
ENSO	El Nino Southern Oscillation
EWS	Early Warning System
EU	European Union
FAO	UN Food and Agricultural Organization
FEWS NET	Famine Early Warning Systems Network
FSNWG	Food Security and Nutrition Working Group
GAM	Global Acute Malnutrition
GEG	Global Emergency Group
GoK	Government of Kenya
INGO	International Non-Governmental Organization
KCO	UNICEF Kenya Country Office
KFSSG	Kenya Food Security Steering Group
KRCS	Kenya Red Cross Society
KWSCRP	Kenya Water Supply Climate Resilience Project
M&E	Monitoring & Evaluation
MoH	Ministry of Health
MoWS	Ministry of Water & Sanitation
NCCAP	National Climate Change Action Plan
NDMA	National Drought Management Authority
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organization
OCHA	UN Office for the Coordination of Humanitarian Affairs
ODF	Open Defecation Free
O&M	Operation and Management
PPP	Public Private Partnership
RTE	Real Time Evaluation
UNICEF	United Nations Children's Fund
U5s	Under Five year old children
WASH	Water, Sanitation and Hygiene
WESCOORD	Water and Environment Sanitation Coordination Mechanism
WEDC	Water Engineering Development Centre

Introduction

Across East Africa, surface temperatures have increased significantly over the last 50 years. The primary impacts of climate change are mostly felt through water. Climate related events such as droughts and flooding are already having a significant and diverse impact across the region, exacerbating existing challenges such as rapid population growth, extreme poverty, water shortages, rapid urbanisation and conflict. As WASH and climate change are so interrelated, it is vital that Governments, UNICEF and their partners work to protect children and their families from the impacts of climate change and ensure that children everywhere are able to live in safe and sustainable environments. Various studies have been carried out in the region and several UNICEF country offices have already commenced the piloting of climate resilience water programming[1]. For most however, this programming is still in the very early stages and there is a lack of capacity on how to effectively assess and address the impacts of climate change and, increasingly frequent, climate related events on the WASH sector.

In 2017, Kenya experienced severe drought resulting in widespread food insecurity, increased malnutrition, and loss of livelihoods affecting around 2.6 million people. The impacts of the drought were exacerbated by the high proportion of non-functional rural water systems, as well as water systems that were not designed to be climate resilient. . A UNICEF Kenya sustainability study of 130 rural water systems in 2014[2] found that only 68% of rural water systems constructed under the WASH programme 2008-2014 were fully functional.

Across all sectors there is a concerted effort to develop the resilience of communities in the arid and semi-arid lands (ASALs) of Kenya, East Africa and the Sahel. Although the concept of resilience is much debated, consensus has not yet been reached on the precise meaning of resilience and what it means for interventions in these areas. Despite the obvious fact that the primary drought risk for communities in the ASALs is water shortage, much of the focus of these debates and resilience interventions have focused on the livelihoods and food security sector. Therefore, the role of water in the resilience concept and related interventions is far from clear.

This strategy brief presents an overview of the existing systems and approaches for sustainable and resilient water systems in drought-affected counties as well as innovations for water resilience in other parts of Kenya. Based on this review the brief recommends a strategic approach for UNICEF Kenya to support climate resilient water services. The review and resulting strategy focus on rural water supplies in ASAL areas where drought is the main hazard. Strengthening resilience of wider WASH systems to multiple hazards would require a different strategy.

Background

Kenya's Climate Risk Profile

Kenya is prone to numerous disasters including political and ethnic conflicts, slow-onset natural disasters such as droughts and food insecurity, and rapid-onset disasters including floods, land/mudslides and disease outbreaks. The arid and semi-arid lands (ASALs) to the north, east and south of the country covering about 89% of the total land mass and home to about 36% of the population are regularly affected by droughts, resulting in food insecurity, high levels of

[1] See UNICEF ESAR Resilience Case Studies; Ethiopia Building Resilience through Drought Resilience Water Systems

[2] UNICEF Kenya, Rural Water Supply Sustainability Review, 2014

malnutrition-related illnesses and deaths, and disruption of livelihoods.[3] The ASALs also have the highest levels of poverty and lowest access to public goods and services in Kenya. Typically, droughts are large-scale disasters in Kenya. According to Kenya's Disaster Risk Financing Strategy 2018-2022, there were ten droughts in Kenya between 1990 and 2015. On average, these droughts were found to affect 4.8 million people.[4]

The disaster risk in Kenya is exacerbated by climate change and significant changes have already been observed as follows:

- Rising temperatures (max. 0.2-1.3°C >day time, min. 0.7-2.0°C >night time)
- Irregular and unpredictable rainfall
- Increased frequency of intense rainfall
- Melting and retreat of mountain glaciers;
- Increasing frequency of ENSO events (extreme climate events- Frequent occurrence of droughts and Floods)

These are predicted to continue with an overall decrease in the March April May (MAM) season rainfall and an increase in the October-November-December (OND) season rainfall

Kenya Government Commitments

Kenya has a Climate Change Act (2016)[5] which requires government departments to mainstream climate change actions into planning, integrate climate risk and report on climate change adaptation. The Ministry of Environment, Climate Change Directorate has also drafted a National Climate Change Action Plan (NCCAP) in which Water and the Blue Economy are seen as priority areas and Strategic Priority 3 aims to '***Enhance resilience of the water sector by ensuring adequate access to and efficient use of water for agriculture, manufacturing, domestic, wildlife and other uses'***. The plan focuses on infrastructure development and water harvesting/conservation structures and emphasises the importance of efficient water use. However, there is little reference to making water services resilient to climate change related events (e.g. increased frequency of drought and flooding).

The Ministry of Water & Sanitation recently drafted a new National Water Policy[6] which recognises the critical threat posed by climate change on the countries water resources. It commits the government to '***Mainstream climate change in the water sector to safeguard it from adverse effects of climate change by promoting adaptation and mitigation actions at national, basin and county levels***'. The policy further recommends that the coordination of this mainstreaming should be carried out by establishing climate change units in all water sector institutions. However, there is no evidence of these units being established to date. The policy makes very little reference to the need for water supplies or water systems to be resilient to climate related events, reflecting the tendency for sector stakeholders to plan separately for climate change and climate related disasters instead of adopting a risk informed development approach.

While these policy instruments appear to recognize the links between climate change, climate related events and the water sector, in a poll carried during a recent National workshop on climate resilient WASH, the majority (59%) of participants felt that the **existing water policies/strategies**

[3] Development Initiatives (2017), Assessment of Kenya's preparedness to disasters caused by natural hazards.
[4] The National Treasury and Ministry of Planning (2018), Disaster Risk Financing Strategy 2018-2022.
[5] Government of Kenya. Climate change act (2016).

[6] GoK, MoWS (2018), Sessional Paper no. XX on National Water Policy (Draft)

and climate change strategies and action plans are not fit for purpose to guide climate resilient water development.

UNICEF Commitments

UNICEF Kenya's WASH Strategy 2018-2022 (UNICEF, 2017) prioritises actions to reduce the inequality of WASH services and the risks that drought prone counties face in Kenya. Specifically, UNICEF aims to "Support county governments to incorporate risk-informed planning for resilience, and establish systems approaches to water and sanitation services sustainability". Also reducing stunting is one of the 5 UNICEF Eastern and Southern Africa Regional (ESAR) Priorities that were established in April 2014. The growing body of evidence suggests that there will be no meaningful reduction in the rates of stunting and acute malnutrition through nutrition specific action alone. The critical contribution of water, sanitation and hygiene to creating the environment for stunting and the specific impact of women's work load in water insecure areas on under-nutrition are areas of concern for UNICEF and its partners in Kenya.

UNICEF has collaborated with the Global Water Partnership to produce a strategic framework for WASH and Climate Resilient Development together with Technical Briefs which aim to improve understanding on how to ensure that climate resilience in considered in WASH strategies, plans and approaches (see Appendix A). UNICEF Kenya has commissioned a number of pieces of work to help the WASH section and its partners, principally the Ministry of Water and the County Water Departments, to assess the risks to water services from recurrent climate related shocks and contextualise these global guidelines to achieve its objectives to support risk informed planning and development.

Water System Resilience and Resilient Water Supplies – contributing to sustainability in ASAL areas

What is sustainability?

Sustainability is the process of maintaining change in a balanced fashion, in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspiration.[7]. Sustainability is frequently defined in terms of the following factors:

1. Financial - affordability, ease of payment, transparency, trust, etc.,
2. Technical – appropriate and well-designed technology and available capacity to maintain it
3. Social – available management skills and social cohesion to support a communal service
4. Environmental – extraction and use of water resources without negative environmental impacts

Box 1 – Definition of Water Supply Sustainability

A water supply service can be said to be sustainable if:

- the water sources are not over-exploited, but naturally replenished;
- water systems are maintained in a condition which ensures a reliable and adequate water supply;
- the benefits of the supply continue to be realized by all users indefinitely; and
- the service delivery process demonstrates a cost-effective use of resources that can be replicated.

Source: Sustainability of rural services: principles and practice (UNICEF 2011)

[7] http://www.globalfootprints.org/sustainability/

What is resilience?

Resilience can be defined as the ability to withstand (or recover from) threats or shocks, or the ability to adapt to new livelihood options, in ways that preserve integrity and that do not deepen vulnerability.[8]

A resilient society is one whose basic needs and key livelihood assets, such as water, are protected and continue to operate despite frequent shocks. In order to understand resilience in a particular context we have to identify Resilience for whom? Resilience of what? Resilience to what? For the purposes of this strategy we are **exploring the resilience of the water system for households in rural ASALS in Kenya with high exposure to drought risk**.

What is Water System Resilience?

Water resilience can be looked at from a water resource (environmental) perspective, from a water supply systems perspective and from the perspective of the water security of groups and households. This section focuses on a systems approach to water resilience, looking at the resilience of the system as a whole to deliver a reliable water supply to households at risk. The next section explores the resilience of individual water supply technologies and supply models.

Underpinning water resilience is conservation and sustainable use of water resources. In a scenario of climate change and rapid population growth the sustainability of water resources is in doubt. Water supply development has to be built on sound knowledge of the available water resources and their capacity to meet projected demand. The K-RAPID 3R approach[9] advocates for a conservation-based approach to water development to ensure water resilience. Effective policy and regulation are key to establishing a culture of looking at water development through a conservation lens.

Many rural water supplies in ASAL areas are seasonal and therefore, by definition, not reliable or resilient to a shock event such as drought. However, it is possible to look at community's access to water in a more holistic way and ensure that there are alternative water sources made available as the dry season or as drought progresses and hence the water supply 'system' is resilient. The system

[8] https://www.unicef.org/esaro/5484_emergencies_results.html
[9] https://en.acaciawater.com/pg-29143-7-111883/pagina/project_kenya_rapid.html

has to be designed for the livelihood of the users.

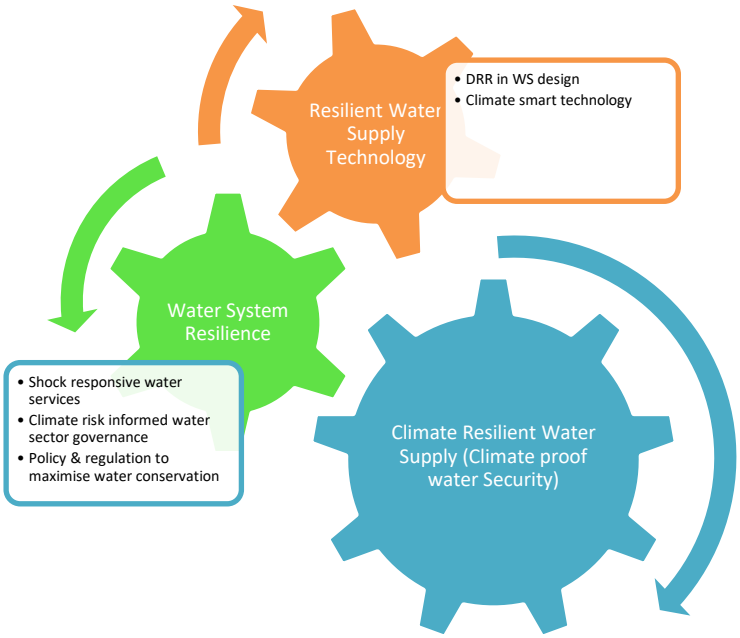


Figure 1 - Diagram of Water Resilience

Pastoralism and agro-pastoralism are themselves systems of resilience centred on water availability - using mobility and many strategies developed to build sustainable livelihoods in harsh and unforgiving environments; these should be incorporated, built upon and complimented. As movements (often between water points) are seasonal, so assessments, planning (programming), and implementation need to be seasonal too, aligning with this mobility and carried out by and together with the mobile hard to reach communities.

Many communities in ASAL areas[10],[11], of Kenya rely on a few, strategic water points (usually boreholes) in the dry season and keeping these operational to meet the increased demand as drought worsens is critical. These strategic water supplies need to be sustainable in terms of their technology, management, operation and maintenance (see section below). Investment in robust systems for sustainable water service delivery is essential but the systems should be risk informed and shock responsive, designed with understanding of the impact of drought on the supply and a mechanism for increasing capacity during a shock ('surge'). In other areas, multiple water supply systems need to be available at different times and different places, including seasonal ones. The system needs to 'flex and contract' in order to meet different family needs (crops & kitchen gardens, livestock, drinking, washing, cooking, etc.) at appropriate quantities and qualities, and notably with safe drinking water at all times and places, including 'on the move'. The central principle of water resilience is therefore the **reliability of the system to meet household needs**.

In Kenya, county governments have the responsibility for providing water to its citizens but this is often planned as a one-off investment in water infrastructure instead of continuous investment in a system which ensures reliable water supply throughout the seasons and through drought shocks. A 2017 UNICEF-Oxford University study of the functionality of rural water systems in Kitui County

[10] Radcliffe (2015a), Guidance note: Water Use and Management with Pastoral Communities in the Horn of Africa, UNICEF ESARO, May 2015.
[11] Radcliffe (2015b) Desk Review of Programming with Pastoral Communities on Water Use and Management in Arid and Semi-Arid Lands of Eastern Africa, Main Report, UNICEF ESARO, May 2015

recorded that there are more than 3,000 systems, (of which 50% were fully functional, and a further 14% partially functional), dispersed across an area of 24,385 km^2. County water departments don't have the human resources to efficiently service such large numbers of systems within an acceptable timeframe. Ad hoc and costly provision of water to remote communities by tanker does not build water resilience.

A recent study into water security for pastoralist women in Samburu[12] shows that women are spending an average of two and half hours a day collecting water, even in the wet season. The gendered nature of water leaves women with the burden of water collection without resources to ensure water security and no power to influence the management of water supplies.

Water resilience also has to be considered as a multi-faceted and multi-sectoral system recognising that multiple aspects affect households with respect to water depending on their main livelihood:

- Hygiene - handwashing, water treatment, storage, and use,
- Sanitation - including drainage and siting away from flood risk, ODF
- Health - disease and prevention, and including animal health - CHWs promote safe water sources, safe water handling and storage, household water treatment, hygiene promotion including hand-washing, WASH in health facilities and CLTS
- Nutrition[13] - notably milk for U5s, especially in times of drought, links to supplementary feeding centres and hygiene promotion to reduce diarrheal incidence.
- Livestock & agriculture - crops & kitchen gardens, livestock, fodder (note that irrigated fodder can maintain milk supply for U5s in times of drought)
- Education - relevant (WASH) curricula in education, better understanding relationships between human and animal nutrition, water and sanitation facilities in schools
- Security - access, risk for women in collecting water, conflict over water resources, especially during drought

Components of water resilience may include seasonal water supplies, providing water is there for a time when needed. Some water technologies can be more environmentally resilient (self-limiting, dependent on sizing and other factors) than others. For example, pans and other catchment systems can be carefully sized to protect fragile grazing reserves (in wet years there is more water stored and more grazing available, in dry years the inverse). The same is true of some shallow groundwater systems including shallow wells, infiltration galleries, and sub-surface dams

Water resilience for a household in ASAL areas therefore depends on a system to maintain reliable water access which may depend on a combination of multiple sources and services which work together at different levels and at different times/seasons. The system may be 'stretched' or have to flex in times of stress but should be able to bounce back to equilibrium without lasting damage.

What is Resilient Water Supply Technology

From a water resources and environmental perspective, resilient water supplies can be said to be those which supply water continuously even in times of drought, and where recharge can sustainably maintain these in future years. However, this reliability and sustainability cannot always be assumed to lead to water resilience as in ASALs permanent water supplies can lead to environmental damage, with overgrazing and unsustainable depletion of rangelands around water points.

[12] Balfour, Mutuku, 2018, Addressing Challenges of Water Security, proceedings of WEDC conference
[13] Centre for Humanitarian Change, 2016, Toolkit for Synergised WASH and Nutrition,

During the recent WASH climate risk assessment exercises in three ASAL counties, stakeholders identified a number of options for climate resilient water development. Many of these focused on infrastructure development intended to improve water storage and surface water harvesting, such as mega dams and sand dams. However, there was also recognition that much of the existing water supplies in ASAL areas (e.g. river abstractions, pans and rock catchments) provide only seasonal water access and are not reliable through a drought period.

The Kenya Government, with EU support, have created a common investment framework for a climate-proofed investment pillar in the Medium Term Plan with the aim of ending drought emergencies (EDE)[14],[15]. The climate-proofing concerns improved engineering design, planning for socio-economic synergies in times of crisis, long-lasting operation and maintenance, environmental soundness, and economic viability, and the investment needed in water retention structures alone is circa USD 1.6 billion. In line with EDE, for example, a recent UNICEF proposal[16] for Turkana County calls for investment in groundwater availability for livestock and domestic use, functionality of rural water points, and institutional and community capacity

Learning from Experience (2016/7 Drought Response)

Findings from Real Time Evaluation

In 2017 UNICEF commissioned an innovative real time evaluation (RTE) process to measure the success of its drought response[17]. Some of the findings from this exercise provide valuable learning to inform better programming for resilience in WASH.

1. Monitoring for early warning wasn't strong enough and typically monitors indicators that do not measure water stress. Recent research[18] is testing a scale for measuring household water security which could improve early detection of water stress as well as identifying particularly vulnerable households and communities in need of support.
2. In order to ensure that WASH responses to drought are relevant and effective the sector actors need to have a good understanding of how the water system works in each community (components of a multi-faceted system). Assumptions about household needs can lead to actions which did not address the acute water stress that some communities were facing (e.g. extension of pipelines to schools with existing water supplies and rehabilitation of saline water supplies while women were spending more than 8 hours a day collecting water from distant, seasonal river beds).
3. Support to assist the existing water systems to flex and respond to the drought stress, specifically meeting incremental increases in demand as seasonal water supplies failed, is required to ensure water resilience for drought affected households.
4. This support requires predictable, flexible financing. Some of this was available through County Government and the NDMA managed contingency fund but county government's

[14] Republic of Kenya 2014a, Ending Drought Emergencies Common Programme Framework
[15] Republic of Kenya 2014b, Ending Drought Emergencies: Common Programme Framework for Climate-proofed Infrastructure
[16] UNICEF 2018, Strengthening community resilience to climate change through improved WASH services in Turkana County, Kenya, Project Proposal
[17] Global Emergency Group, Centre for Humanitarian Change. (2018). *Real Time Evaluation of the Emergency Drought Situation Response in Kenya, 2017*.
[18] Balfour, N., & Mutuku, C. (2018). Addressing challenges of water resilience: a study of water security risk in pastoralist households in Kenya Retrieved from https://wedc-knowledge.lboro.ac.uk/resources/conference/41/Balfour-2910.pdf
.

use of the funds was ad hoc, did not follow a predefined plan and often did not address the areas of highest risk. UNICEF's funding was late and unrealistically restricted in activities and duration which made the UNICEF response less effective than it could have been.

5. UNICEF Nutrition has an ongoing resilience programme with a focus on system strengthening including roll out of the CMAM surge model for response to nutrition crises. This allowed the section to continuously monitor the emerging drought situation, advocate for a strong nutrition response from government and increase their support to 'surge' services in response to growing malnutrition. The UNICEF response therefore strengthened rather than substituted the government response. This system strengthening approach helps to build resilience and could equally well be applied to the water sector.

Programming for Resilience and Sustainability

This section presents the review of current programming, presenting examples of good practice as well as evidence from research in water resilience and sustainability. The review follows the theoretical framework described above, i.e.

- Resilient Water Supply Technology, including risk informed development (DRR) & climate smart technology
- Water System Resilience, including sustainable water supply systems and shock responsive systems ('Surge models')

Risk Informed/Resilient Water Supply Technology

Risk informed water development has three components:

1. Understanding the risk
2. Getting the technology right
3. Flexible design

At the county level, UNICEF support, as part of a multi-sectoral (and multi-agency) DRR process (usually led by NDMA) includes vulnerability capacity assessments, identifying gaps and risks and very importantly priorities related to water resilience. These need to be identified for current and future scenarios (e.g. dry season, wet season, drought year, disease outbreak), and together with all relevant available data and information inform discussion and analysis for planning, preparedness (along a 'no-regrets' approach), implementation, monitoring, emergency response, and recovery.

The risk related to a specific hazard such as drought is context specific and depends on a number of factors including; exposure, capacity and vulnerability. In the case of water insecurity risk the capacity of the system as a whole is the critical factor. Risk for a specific community, sub-county and county can be assessed in a number of different ways but the newly developed UNICEF WASH risk assessment methodology has proved useful in the recent pilots in Kitui, Garissa and Turkana. The results of the assessments can be summarised as follows:

- Drought is the highest risk with widespread exposure & economic loss
- Water Sources are vulnerable because infrastructure is not climate proof
- Environment is vulnerable because water abstraction is not sustainable and soil erosion is high
- Population is vulnerable because
    - the cost of reliable, drought proof, safe water supply is unaffordable (financial and labour cost to collect)

Box 2 - Solar-Powered BH Rehabilitation, Turkana, Sept 2017

The community borehole was rehabilitated as part of the drought response in 2017. The community reported that it had functioned briefly after the rehabilitation in June/ July and then stopped functioning. Upon investigation, it turned out that the solar power controller had tripped off the pump. The community had not understood that the pump that is running the system is designed to switch off once the groundwater levels fall below certain levels to avoid the pump running dry. Once that happens the safety switch needs to be reset after several hours. The community had therefore gone for 2 months without obtaining water from the borehole supply because no-one knew how to operate the new technology.

- the county Water Departments don't have ring fenced emergency funds

Technology choice is often driven by considerations of cost or donor preferences without adequate consideration to 'drought proofing'. In order to ensure a resilient water supply the disaster risk need to be taken into account at the design stage. For example, water supplies for institutions, such as health facilities and schools, that rely on rainwater harvesting without an alternative, 'surge' capacity for extended dry periods and droughts will result in closure of institutions during drought when they are most needed. Conversely a water supply which depends on a high level of technical knowledge to operate and maintain can result in a failure to provide water at critical times unless adequate technical capacity is available in the system (see box 2).

Climate Smart technology is being explored for many sectors in response to threats from both climate change impacts and increasing frequency of climate related hazards. In the water sector, solar water pumping technology qualifies as 'climate smart' and also climate resilient in that it reduces dependence on costly fossil fuels and also provides reliable water supply through a shock without requiring users to draw down their financial capital (see box 3)[19].

Box 3 - Solar Water Pumping Technology – Findings from GSWI

Global Solar Water Initiative (GSWI) formed by Oxfam, IOM and NRC in 2016. Through training, undertaking technical field assessments, managing a technical helpline, documenting and disseminating best practice, the GSWI has improved awareness, developed and strengthened technical skills and built an evidence based to lobby Governments and donors to invest more in renewable solar energy and enable humanitarian responders to increase the number of solar pumping systems being used within humanitarian operations globally. By analysing 140 different water schemes, they found that switching to solar will **pay for itself within four years**, and in some circumstances, solar is cheaper than a diesel generator from day one. **Over the life time of these systems solar will be 40-90% cheaper**.

However some challenges remaining

- **Low technical expertise still**
- **Panel theft/ vandalism** - Measures have to be put in place in some cases to this. Other measures: fencing, guard, siren, elevate them high
- **Availability of technicians and spare parts** normally only at capital level.
- **Global lack of solar evaluations,** need of building up stronger evidence
- **Management models for host populations**: transitioning to a much more **spaced use of water fees**, since it might take years for breakdowns to happen & potential cost of repairs is higher than for other systems

[19] Solar Water Initiative https://energypedia.info/wiki/Solar_Pumping_Toolkit_-_The_Global_Solar_%26_Water_Initiative

The deep boreholes developed in Somali Region of Ethiopia provide another example of risk informed/climate resilience water supply technology (see Box 4)

For water development to be risk informed in ASAL counties it also has to be designed to be flexible. Successful livelihood strategies for these areas depend on mobility and adaptation and households in these areas (particularly pastoralists) adopt these strategies to cope during a drought. This mobility and adaptation mean that water supplies have to able to cope with sudden increase and decrease in demand. A water supply serving 20 households in normal times may have to supply twice that many together with hundreds of head of livestock. It is important to plan water development holistically (at 'landscape' level rather than individual settlement level) so that critical, strategic water supplies are identified and these 'flexes' are anticipated and built into the design at the development stage. Ongoing pilots to implement holistic water resource management strategies within community conservancies in Northern Kenya provide an interesting model for this.

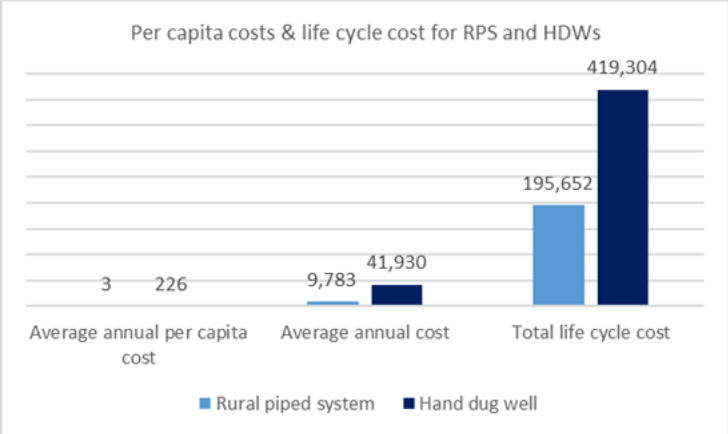
Box 4 -Deep Borehole Based Water Supplies in Ethiopia

In order to advance towards MDGs, Ethiopia drastically increased rural water supply, mainly through point-sources of protected hand-dug wells and springs. These sources are highly vulnerable to periods of low rainfall and drought as shallow groundwater is absent in the driest period of even an average year in the arid and semi-arid areas. Leading to tens of millions of dollars and significant man hours invested during each water shortage period for emergency operations. In 2015, UNICEF Ethiopia's WASH section took action to:

- Develop a scientific, evidence-based and open source method for identifying drilling sites with high potential for producing water of adequate quantity and quality
- Establish a piped multi-village water scheme, connecting the water source to settlements, schools and health facilities as well as providing livestock water points in pastoralist areas

The deep-borehole water systems provide:

- Reliable and resilient water supplies reduce vulnerability of communities to drought
- Lower lifecycle cost when emergency water supply to cover non-operational periods of shallow wells is taken into account



Source: UNICEF, 2017, ESAR Resilience Case Studies-Ethiopia Building Resilience through Drought Resilient Water Supplies

Water System Resilience

The following components need to be in place for a system to deliver reliable water services at household level (equivalent to ensuring household water security) in a risky environment:

- Sustainable water supplies
- Shock Responsive Services
- Responsible water resource management

Sustainable Water Supply Systems

Ensuring the sustainability and resilience of rural water supply is a complex issue. However, the increasing recognition that community based approaches alone are inadequate to achieve this goal paves the way to pilot and scale up alternative models. The availability of low-cost monitoring technologies, pre-paid water meters (ATMs), the growing experience with innovative financing, tried and tested rapid community monitoring, experience with surge models, and a devolved governance structure that facilitates local level and faster decision-making, together offer new opportunities to develop sustainable and resilient rural water supply.

Box 5 - Commercial Service Contracts and Automated Payment Systems

From 2008, with UNICEF and others, rural water supply boreholes in Turkana County with submersible electric pumps driven by solar panels. As part of a commercial service contract under a 'donation model' with a 15yr lifespan of continuous water supply, and local water pricing to cover O&M, users tap the water from the automatic dispenser using a smart card loaded with water credit via the mobile phone Mpesa system; a surveillance unit that allows remote monitoring via GSM and the Internet ensures timely maintenance. Oxfam has installed similar systems, known as Water ATMs (a total of 31 in Turkana and Wajir) and their reviews found that the units improved the efficiency, accountability and transparency of water supply as well as having the potential to provide early warning and early response in case of a climate shock. , The systems are technically, environmentally, and socially resilient, but the transparent payment system to a closed bank account is a key resilience feature. Units with surface water treatment are also in place; components of the system are available separately, including water ATMs.

A systems approach is required to address the need to ensure finance and technical support is available for both preventive and reactive maintenance. A blended finance model is proposed to ensure that there is sufficient revenue to meet the costs of maintenance (figure 2). Advocacy for widespread use of water 'ATM' is needed to strengthen the culture of payment for water, as well as improve transparency and strengthen accountability for revenues derived from user tariffs (see Box 5)[20].

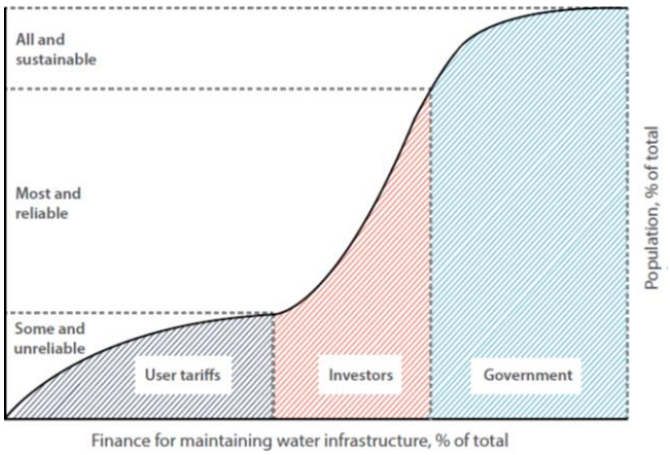


Figure 2 - Blended financing model for rural water supply

[20] Swift Consortium. (n.d.). *SWIFT water ATMs : experience and impact in Turkana and Wajir counties of Kenya*.

Box 6 – Fundifix Maintenance Model

- Professional Services – user payments and investor finance are contingent on service delivery. The FundiFix model guarantees a rapid service with offices staffed by local entrepreneurs and qualified technicians, with contracts contingent on high quality service delivery;
- Sustainable Finance – stable and adequate flows of finance from government, users and investors are required to maintain water infrastructure across a diverse portfolio of waterpoints serving everyone, every day;
- Smart Monitoring – regular data flows from mobile technologies with data analytics support a rapid repair service and inform sector monitoring, regulation and resource management;
- Institutional Coordination – government leadership in separation of policy,regulation and delivery is critical to ensure sector partners have clear roles and responsibilities

The model also adopts a fixed fee and contract approach but from the outset has stated that in the short-to-medium term the service will require subsidy if the poorest rural communities are to be provided with a reliable drinking water system. It differs in that the service provider is from the local private sector, arguing that for the model itself to be sustainable it needs to be Kenyan owned and managed. In the longer term, scale will minimise or eliminate the need for subsidy on the assumption that the customer base will grow sufficiently to cover costs. This is the 'insurance logic' model

For the poorest and most vulnerable communities it is unrealistic to expect that user tariffs will be able to cover the full costs of maintenance. In the medium term, subsidy from government and/or investors (donors, private investors, corporate social responsibility) is required to meet the short fall in revenue that will be required to provide an effective, performance-based maintenance service. The FundiFix PPP model has potential to meet this need and should be scaled up and evaluated (see box 6).

Shock responsive water services - The Water Surge Model

A surge approach for community management of acute malnutrition (CMAM) was designed and trialled in Kenya over the last 5 years. In addition, it has now been implemented in around 12 other countries. The approach assumes that a locally designed and led approach to programming ensures that the system can expand and contract quickly, appropriately and efficiently to sudden or slow onset shocks, while maintaining service quality. Completed and ongoing evaluations of the Surge approach in Kenya, Uganda, Niger and Ethiopia have shown that it is a highly acceptable and adaptable model for promoting resilience of the health system in the face of both predictable and unpredictable events. The evaluations have found that the Surge approach is highly valued by both individual health workers as well as the Ministry of Health.

A similar model can be developed for the water sector to address some of the failures of the sector to provide resilient and sustainable services. A model to allow services to scale up and scale down in response to changing water conditions to protect the health and production of the vulnerable population.

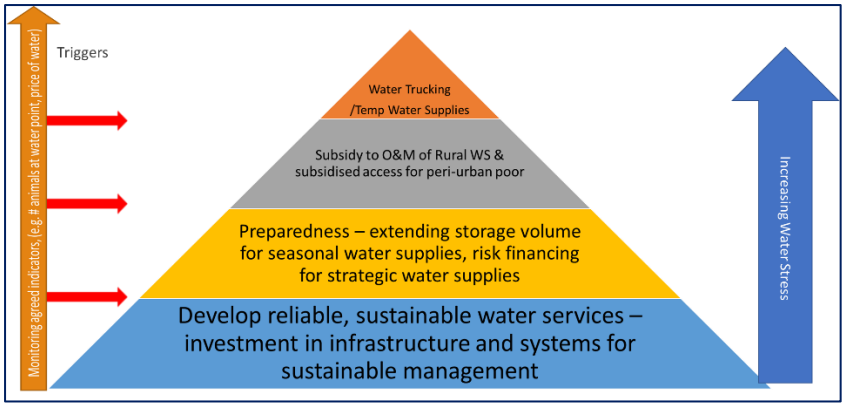


Figure 3 - Shock Responsive Water System ('Surge') Model

The principle of the model is to build on a strong base of reliable and sustainable water services. The 'surge' mechanism should include people or resources that can be added on quickly to the existing systems to meet additional demand/needs in a shock. It relies on a robust early warning system that monitors key indicators at a local (sub-county or ward) level. Different scale ups of support should be "triggered' when indicators reach pre-defined levels. The mechanism is designed to supplement rather than substitute existing service delivery systems (e.g. community management or public private partnership). In Kenya this could make use of the water indicators in the NDMA drought monitoring system and/or water actors could develop a unique set of indicators, easily measured by communities. These need to be reviewed monthly (or more frequently) to decide if a scale up, or down, should be triggered and could include:

- Water scarcity (measured by time taken to fetch water or price of water),
- Water storage volume or water supply delivery volume
- Water point reliability or functionality (measured by failure frequency)
- Water price (per litre).

Box 7 - Monitoring for Early Warning & Early Response

Oxfam in Wajir County, under the Consortium for **Sustainable WASH in Fragile Contexts (SWIFT)** project, improves drought early warning systems collecting data by mobile phone App placing inventory and monitoring data from water supplies to a web platform, including water usage patterns in chronically drought-affected areas, to develop better improve resilience and 'triggers' for drought response activities.

In 2014-15, Oxfam piloted the use of water ATM dispensing units with WAJIRSCO and a private company, in both Wajir town and outlying villages with payment made through credit vendors and small kiosks with the credit vending machines. These not only improved water availability and reduced queuing times, but increased revenue collection several-fold. During the floods in 2018, Oxfam sent free credits to the target affected ATM card holders (households) as part of their response. This is a good example of a shock responsive system which 'flexes' or expands in times of stress

The model requires multi-year investment in strengthening the water service delivery systems, particularly in the neglected, remote rural water supplies in ASALs where systems are weak and dependent on water trucking as a first response to dry season demand. There are examples of shock responsive water systems being piloted in Kenya, specifically through Oxfam's SWIFT programme (see Box 7)

Responsible Water Resource Management

The resilience of the water resources in Kenya have been extensively studied in both past and ongong research programmes in Kenya. In recent years these have focused on the impact of climate change on water resource resilience. Programmes such as REACH[21] and UpGroW[22] are introducing state of the art monitoring techniques to be able to predict the resilience of the water source under a number of development scenarios. Results indicate considerable risk of water resource depletion under scenarios of increasingly variable weather patterns and rapid population growth. The government is being supported by a number of partners to take early action to manage these risks, including World Bank through the Kenya Water Security and Climate Resilience programme (KWSCRP), which focuses on improved water resource management and construction of major water conservation projects.

Responsible water resource management to adapt to climate change requires a number of related initiatives

- Better monitoring, e.g. telemetric systems for groundwater and surface water monitoring.
- Good governance of water resources through empowerment of local water resource users associations (WRUAs), mandated by the Water Act (2016). This should include systems of restricted/prioritized water abstraction during dry periods under the principle that perennial water sources should remain perennial and not become seasonal.
- Strengthening of policy and regulation to support water conservation e.g. to include requirements to develop storage in all abstraction permits, installation of meters, use of efficient technologies (e.g. drip irrigation)

Further development of groundwater potential similar to the UNICEF Ethiopia experiment with deep groundwater investigation may not be appropriate in Kenya. Considerable investment by county governments since independence has resulted in abundant borehole infrastructure. What is required is better monitoring to avoid over exploitation of groundwater resources and investment in financing and technical support for improved operation and maintenance of borehole water supplies.

Measuring Progress

Considerable resources have been put into developing systems for measuring resilience over the last few years with complex models now being applied in various resilience programmes in the region[23]. However, there is little evidence of attempts to measure water resilience as a whole. Some progress is being made in measuring household water insecurity using a scale of household experience of

[21] https://reachwater.org.uk/research/where-we-work/small-towns-fragile-environments/
[22] https://upgro.org/catalyst-projects/gro-for-good1/
[23] Constas, M. A., Cisse, J., & Downie, K. (2016). *Technical Report Series No 2 Strengthening the Evidence Base for Resilience in the Horn of Africa R E P OR T 12 A Focused Review of Methodologies to Measure Resilience : An Analysis of Conceptual Presentations , Indicators , and Estimation Procedures*.

water insecurity[24]. This scale has been tested in Samburu and found to be reliable. It provides an opportunity to compare water stress across different households, communities and sub-counties as well as measuring changes in water insecurity in a particular area over time so it could potentially be used for early warning of a deteriorating drought situation. The household water insecurity scale could be considered as a proxy indicator for household water resilience.

The GWP/UNICEF Strategic Framework includes a Technical Brief on climate resilience WASH monitoring and evaluation. This proposes a results framework for climate resilient WASH and selected indicators to measure achievement of these results. Similar results frameworks were developed by three county WASH forums in March 2019. The activities selected for inclusion in these frameworks were appraised for climate resilience using a series of criteria (see figure 4). Some counties plan to use this to screen future water projects to ensure that climate resilience is part of the design of the project

- **Effectiveness:** will the option ensure sustainable and resilient WASH service delivery or behaviours?
- **Efficiency:** how much will it cost to implement? What economic benefits will there be to the community? Do these benefits exceed initial costs?
- **Timing of implementation:** How soon can it be implemented?
- **Uncertainty:** Is the option highly sensitive to uncertainties in future climate?
- **Capacity:** Is there sufficient capacity available to implement the option? Do communities have the capacity to manage the system, post installation?
- **Equity:** does the option ensure access for the poorest? Will the poor be expected to pay for access?
- **Synergies:** does the option offer opportunities to impact on other sectors?
- **Legitimacy:** is the option politically and socially acceptable?

Figure 4 - WASH Resilience Appraisal Criteria

As an alternative to trying to measure water resilience as a whole, the measurement of water resilience can be broken down into measurement of the different activities and results within the conceptual model of water resilience above (see Figure 1). Some examples of initiatives to monitor components of water resilience include:

- Remote monitoring of water supply performance and usage (Oxfam, Sweetsense and Fundifix) – linked to early warning systems (FEWSNET) and used by service providers to ensure rapid response to maintenance problems.
- Sustainability checks – point in time assessment of sustainability of water supplies across national and/or sub-national areas.
- GoK WSTF Joint Annual Operations Monitoring Exercise – analyzing data to produce a 'Sustainability Index (SI)' score for each county.

[24] Young, S. L., Collins, S. M., Boateng, G. O., Neilands, T. B., Jamaluddine, Z., Miller, J. D., … Schuster, R. C. (2019). Development and validation protocol for an instrument to measure household water insecurity across cultures and ecologies : the Household Water InSecurity Experiences (HWISE) Scale. https://doi.org/10.1136/bmjopen-2018-023558

Recommended Water Resilience Strategy for UNICEF KCO WASH

In the past UNICEF has used its considerable funding as the way to influence government but in future the role of trusted partner will need to be developed through provision of high quality advice and lobbying for support to institutional development of the sector. To strengthen water resilience in counties where there is high risk of regular disasters, UNICEF should advocate for more risk informed water development and support to system strengthening. This can most effectively be done through water sector coordination forums at county level which link closely to the Drought Management Authorities. Promising tools for monitoring water security alongside food security should be trialled at scale and built into surge models for shock response water systems.

While new county governments are prioritising new, large scale water development projects, UNICEF should continue to advocate for and support development of sustainability frameworks in county governments to manage operation and maintenance of 'non-viable' rural water supplies, including partnerships with private operators. Strong evidence to support the investment case for rural water sustainability should emerge from the ongoing risk assessment and this will help to shape the strategy for resilience. In future UNICEF can work at National and County levels to establish roles and responsibilities and capacity for a systematic approach to water resilience.

UNICEF should continue to partner with thought leaders, such as Oxford University, to trial and, where appropriate, take to scale innovative models for water sustainability. UNICEF's strength is really in being able to take good models to scale with government rather than as an innovator but strong documentation of lessons learnt from these innovations will be needed to provide the evidence base for scale up. Private operator models within rural water supply are supported within the new Water Bill (2016) and UNICEF will need to develop the skills and expertise to work within these models to ensure equitable service delivery instead of delegating to stronger international partners. Expanded partnerships including with academic institutions and private sector will be required to effectively engage in this area.

UNICEF's Water Resilience Strategy should follow the three-part approach of i) ffoundational – risk informed and climate smart development (DRR), ii) Reliability – Sustainable water supply systems and iii) Response capacity – Shock responsive systems ('Surge models' - services that expand and contract to meet demand). The foundational work will contribute to resilient water technology while the reliability and response capacity work contributes to water system resilience. Specifically;

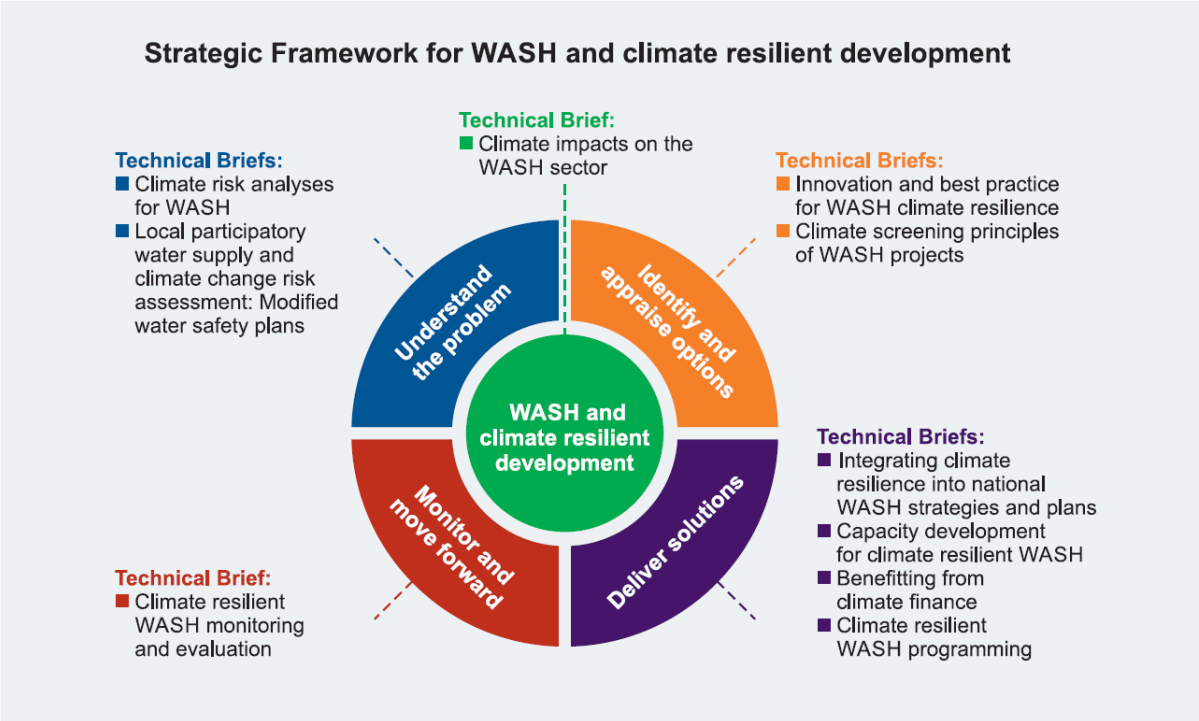
1. UNICEF should engage with government to encourage a **risk-informed development approach,** including:
    a. Working with country government water departments to carry our risk assessments to identify high priority areas for risk informed development
    b. Facilitating a multi-actor national steering group on climate resilient WASH to advocate for and support a more risk informed development approach
    c. Supporting review of planning to ensure that the Ending Drought Emergencies (EDE) framework and country risk assessment is mainstreamed into annual plans.
    d. Risk informed systems strengthening support should focus on capacity for early warning, needs assessment, contingency planning, surge mechanisms and community participation and accountability. Attention to strengthening sub-county governance capacity is of particular importance.
    e. Support water system strengthening including options to second Water Support Officers (WSOs) to county water departments (as a technical advisor to support coordination, appropriate technology choice and M&E)

2. UNICEF should continue to partner with academic institutions, innovative NGOs and private sector to promote viable options for **sustainable water supply systems.** This requires:
    a. Investment in piloting models for sustainable operation and maintenance of rural water supplies
    b. Building capacity of county water departments to interpret the new Water Act in a way that addresses the needs of vulnerable rural and urban[25] communities, including establishment of public private partnership models for water supply management and blended financing models
    c. Supporting strengthening of water management models, including appropriate capacity building using, e.g. Caritas Water Integrity Management Toolkit[26], which works at all levels of the system.
3. UNICEF should advocate for a more **shock responsive system for water service provision**. This requires strengthening the system and building in surge capacity at all levels, including
    a. Risk based planning and putting in place standard operating procedures for rapid decision making
    b. Piloting the surge model for one area (sub-county) including establishing water security monitoring (EWS), thresholds for triggering surge and agreed surge actions
    c. Work with NDMA CRF, insurance companies and others to establishing predictable and appropriate risk financing with pre-defined mechanisms for triggering release
    d. Strengthening coordination and collaboration in the sector to ensure all actors are supporting the same system instead of parallel emergency response mechanisms.

[25] UNICEF programming currently targets rural areas exclusively. However, the RTE recommended that UNICEF develop a better understanding of urban vulnerability (especially in pastoralist areas) and engage in securing reliable service delivery to these populations.
[26] Caritas, Water Integrity Management Toolkit, https://www.caritas.ch/fileadmin/user_upload/Caritas_Schweiz/data/site/was-wir-tun/engagement-weltweit/wasser/IM_toolbox_Methodology_outline_v3_for_scaling_up.pdf

APPENDICES

1. UNICEF/GWP STRATEGIC Framework for WASH and Climate Resistant Development[27]



[27] UNICEF/GWP STRATEGIC Framework for WASH and Climate Resistant Development, accessed from https://www.gwp.org/en/WashClimateResilience on 09/07/2019