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Improving the functionality of water investments in the drylands

Learning from Kenya's County Climate Change Fund

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Acronyms

ALDEF	Arid Lands Development Focus
ADA	Adaptation Consortium
ADSE	Anglican Development Services Eastern
ASAL	Arid and Semi-arid lands
Baraza	Public community meeting
BoQ	Bill of Quantities
CIS	Climate Information Services
CCCF	County Climate Change Fund
CCCPC	County Climate Change Planning Committee
CBWM	Community-Based Water Management
CIDP	County Integrated Development Plan
IIED	International Institute for Environment and Development
KMD	Kenya Meteorological Department
MIDP	Merti Integrated Development Programme
M&E	Monitoring and Evaluation
NDMA	National Drought Management Authority
O&M	Operations and maintenance
WASH	Water, Sanitation and Hygiene
WCCPC	Ward Climate Change Planning Committee
WOKIKE	Woman Kind Kenya
WUA	Water User Association

Executive summary

Water investments in the drylands are critical for water and food security, where access to water is essential for domestic and productive uses, including livestock production and rain-fed cultivation. Yet, ensuring the sustainability of water investments in the drylands remains an ongoing challenge, with evidence of approximately 20-40% failure rates of rural water supplies across East Africa and beyond *(Banks and Furey 2016; World Bank 2017; MacAllister et al 2020)*. Despite global improvements in water coverage, the functionality and long-term sustainability of improved coverage has lagged behind, often with a limited understanding on how and why investments in water supply fail *(Bonsor et al 2015)*.

Water development in the drylands has commonly lacked acknowledgement, nor taken account, of the dynamics of variable dryland environments and mobile pastoral production systems *(Walker and Omar 2002; Davies et al 2016; Gomes 2006; Mtisi and Nicol 2013; Nassef and Belayhun 2012)*. Greater emphasis has been given to the construction of water development infrastructure at the expense of institutionalising good water governance, or considering the needs of multiple users of water who may periodically access the water resource. Achieving sustainable access to water is not simply dependent on physical infrastructure and availability, but also the governance systems (social, political, economic issues) in place to deliver water. For these reasons, despite a proliferation of new water point infrastructure in some areas in recent years, many dryland communities continue to face water shortages, especially in the dry and drought seasons.

This paper evaluates the functionality of water investments in Kenya's drylands through a case study of water investments funded by the County Climate Change Fund (CCCF) in five pilot arid and semi-arid (ASAL) counties in Kenya; Isiolo, Wajir, Garissa, Kitui and Makueni. Kenya's CCCF mechanism is facilitating the finance of public goods investments focused on the water sector to increase the resilience of communities to climate change. Recognising the importance of water for food security in the drylands, the majority of the CCCF investments focus on increasing water availability and access through the rehabilitation and construction of water infrastructure. These investments are prioritised by communities through the participatory community-driven CCCF mechanism. The CCCF mechanism is now being scaled-out to other counties in Kenya. Learning on the functionality of water investments in the pilot counties will help inform the scale out to ensure the sustainability of water investments in the ASALs that build communities' resilience to a changing climate.

The study was implemented by the Adaptation Consortium and partners to better understand the challenges and opportunities in ensuring functional water investments for sustainable water and food security in the drylands. We carried out a literature review of past studies and evaluations assessing the functionality of water investments and the associated sustainability challenges when implementing water investments in the drylands. The literature review revealed the multi-faceted and multi-layered nature of determining water point functionality, and the complexity of understanding the immediate and underlying causes that lead to water point failure *(Bonsor et al 2015; 2018)*. The review also highlighted the need for an interdisciplinary approach that uses mixed methods to investigate the range of physical, social and institutional factors that can determine water point functionality. The

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study thus took an approach that assessed both the physical functionality of the water investments and interrogated the governance and social dynamics to help understand poor functionality.

Based on the review of literature, we designed a functionality survey to assess the functionality status of 62 CCCF water investments in the five pilot counties. The survey was co-developed with the field teams who were made up of county water department officials and the county implementing partners of the CCCF mechanism. The survey used the following categories of functionality to describe investments: functional, partially-functional, non-functional, and not-in-use. The main factors that contributed to the non- and partially-functional investments were determined from physical assessment of each investment by the survey team with input from respondents present at the investment sites.

The survey was followed by a stakeholder workshop and focus groups in each of the five counties to understand the underlying reasons behind poor functionality of the investments and challenges related to their sustainability. The functionality survey teams presented findings from the survey and detailed explanation was gathered on community management arrangements and dynamics, and the underlying factors (historical, institutional, political) affecting the design, implementation and maintenance of the water investments. Workshop participants included male and female water users, members of the investment site management committees and policy makers.

Across the five counties, just over half of the investments (51.6%) were functional, in comparison to 22.6% partially functional and 14.5% non-functional. Another 11.3% of investments, either water pans or sand dams, were assessed as not-in-use, as they are used seasonally and were dry during the time of the assessment, but were functional otherwise. If combining the functional and not-in-use investments, a total of 39 (62.9%) investments can be considered fully-functional, compared to 23 (37.1%) as either partially or non-functional. Functionality status was considered according to the investment being a construction or rehabilitation, with slightly more rehabilitation investments (68.6%) being functional compared to new-construction investments (55.6%).

The functional investments were operating well and communities were able to access water, although most functional investments showed signs of emerging or anticipated problems. For the non-functional investments, the waterpoint was not operational and the community were unable to access water. Factors contributing to non-functionality were assessed to be due to a range of reasons including; poor design and workmanship, poor siting, and damage from floods, wind or other causes. In the case of the partially functional investments, water was still accessible at the water point, but often in a limited capacity, and some of the infrastructure had collapsed or was broken. This was due to factors such as poor design and workmanship, poor siting, vandalisation, and lack of repairs and maintenance. Many of these factors were overlapping, such that in many cases more than one factor contributed to an investment being non or partially functional. The main factors contributing to non-functional investments were technical problems, while both technical and management problems contributed to the partially-functional investments. This suggests improving the management, and operation and maintenance (O&M) of investments, could help partially-functional investments regain their functional status.

Further investigation into the underlying causes of poor functionality show that the technical and management problems can be explained by a mix of governance, institutional, capacity, technology, and financial deficiencies. These include issues to do with the use of climate or hydrological information in siting and designing investments; the capacity of the county water departments and the community water management committees in implementing and maintaining investments; the overlapping roles between county water departments and community water management committees; cross border conflict; the costs of running investments and user's willingness to pay; and the absence of an effective water resource monitoring framework. This range of issues, many closely interlinked, capture the complexity of the situation underlying water provision in the rural drylands.

A number of drivers of sustainability of the CCCF water investments also emerged from the study. These can be viewed as positive elements that contribute to the long-term functionality of the water investments and provide lessons on good practice in planning future sustainable investments in the drylands. This includes an emphasis on rehabilitating and upgrading existing facilities to avoid the construction or duplication of investments when existing facilitates can be re-established; the separation of domestic and livestock water collection points to improve access to water for different users and water quality; the community prioritisation of water points that reflect local needs and demands; and the inclusion of women across all levels of project development and implementation to ensure they are at the centre of decision-making.

The findings highlight the importance of strong management and governance systems for functional water investments that continue to reliably provide water for enhanced resilience and water and food security outcomes. This includes greater emphasis on the 'software' aspects, such as O&M, good governance practices, and an appropriate institutional framework, to accompany the ongoing development of water 'hardware' infrastructural investments in the drylands. The study also highlights the challenges to community-based water management and the lack of external support to communities from county government as well as the private sector. Communities needs stronger support systems, especially in O&M, if they are to successfully manage sustainable water systems long after an investment is established.

The study provides a number of recommendations to improve functionality in the context of community-managed water investments in the drylands, and as the CCCF mechanism is scaled out to other counties in Kenya. These include; better integration of climate and hydrological information into siting and design; strengthened capacity of county government and community water management committees; better supervision of contractors; increased external support to communities in managing water investments; strengthened cross-border conflict mechanisms; improved water resources monitoring; and the development of a quality assurance framework.

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1. Introduction

Kenya's County Climate Change Fund (CCCF) mechanism is facilitating the finance of public goods investments focused on the water sector to increase the resilience of communities to climate change. In the drylands, investments in water are critical for water and food security, where access to water is essential for domestic and productive uses, including livestock production and rain-fed cultivation. Yet, ensuring the sustainability of the water investments in the drylands remains an ongoing challenge, with evidence of approximately 20-40% failure rates of rural water supplies across East Africa and beyond *(Banks and Furey 2016; World Bank 2017; MacAllister et al 2020)*.

Despite global improvements in water coverage since the Millennium Development Goals, the focus on increasing coverage and developing water infrastructure has obscured a 'hidden crisis' of water supply failure *(Bonsor et al 2015; Calow et al 2013)*. The functionality and long-term sustainability of improved coverage has lagged behind, often with a limited understanding on how and why investments in water supply fail (Bonsor et al 2015). Achieving new ambitious goals for universal access to safe and reliable water for all by 2030 under Sustainable Development Goal 6 will depend on the functionality and sustainability of these water supplies.

This paper assesses the functionality and sustainability of water investments in Kenya's drylands through a case study of a sample of CCCF water investments in five arid and semi-arid (ASAL) counties in Kenya. The study was implemented by the Adaptation Consortium and partners to better understand the challenges and opportunities in ensuring functional water investments for sustainable water and food security in the drylands. As the CCCF is further implemented and scaled out to other counties in Kenya, understanding the reasons behind poor functionality will enable existing and future water investments to become more sustainable and ultimately ensure water security.

1.1. Kenya's County Climate Change Fund (CCCF)

Kenya's CCCF mechanism was initially piloted by the Adaptation Consortium under the leadership of the National Drought Management Authority (NDMA) and is now being scaled out by the Government of Kenya under the Financing Locally-Led Climate Action programme (FLLoCA). The CCCF mechanism facilitates the flow of climate finance to the local level and strengthens public participation in the management and use of those funds. The CCCF was piloted in the ASALs to enable communities living in the ASALs to access climate finance to build their resilience to climate change. The CCCF mechanism was first piloted in Isiolo County in 2012 and then extended to four additional counties in 2013; Garissa, Kitui, Makueni and Wajir.

The CCCF mechanism has four interrelated components: 1) A fund to finance climate resilient investments at ward and county levels; 2) Ward and County Climate Change Planning Committees to prioritise investments that build resilience; 3) Participatory resilience planning tools and Climate Information Services to inform the design of investments and; 4) A Monitoring, Evaluation and Learning system to assess the contribution of investments in building the climate resilience of local communities while ensuring continuous learning, sharing and improvement.

The CCCF mechanism supports community-driven, bottom-up planning to develop and prioritise investments in public goods that strengthen communities' adaptive capacities. As prioritised by the communities themselves, the investments implemented in the five counties focus predominantly on improving access and availability of water (Table 1) reflecting the critical role of water security in strengthening resilience to climate change in the ASALs.

The CCCF mechanism is now being scaled-out to other counties in Kenya with the aim to institutionalise it within county governments with support from key national government institutions and development partners. Learning on the functionality of water investments in the pilot counties will help inform the scale out to ensure the sustainability of water investments in the ASALs that build communities' resilience to a changing climate.

Table 1 Summary of CCCF investments implemented in the five pilot counties

Type of investments	Number
Water investments	95
Strengthening natural resource governance	12
Livestock handling facilities	5
Livestock disease laboratory	1
Community radio station	1
Total	**114**

1.2. Water investments in the drylands: Sustainable management of water and pasture

The drylands or ASALs of Kenya, cover 89% of Kenya's surface area and support over a third of its population *(RoK 2012)*. Yet, the ASALs have suffered decades of economic and political marginalisation and a history of underinvestment and neglect by the national government. There has been a lack of public and private investment in basic services and infrastructure development and the ASALs lag behind in basic services such as in water, education and health provision.

When investment does occur in the ASALs, it does not always take into account the specificities of dryland environments where considerable variability in seasonal and inter-annual rainfall is the norm rather than the exception *(Krätli 2015)*. Dryland development policies are recurrently based on the presumed limitations of the drylands resource base with efforts to stabilise conditions rather than harnessing their inherent variability, resulting in interventions that undermine the resilience of dryland communities *(Krätli 2015)*.

Water development in the drylands has commonly lacked acknowledgement, nor taken account, of these dynamics of variable dryland environments and mobile pastoral production *(Walker and Omar 2002; Davies et al 2016; Gomes 2006; Mtisi and Nicol 2013; Nassef and Belayhun 2012)*. Water points have been placed with little regard to livestock grazing strategies and seasonal mobility. This has disrupted pastoralists grazing patterns and customary forms of grazing management, including the traditional space management strategies of pastoral communities who use access to water as a means of managing environmental variability. Water availability in the dry season is the critical factor that limits access to grazing and thus livestock populations. If there is no water supply, livestock are unable to graze on the surrounding pasture with consequences for livestock productivity. Where there is an oversupply of water, this can lead to intensive dry season access, degradation of pasture, and social conflict.

Controlling access to permanent water in the wet season is also important for ensuring the availability of pastures during the dry season. A focus on securing year-round availability of water for livestock use in the same locality, can encourage unsustainable groundwater use, permanent grazing and land degradation. For example, high-yielding boreholes attract large numbers of livestock from the surrounding area that are beyond the seasonal grazing potential of the area, negatively affecting rangeland and livestock productivity. There is thus need to balance any new water intervention with the number of livestock and pasture availability in the surrounding area on a seasonal basis. This seasonal 'pasture-water balance' requires good understanding of the local environment, including water and pasture availability and seasonal livestock grazing patterns. Simply increasing the number of water points for livestock may not necessarily achieve a sustainable water supply in the ASALs.

Furthermore, greater emphasis has been given to the construction of water development infrastructure at the expense of institutionalising good water governance, or considering the needs of multiple users of water who may periodically access the water resource. Achieving sustainable access to water is not simply dependent on physical infrastructure and availability, but also the governance systems (social, political, economic issues) in place to deliver water.

For these reasons, despite a proliferation of new water point infrastructure in the drylands in recent years[1], many residents continue to face water shortages, especially in the dry and drought seasons. For example, in Wajir County, water points may fail, breakdown or are abandoned only a couple of years after establishment *(Bedelian 2019)*. The poor design and governance of water investments is likely to affect their functionality and sustainability, accentuating water scarcity in the drylands with negative impacts on livelihoods, food security and wellbeing.

1 In Wajir County, the number of boreholes increased from 98 to 272 and the number of water pans from 206 to 260 between 2013 and 2018 (WCG 2018).

1.3. Core components of water security in the drylands and links to food security

Access to clean and reliable water is critical to the sustainability of the dominant livelihood activities in dryland areas – livestock keeping and rain-fed crop cultivation. In the drylands, where rainfall is erratic and unpredictable, the availability and access to water can be a major constraint to production. Water stress and access to clean and reliable water is a key challenge affecting the resilience of dryland communities, as identified by communities in local resilience assessments in piloting the CCCF mechanism *(Crick et al 2019)*. Climate change is likely to accentuate this stress, leading to increased pressure on water availability and access, ultimately leading to increased water and food insecurity.

Water security is a concept that is used to describe the outcome of the relationship between the availability, access and use of water *(Calow et al 2010)*. Water security is defined as 'availability of, and access to, water in sufficient quantity and quality to meet livelihood needs of all households throughout the year, without prejudicing the needs of other users' *(Calow et al 2010)*. The availability, access and use of water are intrinsically linked to food security and livelihoods. Food security is determined by the options people have to secure access to agricultural production and exchange opportunities, and these opportunities are influenced by access to water *(Ludi 2009)*.

In the drylands, communities need access to water for domestic and productive uses, such as livestock and crop production. Pastoralists depend on access to grazing and water for livestock, yet water needs for livestock are often neglected even though livestock are an essential component of livelihoods. Poorly designed dryland water policies and interventions that do not taken into account the dynamic and variable needs of dryland communities, can accentuate water and food insecurity.

Identifying the linkages between water and food production helps to understand how water security impacts on food security. Links between water and food security have been conceptualised by links between water, health, production and income *(Ludi 2017; Calow et al 2010)*. Inadequate access to water compromises food security through three principal pathways at the household level (Figure 1):

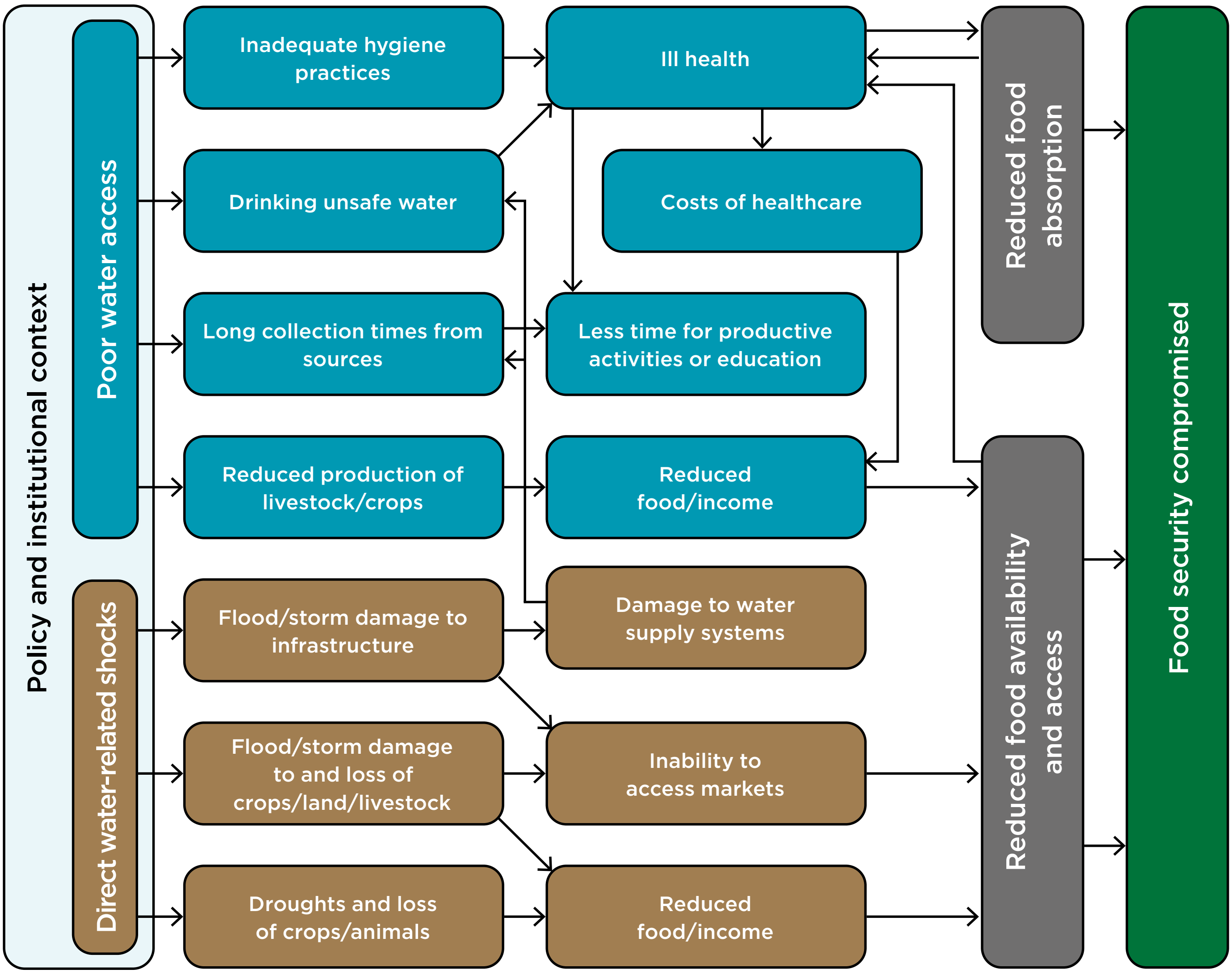
1. Lack of access to an adequate quantity and quality of water for domestic use, including for hygiene, causes water-related diseases and increases susceptibility to other illnesses.
2. Long water collection times reduce the time available for productive or education activities, and disproportionately affect women and girls.
3. Lack of access to water for productive use, such as for livestock and crop cultivation, limits food production and income generation.

In this analysis, we conceptualise a further layer – the policy and institutional context – in which the linkages between water and food security at the household level are embedded (Figure 1). Effective policies are required to achieve water and food security, but in the drylands, there has been a lack of appropriate, inclusive policy formulation which adequately integrates and accounts for the specificities of variable dryland environments and livelihoods. This has been accompanied by a weakening of customary governance institutions which have evolved to manage water and pasture resources sustainably. An unsupportive policy and institutional context mediate access to water, and the linkages between water and food security, and thus determines food security outcomes.

In the absence of appropriate policy, the impacts of climate change are likely to increase water stress, affecting water access and availability with high risk of water and food insecurity outcomes. The lower half of Figure 1 shows how the impacts of water-related shocks, such as floods and droughts, cause damage to infrastructure and the loss of crops and livestock. These in turn prevent access to markets, reduce food production and income, and ultimately compromise food security *(Ludi 2017)*. Climate shocks also accentuate poor access to water. For example, during drought, the distance and waiting times to collect water increase, and this impacts on livestock and crop production, educational opportunities, and income generation. Too much water can also cause impacts on health through contamination of domestic water sources.

These impacts can be particularly acute for poor and very poor households, who may not be able to meet their basic domestic or productive needs and negatively affect their wellbeing. Achieving water security during climate-related shocks is thus essential for household resilience and food security. Households can be supported by investments that aim to increase their resilience to climate-related hazards, by maintaining their access to water for domestic, productive and livelihood needs.

Figure 1 Causal pathways from lack of access to water and water related shocks to food-insecurity outcomes (adapted from *Ludi 2017 and Tucker et al 2013*)



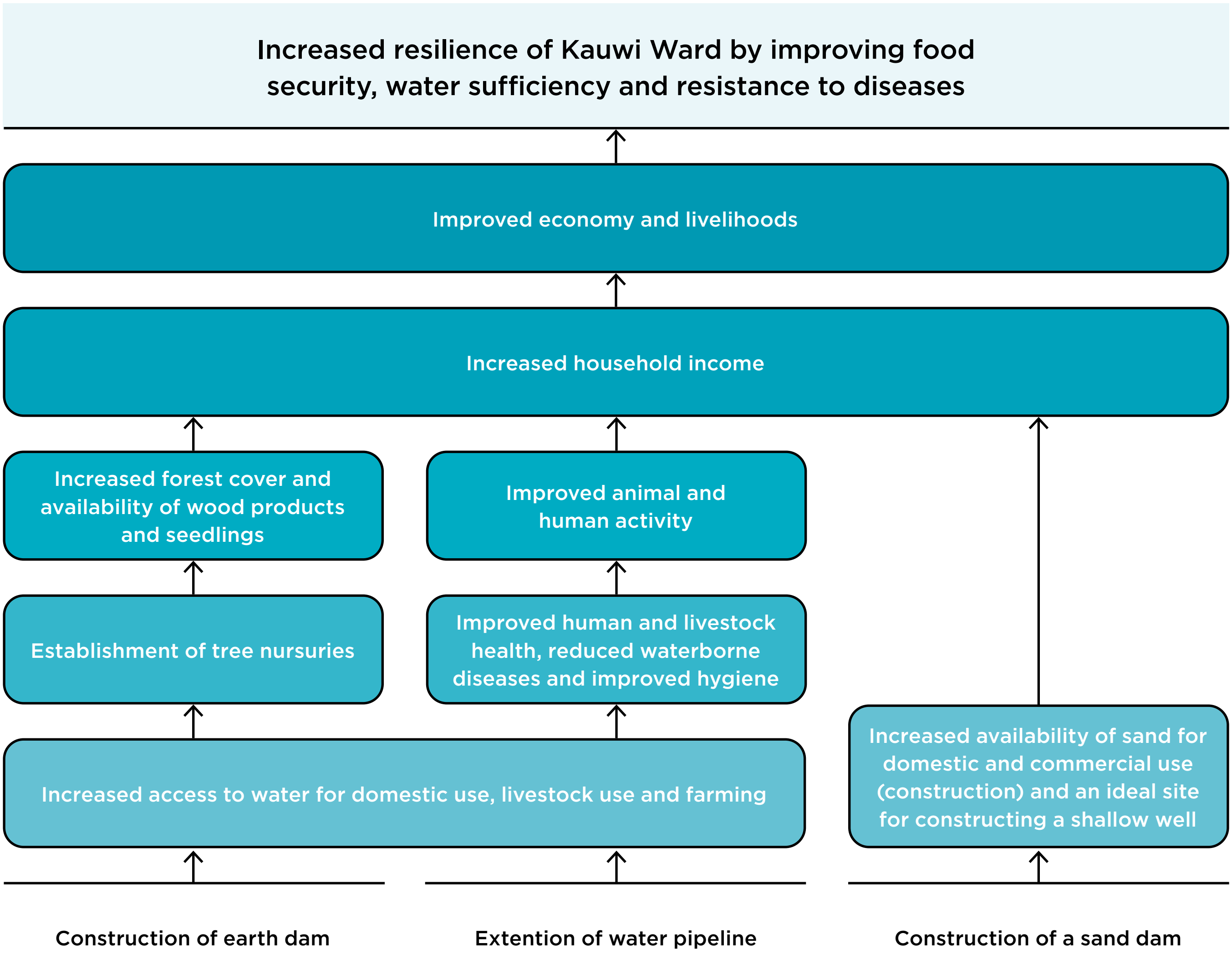
1.4. Improved water and food security and the CCCF investments

Recognising the importance of water for food security in the drylands, the majority of the CCCF investments in Kenya's dryland counties focus on increasing water availability and access through the rehabilitation and construction of water infrastructure (see number of rehabilitations vs constructions in Table 6). These are the investment choices prioritised by communities in the five counties through the participatory community-driven CCCF mechanism.

The CCCF investments in water infrastructure increase the availability of and access to clean water and ensure the reliability of water for livestock and domestic use for longer periods of time after the rains *(Crick et al 2019)*. This is critical to building greater resilience to drought. The CCCF investments also increase water security through strengthening governance structures and institutions in water management that govern control over water access and availability. Other key aspects of the CCCF investments for increasing water and food security include: reducing water contamination; spending less time fetching water; improving resource management; and strengthening conflict-resolution mechanisms *(Crick et al 2019)*.

Increased access to clean and reliable water can bring a number of benefits to communities and households, including improved human and livestock health, increased food security, and ultimately improved livelihoods. The CCCF investment proposals include a Theory of Change (ToC) that outlines the different steps in how an investment is expected to lead to increased food security and resilience to climate change *(Crick et al 2020)*. For example, for Mikuyuni Earth Dam in Kitui County, the construction of the earth dam brings increased access to water for domestic, livestock and farming uses, leading to improved human and livestock health and fewer diseases, improved animal and human productivity, increased household income, improved economy and livelihoods and ultimately increased resilience and food security for the Kauwi Ward community (Figure 2).

Figure 2 Theory of change of Mikuyuni Earth Dam in Kitui County *(Crick et al 2020)*



Studies on the early outcomes of the investments show how these expected outcomes are bringing about positive benefits for water and food security, and increased resilience *(Crick et al 2020)*. These outcomes correspond to positive steps in the investments' theories of change, that ultimately lead to improved water and food security, improved livelihoods and greater climate resilience. For example, at Guticha borehole in Wajir, herders reported no longer having to migrate during drought due to the rehabilitation of the investment, improving livestock health and production. At Jehjeh water pan in Wajir, the rehabilitation of the pan reduced water scarcity since rainwater now lasts longer into the dry season, thus preventing livestock losses due to drought. A water pump reduced the time taken to water livestock, and since livestock no longer access the pan directly, the water is cleaner for domestic and livestock use. Additionally, improvements in the governance of water access and use, meant migrant pastoralists are not allowed to use the pan during the rainy season, ensuring pasture remains available for grazing in the dry season. Crick et al (2019) summarise several studies from earlier pilots in Isiolo County to more recent assessments *(Ada Consortium 2018; Bonaya and Rugano 2018; Tari et al. 2015)*, to find a number of benefits to beneficiary households and communities (Table 2).

Table 2 Summary of benefits of CCCF investments to beneficiary households and communities (summarised from *Crick et al 2019*)

Positive outcomes observed as a result of a CCCF investment	Mechanism
Reduced time spent fetching water	Reduced time waiting times at water points and improved access to water through new water distributional infrastructure.
Increased water availability throughout the year	Improving the infrastructure of the water point, such as through fencing and tanks, allows the water to last much longer.
Improved water quality	Access to livestock and domestic use is now separate so the water is cleaner.
Reduced livestock deaths	Water is cleaner and lasts for longer so livestock suffer less from disease and drought mortality.
Livelihood diversification/ new economic activities	Greater availability of water for new livelihood activities, such as kitchen gardens, and growing and selling tree seedlings. More time to spend on livelihood actives as time taken to access water is reduced.
Economic benefits	Water lasts for longer so no need to buy water from elsewhere. Access to water throughout the year so farmers are able to produce for longer improving income earnings and food security.
Educational benefits	Greater educational opportunities as girls and boys attend school for longer.
Benefits to women	Women and girls have better access to domestic water and spend less time fetching water. They have more time for domestic responsibilities and other livelihoods activities. Reduced need to trek long distances or draw water at night reducing conflict with wildlife.
Other	Less migration away from home in search of water leading to less disease, conflict and stress. Strengthened natural resource customary management institutions.

To ensure the investments do lead to tangible benefits and positive impacts on resilience, food security and wellbeing, there is the assumption that water investments are functional, and enable the access and use of water for which they were designed. Non or poorly functional investments will break the chain of steps leading to improved human and livestock health and production, improved incomes, greater resilience, and sustainable water food and water security. It is thus important to understand how and why investments are non-functional to learn from past failures and ensure their long-term sustainability.

1.5. Rationale and aim of the study

The CCCF water investments occur within a context of inadequate water development in the ASALs and weak water governance. Ensuring functional water investments is a chronic problem in the drylands due to a legacy of poor policy and practice with respect to water investments and the significant development deficit in the ASALs. This results in significant challenges to ensure the long-term sustainability of water investments in the ASALs.

Community water supplies are the main source of water supplies in rural dryland areas in Africa and elsewhere. This is reflected in how communities in Kenya's dryland areas are prioritising community water investments through the CCCF decentralised climate finance mechanism. Dryland communities are dependent on access to water for domestic and productive uses, and an inadequate and unreliable water supply will accentuate water insecurity. Moreover, the impacts of climate shocks are likely to make this worse.

It is thus important and timely to understand whether water investments are functional, and how and why they may become non-functional, to inform future investments and interventions and provide more sustainable services. One of five key challenges in scaling out the CCCF to other counties includes ensuring the long-term sustainability of investments *(Crick et al 2019)*. If climate finance mechanisms such as the CCCF are to lead to positive outcomes for water and food security, in addition to the prioritisation and development of investments in water infrastructure, there must be sufficient support for their continued functioning and maintenance.

Given the technical and governance complexity of sustaining investments in water, the Adaptation Consortium in partnership with county partners in the five CCCF pilot counties, conducted a participatory study. The purpose of the study was to better understand the challenges and opportunities in order to ensure functional and sustainable water investments for water and food security in the ASALs. The study aimed to assess the functionality status of a sample of investments and the extent to which any failures were due to technical factors such as siting, design and workmanship, or management and governance factors, as well as the broader policy and institutional dynamics.

Research approach

We carried out a literature review of past studies and evaluations assessing the functionality of water investments and supply systems. The review also documented the challenges associated with implementing water investments in the drylands. Based on this review, we designed a functionality survey to assess the functionality of water investments in the five counties. We complemented the survey with a qualitative analysis of the reasons behind poor functionality and the challenges to their sustainability through stakeholder workshops and focus groups. In brief:

1. Literature review to review the functionality and sustainability of water investments in the ASALs.
2. Functionality survey to determine the functionality status of the CCCF investments.
3. Stakeholder workshops and focus groups to understand the reasons behind poor functionality and explore the challenges to the sustainability of the investments.

This working paper gives a summary of the findings of each of the steps above. The findings are then combined to give an overall set of recommendations to ensure the functionality and sustainability of water investments as the five pilot counties progress to full implementation of the CCCF and the mechanism is scaled out to other counties.

1.6. Relevance to policy

Improving the functionality and sustainability of the CCCF investments contributes to a number of global and national policies, including; the Sustainable Development Goals (SDGs) 2, 6 and 13 on Zero Hunger, Clean Water and Sanitation, and Climate Action respectively; Kenya's Big Four Agenda[2], specifically the pillar on Food and Nutrition Security; and Kenya's Ending Drought Emergency (EDE) pillar on climate proofed infrastructure.

The sustainable management of water services is a global priority under the SDGs. SDG 6 on water sets an ambitious goal to achieve universal access to safe and reliable water for all by 2030. Although the Millennium Development Goal target[3] on water was declared globally met, sub-Saharan Africa lagged behind with only two-thirds of people having access to clean water, and even less in rural areas (UNICEF/WHO 2015). Furthermore, ensuring the functionality and sustainability of any improved water coverage has taken a second place. Non-functional water supply will pose a major obstacle to achieving SDG 6 on safe water for all.

Kenya's Big Four Agenda's, Food and Nutrition Security pillar focuses on efforts to make food cheaper and more easily available through initiatives supporting crop farming, livestock keeping and fish production. All these require climate informed investments for better and sustainable management of water resources in support of food and nutrition security under a changing climate.

The CCCF is an expected output of the government's strategy for drought risk management – the Common Programme Framework for Ending Drought Emergencies (EDE) – a mechanism that aims at building synergy and complementarity between a wide range of existing and planned interventions to strengthen drought and climate risk management. Pillar two on climate proofed infrastructure focuses on providing adequate climate proofed infrastructure to reduce vulnerability to drought and climate change. This is expected to result from the provision of basic services and priority investments to expand and diversify the economy especially in water and transport sectors.

The CCCF is aligned with the policy and legislative framework for climate change in Kenya and supports implementation of the Climate Change Act (2016). Scaling up of the CCCF is a priority in the National Climate Change Action Plan (NCCAP) 2018-2022 under priority area one on disaster risk management, and will contribute to the achievement of Kenya's nationally determined contribution (NDC). The CCCF mechanism supports the development and strengthening of Kenya's County Integrated Development Plans (CIDPs) through increasing public participation, improving social accountability and transparency, and mainstreaming climate change into the CIDPs.

2 Focuses on four key areas namely enhancing manufacturing, food and nutrition security, universal health coverage and affordable housing.

3 MDG target 7c for water and sanitation aimed to halve the proportion of people without sustainable access to safe drinking water and basic sanitation.

2. Review of the functionality and sustainability of water investments

2.1. Understanding functionality and sustainability

Evaluating the functionality of a water supply system or water infrastructure is an increasingly common assessment in the evaluation of water projects, including Water, Sanitation and Hygiene (WASH) interventions *(Fallas et al 2018; Bonsor et al 2018: Carter and Ross 2016; Whaley and Cleaver 2017)*. Determining the functionality of water supplies is gaining popularity among practitioner and academic circles. A review of 111 water point functionality studies in the grey and peer reviewed literature found that 81% of studies were published after 2008 *(Wilson et al 2016)*. In another review of the functionality of community-managed water supplies, much of the literature had emerged from practitioner-led studies in the last 10 years by large WASH projects focusing on the sustainability of rural water supplies *(Whaley and Cleaver 2017)*. Understanding functionality is viewed as an essential step towards ensuring water service sustainability *(Tincani et al 2015)*.

The benefit of using functionality is that it is a relatively quick assessment of water facilities to determine whether or not they are operational at the time of the assessment. However, functionality is considered a snapshot view of the condition of the water point on the day of visit, or over a given period, and thus not a good indicator of sustainability *(Carter and Ross 2016)*. It is one dimensional, and binary in its simplest form, i.e., functional or non-functional *(Carter and Ross 2016)*. It is also open to interpretation, unless clearly defined, making consistent and comparable use difficult to ensure *(Carter and Ross 2016)*.

Sustainability on the other hand refers to the continued functioning and utilisation of a water facility over time, in particular looking ahead to the future, and thus includes a temporal/reliability dimension *(Carter and Ross 2016)*. Since functionality is a snapshot view taken on a particular date or set of dates, it is essentially set in the present or past. Functionality and sustainability are thus not synonymous *(Carter and Ross 2016)*. Sustainability is also multi-dimensional as the continued functioning of a service depends on environmental (i.e., the water resources), social, cultural, institutional and governance (i.e., policies, organisations, management), technical and financial dimensions.

There is no universally adopted definition of water point functionality or what constitutes a functioning water point *(Bonsor et al 2018)*. Absence of an approach inhibits comparison across evaluations and studies, as well as the ability to identify the problem and find solutions *(Bonsor et al 2018)*. The review by Wilson et al (2016) found there to be no single accepted definition of functionality. Twenty-eight percent of studies did not explicitly define functionality but assumed a simple binary working/not working definition, and another 34% of studies used the binary functioning or non-functioning to define a water point.

Scholars have argued the need for much clearer definitions of water point functionality to be able to understand and move towards improving service sustainability *(e.g., Bonsor et al 2018, Carter and Ross 2016)*. Specifically, they suggest functionality should go beyond the simple binary definitions and whether a water point was working or not at the time of an assessment, and propose an extended definition and understanding that includes categories of assessment of yield, reliability, and water quality *(Carter and Ross 2016; Bonsor et al 2018)*. For example, Bonsor et al (2018) in the Hidden Crisis project used a tiered approach to define and measure functionality and performance levels of hand-pumped boreholes:

1. **Binary:** Water point working and producing some water on the day of the survey (Yes/No)
2. **Yield snapshot:** Functionality criteria – Water point provides the sufficient minimum design yield (e.g., more than 10 L/min) on day of survey
3. **Reliability of yield:** Functionality criteria – Water point provides a reliable yield year-round (less than one 1-month downtime within the past year)
4. **Water quality:** Functionality criteria – Water supply passes WHO inorganic and pathogen guidelines of water quality indicators

The tiered approach enables an increasingly detailed assessment to be carried out at subsequent levels, but allows the assessment to be reduced to a simple measure where this may not be appropriate nor feasible.

Nevertheless, defining functionality is only the beginning in understanding the causes behind poor functionality. Water point functionality is a multi-faceted and multi-layered issue with growing complexity as you look beyond the immediate causes of failure to the underlying drivers of failure *(Bonsor et al 2018)*. The factors underpinning water point failure maybe numerous and inter-related, and there maybe layered and inter-linked sets of factors which can lead to failure (Bonsor et al 2015). Bonsor et al (2015) identified different layers of causality that help to explain the factors underpinning water source failure:

- **Symptoms of failure** (e.g., low yield, poor water quality, mechanical failure)
- **Causal factors** (e.g., poor siting, poor construction, lack of access to spare parts, lack of basic maintenance etc.)
- **Underlying conditions and root causes of failure** (e.g., institutional arrangements, lack of knowledge to inform policy, corruption, low capacity of community management)

Understanding this range of physical, social and institutional factors that contribute to the functionality of water supply points requires an interdisciplinary approach that uses mixed methods and data. This requires, for example, complementing physical assessments of water points with analysis of community management, governance, financing and the wider institutional arrangements, external support and policy which will influence the water supply service.

Collecting these types of data can help to move beyond just knowing how many water points are functional or non-functional, to understanding why water points fail or what contributes to their poor functionality. They however require considerable investments in terms of time and resources and may not be feasible or appropriate in all surveys. Thus, a balanced approach is required that allows a clear and well-defined assessment of functionality with the resources available.

2.2. Functionality and community-based water management

Community based water management (CBWM) has emerged as the leading model for rural water supply as many nations decentralise their water supply services. In Kenya, following devolution under The Constitution of Kenya, 2010, water service delivery is decentralised to county governments who are responsible for providing water and sanitation services. County governments operate through water service providers to deliver water services; however, these tend to operate primarily in towns, whereas in rural areas these services are dependent on water management committees or water user associations. Most rural water supply is thus delivered through community-managed water points, as is the case with the CCCF investments.

Community water organisations play the leading role in the management, financing and cost recovery, and operation and maintenance (O&M) of water points. When thinking about functionality, Whaley and

Cleaver (2017) warn that it is not only the functionality of the waterpoint itself that is of concern, but also the functionality of the community organisation responsible for managing it. Indeed, in their review of the literature on functionality as it relates to CBWM, they found that it is the management of the water point as opposed to the design and implementation of a water point, that is significant in determining water point functionality *(Whaley and Cleaver 2017)*. The post-construction phase while significant for determining water point functionality, tends to receive less attention by donors, governments and development agencies *(Whaley and Cleaver 2017)*.

Assessments of functionality should thus go beyond a physical assessment (the 'hardware) of functionality, to encompass the management and governance arrangements (the 'software') of the community water organisations. Whaley and Cleaver (2017) further advise to look beyond the form and functioning of committees towards the institutional landscape in which they are embedded, for example at the wider community dynamics which influence the functioning of a water point. Insufficient attention tends to be given to power relations, power dynamics and broader governance processes which influence how committees are able to function, such as in the relationships between communities and local governance actors *(Whaley and Cleaver 2017)*.

Despite the growth in CBWM and its popularity among donors and implementing agencies, there is growing critique of CBWM as a blanket prescription for rural water supply delivery *(Harvey and Reed 2007, Chowns 2015; Whaley et al 2019)*. Poor performance records and functionality rates are indicative of the challenges the CBWM model faces, such as limited training and capacity, the expectation that communities can raise funds for O&M through collecting user fees, and the general lack of support communities receive.

Indeed, the capacity of a water management committee to manage or maintain a water point is not only related to their governance, technical, or operational ability, but it is also influenced by the availability of external support. External support may include technical, financial or management support, and this support may derive from central and local government, NGOs or the private sector. Evidence shows that where community organisations receive effective external support, the sustainability of water services becomes more likely *(Harvey and Reed 2007; McIntyre and Smits 2015)*.

2.3. Functionality and sustainability of water points in the drylands from previous studies

2.3.1 Functionality estimates

This section gives functionality rates of water points across sub-Saharan Africa from a review of the peer review and grey literature. Estimates specifically for the drylands are harder to find, whereas there is a larger body evidence on the functionality of rural water supply more broadly. Examples are given below of functionality estimates of different types of water points and suggested reasons for their failure. The evidence shows high levels of failure of water points in the drylands and beyond, often only a short time after establishment.

In Kenya's ASALs, a study in 2011 of 100 water supply schemes installed by Welthungerlife between 1 and 5 years old *(Behrens-Shah 2011)*, found that 41% of schemes were fully functional (the entire system was functioning as planned), 45% partially functional (at least one component of the system was no longer functioning adequately) and 14% non-functional (unable to deliver water). The main reason for those partially or non-functional systems were insufficient maintenance, and design or construction issues. The study found a clear link between the functioning or activeness of the community-based water committee and the functionality rates of systems.

Data available through the Water Point Data Exchange *(Banks and Furey 2016)* estimate that on average 78% of water points including a variety of water supply system technologies were functional across 11 countries in Africa (not specifically in drylands). There were high failure rates early after installation; 15% after one year and 25% by their fourth year were non-functional. This indicated widespread problems with poor quality water point installation.

In Tanzania, a study by Water Aid *(Taylor 2009)*, estimated that 46% of public improved rural water points were non-functional, with 25% of systems non-functional only two years after installation. Similar figures are reported by the World Bank (2017), after a study showed that 40% of Tanzania's rural water points were non-functional in 2016, with 19% failing within the first year of construction. Determinants of water point failure less than a year after construction were largely attributed to hydrological factors such as groundwater depth and production, but these became less important in the longer term. In the first two to four years after construction, 60% of failures result from the wrong choice of pump type, increasing to 73% in the longer term (11 years or more), suggesting that the choice of technology was a key reason for water point failure.

In Ethiopia, during a drought in 2015-2016, mean functionality ranged from 60% for motorised boreholes to 75% for hand pumped boreholes *(MacAllister et al 2020)*. Motorised pumps were most likely to fail in the first year of operation. Hand pumps failed the least to begin, but the probability of failure rose rapidly after two years and had the highest failure rate from 5-10 years. Gravity water pumps failed least overall.

In another study on the development, use and maintenance of water sources in Borana, Ethiopia in 2018 *(Cullis et al 2018)*, it was suggested that 17-20% of water points were either broken or only partially working at any one time. This was related to there being limited funds to provide quality services, where funds are dependent on short term projects. Inadequate resources at the local government (Zonal) level meant that they were unable to provide leadership and coordination which affected the operation of water sources.

2.3.2 Functionality per water point type

Since each water point type presents its unique set of factors that influence functionality *(Wilson et al 2016)*, the rest of this section gives functionality estimates or failure rates broken down by water point type, and the suggested reasons for their failure. The water point types included here are those applied in the CCCF investments. We also added handpumps as this is where the most literature exists. Table 3 gives the key features of these water point types, including a description, common use, governance, and access.

Table 3 Characteristics of main water investments/technologies:

Water point type	Description	Common uses	Governance/ Management	Accessing water	Common challenges
Motorised borehole	Access deep underground water supplies. Powered by a diesel or solar pump. High or low yielding.	Domestic, livestock, cultivation, water trucking	Water management committee, water utilities company, private sector operator, NGO	Livestock troughs; domestic water kiosks.	Water salinity. Limited capacity of communities to operate. Complex rangeland management/ water issues
Shallow well	Access shallow groundwater. Usually low yielding	Domestic, livestock. irrigation	Private individual, water management committee, customary institutions	Direct from well or through hand pump	Extracting water can take long and lead to water contamination
Water pan or pond	Seasonal rainfed surface water source. Usually separated for livestock and domestic use. Often only operational in the wet season, many dry up soon after the last rains	Domestic, livestock	Water management committee, customary institutions, none	Direct from pan or through livestock trough or water kiosk	Siltation, contamination and high evaporation losses. Ownership disputes
Sand / earth dam	Rainfed. Sand wall constructed to capture water and retain sand upstream serving as a water reservoir	Domestic, livestock, micro-irrigation	Water management committee	Draw off system	Siltation, poor water quality, high evaporation.
Rock catchment	Rainfed. Rainwater runs off the rock surface and is gravitated to a water reservoir constructed with a sand dam	Domestic, livestock, micro-irrigation.	Water management committee	Draw off system to water kiosk and livestock trough	Poor water quality if catchment is not cleaned before rains
Hand pumped borehole*	Manually pumps water. No distribution system. Access groundwater typically to depth of 45m.	Domestic, livestock	Water management committee	Tap stand	Quality and availability of spare parts. Corrosion of pump parts

*not a technology of this study but very widespread in the functionality literature.

General note: This figure is generalised for brevity, so it will not be able to capture all the varieties in application or the diverse conditions found across countries for the different types of water points.

Motorised boreholes

A study assessing water availability in Isiolo County, Kenya in 2002-2003 (Mati et al 2005), found that out of a total of 71 boreholes mapped, 39 were operational in wet season conditions but only 11 throughout the year. The poor state of boreholes was attributed to a lack of community management; only 24% of the mapped boreholes had an organised community management system. Key reasons for boreholes not operating were the lack of a system to organise purchasing fuel for the pump and to undertake repairs when needed. Salinity was also a common problem; only 32% of boreholes had water of sufficiently low salinity for human consumption.

In a large-scale study in Ethiopia, motorised boreholes experienced the lowest levels of functionality (c60%) compared to other water source types, including hand-pumped boreholes, hand-dug wells and springs *(MacAllister et al 2020)*. It was suggested that the functionality of motorised boreholes is hindered by their high and costly requirements for maintenance and repair, especially in rural areas where there is limited access to skilled expertise. However, motorised boreholes were important sources of water for communities as the dry season progressed as shallow groundwater and surface water sources failed *(MacAllister et al 2020)*.

The need for specialised technical capacity for the operation and maintenance (O&M) of motorised boreholes is a reoccurring challenge reported in the literature. A study in 2018 in Wajir County, Kenya *(Bedelian 2019)* found that despite a large number of new boreholes drilled in Wajir in the previous five years, some were not functional within two years of establishment, due to suggested reasons including ineffective management, frequent breakdowns and long repair times. Boreholes that were managed by a private sector operator in partnership with the community, appeared to perform better than those under community management alone.

Water pans and ponds

Water pans usually only operate during and following the rains as they are associated with local rainfall. This is illustrated in a study of 12 water pans In Isiolo County in 2002-2003, which found that only one was operational throughout the year, five were operational during the wet season and six suffered from high siltation (Mati et al 2005). Siltation and lack of maintenance were major reasons for the limited role water ponds played for livestock and domestic use in Borana, Ethiopia in 2018 *(Cullis et al 2018)*.

Shallow wells

A survey of 27 hand-dug wells (fitted with handpumps) in the Kenyan ASALs, found 44% to be fully functional, 37% partially functional and 19% non-functional *(Behrens-Shah 2011)*. Their performance was thought to be more attributed to O&M and committee performance rather than technical issues. In Malawi, a survey of 338 shallow wells fitted with handpumps in 2013, found 69% pumps to be functioning well (good yield and easily pumped by users), 9% functioning badly (low water yield or difficult to pump) but still producing water, and 22% not functioning (Holm et al., 2015). In Ethiopia, the functionality of shallow wells (without hand-pumps) was related to rainfall; there were large declines in functionality as the dry season progressed and shallow groundwater reduced, but functionality began to recover with the onset of the rains *(MacAllister et al 2020)*.

Rock catchments/sand dams

A study of 12 rock catchments in the ASALs of Kenya found 58% to be functional and 42% to be partially functional *(Behrens-Shah 2011)*. Technical issues, such as the inappropriate placement of scour pipes and poor fencing caused many to be partially-functional due to poor water quality. The same survey found sand dams to be more prone to non-functionality: only 17% were fully functional, 42% partially functional and 42% non-functional. Many issues were linked to technical problems caused by poor design and/or construction of the systems *(Behrens-Shah 2011)*.

Handpumps

Handpumps are a widespread rural water supply technology type in sub-Saharan Africa, although not a technology currently applied in the CCCF investments. A large-scale assessment across 20 countries in sub-Saharan Africa found that 36% of hand pumps are not working at any one time *(RWSN 2009)*. Foster et al (2019) present handpump functionality best estimates from a review of studies for 38 countries in sub-Saharan Africa and found that more than one in four handpumps are non-functional at any point in time. MacAllister et al (2020) study comparing functionality of different water source types in Ethiopia, found hand-pumped boreholes had the highest overall functionality rate (c75%), including as the dry season and drought progressed.

2.3.3 Sustainability challenges

The case studies provide a range of estimates of approximately 20-60% non-or partial functionality. Although a crude estimate, besides considering the difficulties in comparing across studies with varying functionality definitions and water point types, this demonstrates the widespread failure of rural water supply investments and threats to their long-term sustainability.

The poor functionality rates are indicative of a multi-layered and interrelated set of factors that determines their ability to achieve sustainable services *(Walter and Javernick-Will 2015; Bonsor et al 2015; Whaley and Cleaver 2017)*. Based on the review of literature of water points in the drylands of East and West Africa, Table 4 summarises how water point failure is attributed to a range of factors, including institutional, technical, financial, management and environmental reasons. These factors influence the sustainability of a water supply system and are commonly used in assessments of existing and future water projects in the WASH literature[4].

Walters and Javernick-Will (2015) argue that although each of these factors affect the sustainability of a rural water system, it is the dynamic and systemic interaction of these factors in the form of feedback mechanisms, that must be considered to understand why a water service may fail. This echoes the need to think simultaneously about the hardware and software components of functionality or sustainability, as well as the cross-cutting and interlinked nature of technical and governance issues with respect to water investments in the rural drylands.

4 The Sustainable Index Tool (SIT) developed by USAID and Rotary International in 2012, covers a range of quantitative and qualitative indicators that are grouped into five main factors that influence the sustainability of services: Institutional, management, financial, technical and environmental https://www.ircwash.org/sites/default/files/sustainabilityindextool.pdf.

Table 4 Common challenges to the sustainability of implementing water investments in the drylands

Sustainability challenges	Example
Institutional	
The politicisation of water development. Political interference in the development of water infrastructure as a way to win votes and elections. Politics and patronage drive decisions regarding the construction of new water points, rather than communities' water needs and priorities.	Kenya *(Walker and Omar 2002; Gomes 2006; Bedelian 2019)*; Tanzania *(World Bank 2018)*; Malawi *(Oates and Mwathunga 2018)*
The partial decentralisation of water services. The incomplete decentralisation of water service management leads to a misalignment of the roles and responsibilities in terms of technical and financial support between national and local government, undermining accountability and service delivery.	Tanzania *(World Bank 2017)*; Malawi *(Oates and Mwathunga 2018)*; Kenya *(Bedelian 2019)*
Poorly defined roles and responsibilities among stakeholders. The large number of uncoordinated actors in the water sector result in badly designed and planned investments, the poor management of infrastructure, duplication of efforts, and poor use of funds.	Burkina Faso and Niger *(Debus 2014)*; Kenya *(Bedelian 2019)*
Emphasis on outputs rather than outcomes. An emphasis on the construction of new infrastructure or water points comes at the expense of good governance and maintenance procedures. New points are established rather than ensuring the sustainability of existing points	Uganda *(Le Sève 2018)*; Kenya *(Bedelian 2019)*; Tanzania *(World Bank 2017)*;
Lack of local participation in design and planning of water investments. Community members' voices, in particular of women, are not included in decision-making over water projects, thus their needs and priorities are not taken into account.	Ghana *(Marks et al 2014)*; Wajir, Kenya *(Bedelian 2019)*
Customary institutions are disregarded in favour of formal institutions. Water investments and their management operate outside of respected customary management systems, undermining the traditional governance structures. This results in the ineffective management of water points and a lack of local legitimacy and trust.	Ethiopia *(Cullis et all 2018)*
Management	
Political interference in the management of water. Locally-formed water management committees are susceptible to dominance by community elites and are sensitive to ethnicity and political issues. This can have implications on how water resources are shared among a community.	Kenya *(Gomez 2006; Bedelian 2019)*
Lack of a preventative maintenance schedule. Maintenance is reactionary and repair-based rather than preventative and set at fixed time intervals to reduce the chance of breakdowns occurring.	Burkina Faso and Niger *(Debus 2014)*

Sustainability challenges	Example
Financial	
Weak financial capacity of community-based water management committees. Committees commonly have limited financial management skills, leading to poor financial transparency and accountability. This limits the revenue available to carry out maintenance and repair of facilities	Burkina Faso and Niger *(Debus 2014)*; Kenya *(Bedelian 2019)*
Inadequate transfer of financial resources from national to local government. The incomplete decentralisation of financial and human resources to lower levels of administration creates resource deficiencies and difficulties for local authorities and institutions to carry out their functions	Burkina Faso and Niger *(Debus 2014)*; Malawi *(Oates and Mwathunga 2018)*
Technical	
Weak technical capacity of water sector actors. There are technical capacity gaps at community and local government levels. Community water management committees have limited technical capacity to maintain or repair water facilities. Local government institutions may also lack technical capacity, especially to handle technologies that require high levels of training and expertise.	Ethiopia *(Cullis et al 2018; USAID 2014)*. Kenya *(Bedelian 2019)*
Poor choice of water point technology. In the case of boreholes, the choice of pump is an overriding factor in explaining water point failure. The choice of technology will not be sustainable if not aligned with the capacity of the community. The choice of technology can also lead to failure if it does not meet the community water users' demands and needs	Tanzania *(World Bank 2017)*; Burkina Faso and Niger *(Debus 2014)*
Environmental/Climate	
Lack of knowledge of the water resources. Incomplete understanding of the groundwater resources causes problems in correctly siting water facilities and can limit the sustainability of water point supply. There is improper knowledge of where the water resources lie, and in what quantity and quality.	Uganda (Bonsor et al 2015)
Water development occurs without regard to livestock grazing and mobility. Water infrastructure is developed in isolation from broader rangeland and natural resource management. This disrupts pastoral grazing patterns and the traditional space management tools of pastoralist who use the lack of water as a mean of controlling access to pasture, encouraging settlements and degradation of surrounding rangelands	Ethiopia *(Cullis et al 2018; USAID 2014)*; Kenya *(Walker and Omar 2002; Gomes 2006; Bedelian 2019)*

3. Methodology

The methodology was designed in light of the preceding review of literature on functionality and sustainability. The review highlighted the need for multidisciplinary field methods to investigate the interlinked underlying reasons of poor functionality or failure of water investments, that balance both the technical and governance aspects, or hardware and software components. Or to put it another way, in our assessment of functionality of the CCCF water investments, we do not just want to know what's functional and what's not, but we want to know why, and unpack functionality and the reasons behind failure.

The study thus took an approach that assessed both the physical functionality of the water investments and interrogated the governance and social dynamics that helped explain poor functionality. First, we designed a water point functionality survey to determine the current functionality status of each water investment visited in the five counties. An assessment was also made at this stage on the status of the community management committee. The survey was then followed by a stakeholder workshop in each of the five counties, where through focus groups, detailed explanation was gathered on community management arrangements and dynamics, and the underlying factors (historical, institutional, political) affecting the design, implementation and maintenance of the water investments.

3.1. Study Area: The CCCF investment counties

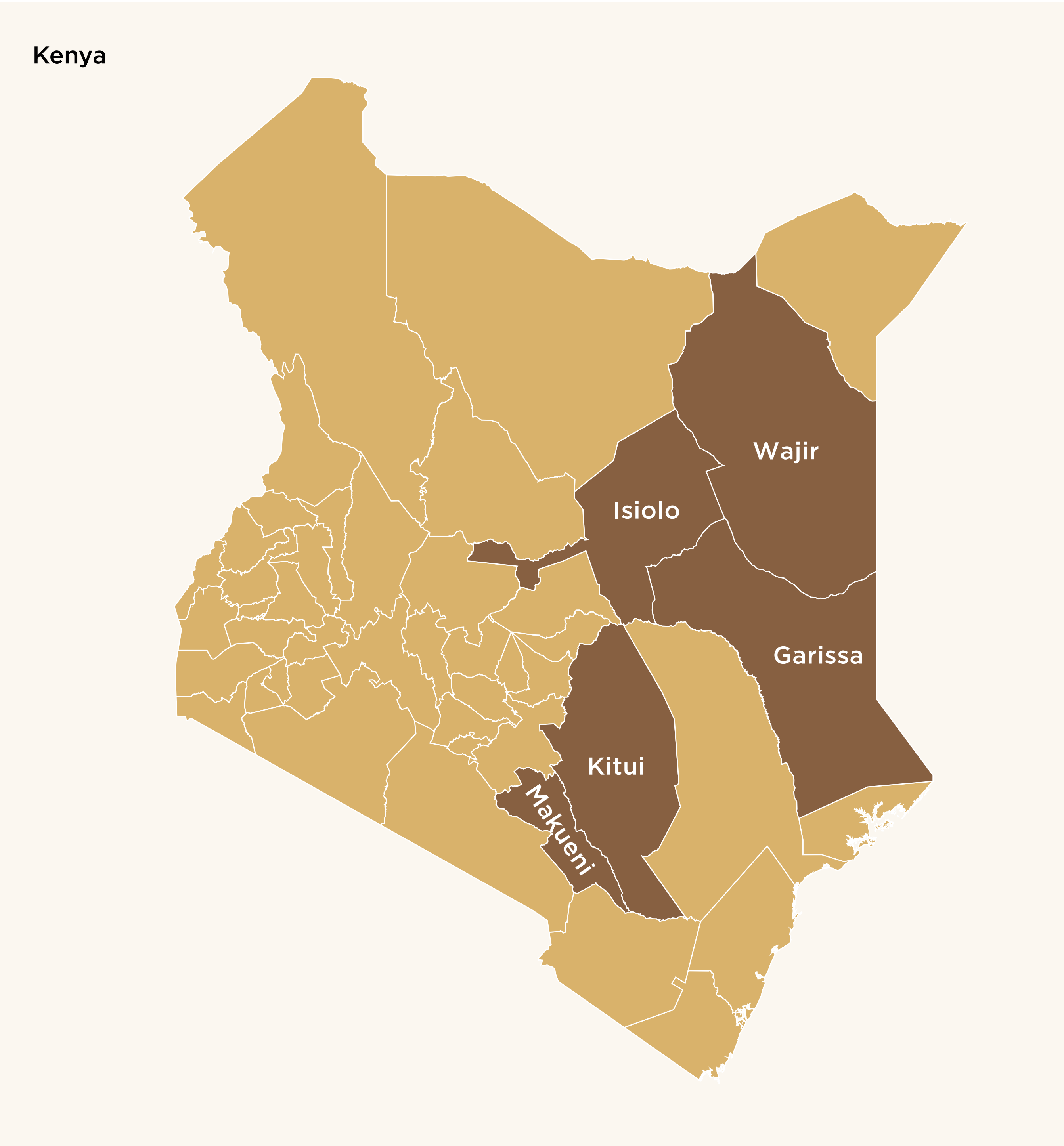
The CCCF water investments established to date are located in the five Kenyan arid and semi-arid (ASAL) counties of Isiolo, Wajir, Garissa, Kitui and Makueni (Figure 3). The first three counties are arid while the last two semi-arid. The five counties in total cover approximately 29% of Kenya's land area and a population of over 3 million people. The dominant livelihood activities are pastoralism in Garissa, Isiolo and Wajir, and rain-fed agriculture and livestock keeping in Kitui and Makueni.

In total, the ASALs make up 89% of the Kenya's land mass, support 36% of the population and 70% of the national livestock herd *(RoK 2012)*. The ASALs are Kenya's major meat producing areas, and the livestock sector, which is predominantly in the ASALs, contributes 12% of the national GDP and 43% of the agricultural GDP *(Behnke and Muthami 2011)*. ASALs contribute to the food and nutritional security through the supply of beef, milk and other livestock products.

The ASALs are characterised by high rainfall variability in both time and space, and regular drought. Water resources are a mix of natural surface water sources (such as rivers, streams and springs), developed surface water sources (such as water pans and earth/sand dams), and developed groundwater sources (such as wells and boreholes). There are few permanent rivers, and seasonal streams usually flow during the wet season and remain dry for rest of the year. There can be high water run-off due to low vegetation cover and the high-intensity rains.

Analysis of climate trends in the ASALs between 1977 and 2014 show an increase in the maximum temperature in all five counties; Isiolo (1.01C), Wajir (0.85C), Garissa (0.69C), Kitui (1.01C), Makueni (1.22C), and a decline in rainfall *(Abuya et al 2019)*. Furthermore, climate projections for the ASALs show maximum temperatures may increase by a further 1.5C by 2030, whilst rainfall will become more unpredictable *(Abuya et al 2019)*. Investing in community prioritised climate change adaptation strategies and investments will therefore be important to reduce vulnerability and build resilience to climate impacts.

Figure 3 Map showing location of study and CCCF investments in the five ASAL counties in Kenya *(Crick et al 2019)*



3.2. Water point functionality survey: assessing functionality

A functionality survey was co-developed and reviewed collaboratively by participants during a training workshop in Makueni County in June 2019 (see Annex 1 for survey). The workshop was facilitated by ADA, IIED and ALDEF. The workshop participants comprised implementing partners and water department officers from each county, who then formed the five county survey teams. Training covered the procedures for data collection, data entry and checking, data analysis and writing up a survey report. During training, three water investments in Makueni (a sand dam, a weir and a rock catchment) were visited to test the survey tool. These investments were representative of the types of investments that would be encountered during the functionality study. After testing the survey, the questions were discussed, agreed upon, and reformulated as necessary ensuring relevance to the study and the investment types. Ethical procedures from IIED were followed and consent obtained from all respondents who assisted during the field work at each investment site. The respondents were usually representatives from the Ward Climate Change Planning Committees (WCCPC), the investment site management committees, area chiefs and beneficiaries. Respondents were asked questions about the management and use of the investment visited.

The survey teams visited 62 out of a total of 95 (65%) CCCF water investments across the five counties. In Kitui and Garissa, all the CCCF investments were surveyed. In Wajir, only one investment was not visited due to insecurity issues, and in Makueni, two investments were not visited due to logistical issues. In Isiolo, it was decided to focus on a representative subset of investments, partly due to the large overall number (39) of investments implemented in the county, but also because a stock-taking exercise had been recently conducted on these investments *(MIDP 2018)*. Table 5 provides a summary of the types of water investments developed, the main uses and number of beneficiaries, the total cost of all the investments, and the implementing partner for each county.

Womens focus group in Wajir County stakeholder workshop © Adaptation Consortium

Table 5 Summary of CCCF investments in each county

County	Isiolo	Wajir	Kitui	Makueni	Garissa
Survey dates	16-24th June	18-25th June	17-21st June	17-24th June	15-25th June
Total no. of CCCF investments	39	24	12	15	5
Investments visited in the survey	9	23	12	13	5
Investment types	Rock catchment, sand dam, water pan, borehole	Borehole, water pan	Sand dam, earth dam, piping system, rock catchment	Sand dam, earth dam, rock catchment, piping system	Borehole, piping system
Main uses of investments	Domestic, livestock (incl. camels), wildlife	Domestic, livestock (incl. camels), afforestation	Domestic, livestock, micro-irrigation, afforestation, brick making	Domestic, livestock micro-irrigation, afforestation, brick-making	Domestic, livestock (incl. camels)
Total number of beneficiaries	175,519 people 1.8M livestock	281,696 people 621,489 livestock	50,500 people 32,100 livestock	35,925 people 116,001 livestock	94,000 people 23,800 livestock
Total cost (KSh)	145 million	100.96 million	56.24 million	58.28 million	10.06 million
Implementing partner	MIDP, County government of Isiolo	ALDEF, County government of Wajir	ADSE, County government of Kitui	ADSE, County government of Makueni	WOKIKE, County government of Garissa

Based on the review of literature, the study used the following definition of a functional water point: 'one that is operating as expected and serving the community well on the day of visit and within the last one month' (Box 1). Including functionality in the last one month, extended the 'snapshot' view to include the previous 30 days. The survey went beyond a binary assessment of functional/non-functional, to include partially functional water points, defined as 'one where some of the components are absent, broken or damaged, but there is still some water available to the community.' The survey did not go into further estimates of yield, reliability, water quality as done in larger recent studies (Bonsor et al., 2018) due to resource and time constraints.

Box 1: Definition of functionality status as used in the survey

A **functional** water point is one that is operating as expected and serving the community well on the day of visit and within the last one month.

A **partially functional** water point is one where some of the components are absent, broken or damaged, but there is still some water available to the community.

A **non-functional** water point is one where some or all of the components are absent, broken or collapsed, with the result that water is not accessible or available to the community.

A **not-in-use** water point applies to those water points that may not be in use due to seasonality and low rainfall, but they are intact and functional during the wet season.

Functionality: 'Snapshot view of the operational status of a particular water point or supply scheme on the day of visit or within a time given/limited period.'

Sustainability: 'Continued functionality and utilisation of a water point or supply scheme into the future.'

The main factors that contributed to each of the non and partially-functional investments were determined from physical assessment of each investment by the survey team with input from respondents present at the investment sites. These factors were subsequently elaborated further during the stakeholder workshops to understand the underlying causes of poor functionality (see below). The period the investment was either partially or non-functional was also asked of the respondents. We also reviewed the functionality of the management committees responsible for managing each water point with the respondents, through questions concerning; current status, membership and gender representation, training, and challenges and suggested solutions.

As highlighted in the review, assessing the functionality of water infrastructure in the drylands has its methodological difficulties. Functionality is a snapshot view of the condition of the investment on the day of visit and the timing of the survey will influence the functionality status. To overcome this, the survey incorporated questions on functionality status in the last one month and any emerging problems that could influence the future functionality status. Moreover, in variable dryland environments, there are seasonal differences that will affect the functionality and use of water points. Since the survey was conducted in the dry season when some investments (such as water pans constructed for seasonal use) were not being used since they are developed for use in the wet season, but during the dry season they dry up, these were labelled as 'not in use', although they were fully functional during the last wet season.

Functionality is also open to the interpretation and the judgment of the observer, leading to possible inconsistency among observers *(Carter and Ross 2016)*. To reduce this bias, all survey observers were involved in agreeing on the definition of functionality status, and technical experts, rather than survey enumerators, carried out the survey *(Carter and Ross 2016)*. The survey teams were made up of county water department officials and county implementing partners, who had technical knowledge of the water points as well as a history of the investments.

The study was primarily designed to assess the functionality of the CCCF water investments. However, many of the investments involve the rehabilitation and addition of supporting infrastructure, such as water tanks, kiosks and troughs, to improve access and availability of water at an existing water point rather than construction of a new water point (Table 6). We report functionality status for the waterpoint overall but explain where this is due to the original or existing water point infrastructure rather than that added as part of the CCCF.

When visiting investment sites, there were some difficulties in finding the right people to talk to and provide up to date and accurate information on the water point. In pastoral areas people move away from seasonal water sources to areas with permanent water sources, hence there maybe few water users to talk to. This issue, as found in other assessments in pastoral areas *(Bekele and Akumu 2009)*, relates to the timing of an assessment, which if occurring during the dry season may mean there are few water users to talk to.

3.3. Stakeholder workshops: understanding functionality

Stakeholder workshops and focus groups discussions were held to understand the underlying reasons behind poor functionality of the investments and challenges related to their sustainability. The functionality survey teams presented findings from the survey, and through discussion and feedback from participants, the underlying causes behind poor functionality were deliberated. Participants also discussed broadly any technical and governance challenges associated with the water investments.

Each workshop was run over two consecutive days. Workshop participants included male and female water users, members of the investment management committees and policy makers. Participants were divided into three focus groups: policy makers; women, including committee members; and men, including committee members. Each focus group discussed the findings of the functionality survey, the underlying causes behind poor functionality, as well as the general context of sustainable water investments in the drylands. Focus groups also discussed the roles and responsibilities of county government, the management committees, and the community, and gave recommendations to improve the development, management and sustainability of water investments. The focus group discussions lasted about two hours and were facilitated by staff from the county implementing partner and supported by ADA staff.

Summary of methodological approach:

	Steps in evaluating functionality	**Method used**
1	Assessment of functionality status	Functionality survey
2	Determining the main factors contributing to non-and partially functional investments	Functionality survey, including discussion with respondents at investment sites
3	Understanding the underlying causes of non and partially functional investments.	Stakeholder workshops and focus groups

4. Findings

4.1. Investment types visited in the five counties

From the 62 CCCF investments visited during the survey, 27 were new constructions, mainly earth and sand dams in Kitui and Makueni, and 35 were the rehabilitation of an existing water point, adding additional storage and distribution infrastructure such as water kiosks, livestock troughs, water pumps and piping to improve access to water (Table 6). Rehabilitation particularly applied to boreholes and water pans in Isiolo, Wajir and Garissa. Almost all new constructions were in the semi-arid counties (Kitui and Makueni), compared to almost all rehabilitations in the arid counties (Isiolo, Wajir Garissa).

Table 6 Number of construction (C) vs rehabilitation (R) investments visited during the survey per water point type in each county

County		Isiolo	Wajir	Kitui	Makueni	Garissa	Total
Borehole	C	1					1
	R	2	11			4	17
Water pan	C						0
	R	4	12				16
Earth dam	C			7	2		9
	R			1			1
Sand dam	C	1		2	7		10
	R						0
Pipeline distribution	C			1	2	1	4
	R						0
Rock catchment	C			1	1		2
	R	1					1
Weir	C				1		1
	R						0
Total	C	2	0	11	13	1	27
	R	7	23	1	0	4	35

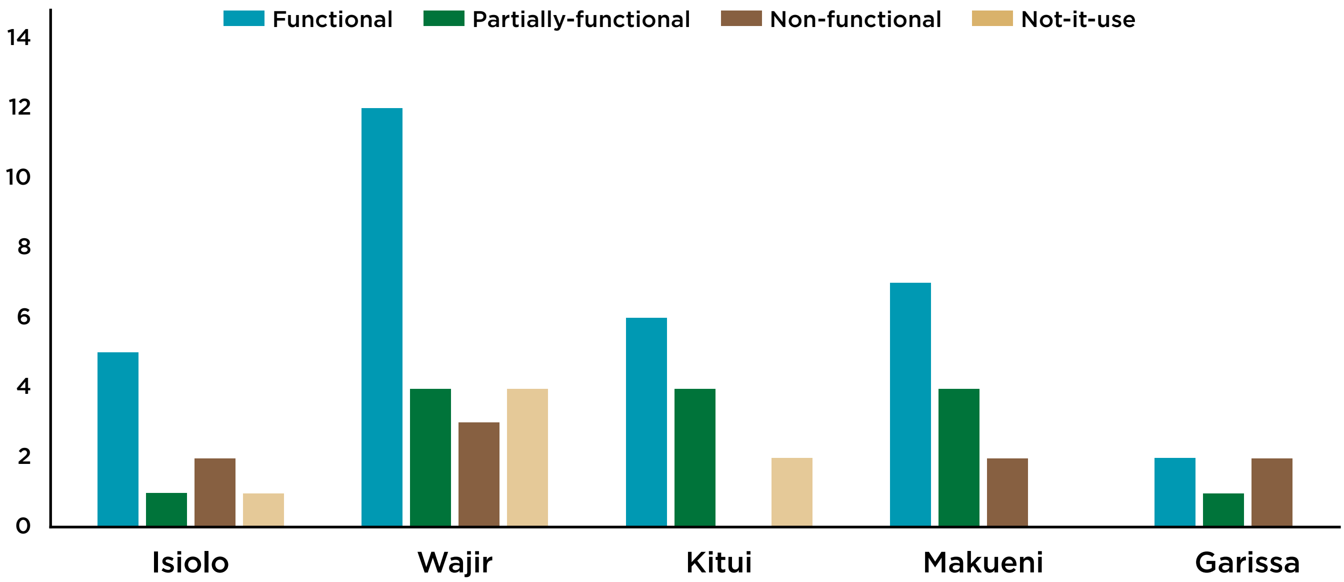
4.2. Functionality status of investments

Across the five counties, just over half of the investments (51.6%) were functional, in comparison to 22.6% partially functional and 14.5% non-functional (Table 7 and Figure 4). Another 11.3% of investments, either water pans or sand dams, were assessed as not-in-use, as they are used seasonally and were dry during the time of the assessment, but were functional otherwise. If combining the functional and not-in-use investments, a total of 39 (62.9%) investments can be considered fully-functional, compared to 23 (37.1%) as either partially or non-functional.

Table 7 Overall functionality status of investments across the five counties

County	Functional	Not- in-use	Partially functional	Non-functional	Total
Isiolo	5	1	1	2	**9**
Wajir	12	4	4	3	**23**
Kitui	6	2	4	0	**12**
Makueni	7	0	4	2	**13**
Garissa	2	0	1	2	**5**
Total	**32 (51.6%)**	**7 (11.3%)**	**14 (22.6%)**	**9 (14.5%)**	**62 (100%)**

Figure 4 Functionality status of surveyed investments in each county



Functionality status per investment type

Functionality status was considered according to the investment being a construction or rehabilitation (Table 8). In total across the five counties, slightly more rehabilitation investments (68.6%) were functional compared to new-construction investments (55.6%).

Table 8 Functionality status per construction or rehabilitation of investment for each county

	No. of construction investments	Construction investments functional*		No. of rehabilitation investments	Rehabilitation investments functional*	
Isiolo	2	1	50%	7	5	71.4%
Wajir	0	0	0%	23	16	69.6%
Kitui	11	7	63.6%	1	1	100%
Makueni	13	7	53.8%	0	0	0%
Garissa	1	0	0%	4	2	50%
Total	**27**	**15**	**55.6%**	**35**	**24**	**68.6%**

*includes not in use investments

Functionality status was also considered according to the investment water point type (Table 9 and Figure 5). Boreholes, water pans, sand dams and earth dams were in the majority functional, with a few cases of partially-functional and non-functional investments. In comparison, pipeline distributions and rock catchments suffered from more non or partial functionality investments, although the number of each of these investments were few.

Table 9 Functionality status per investment water point type

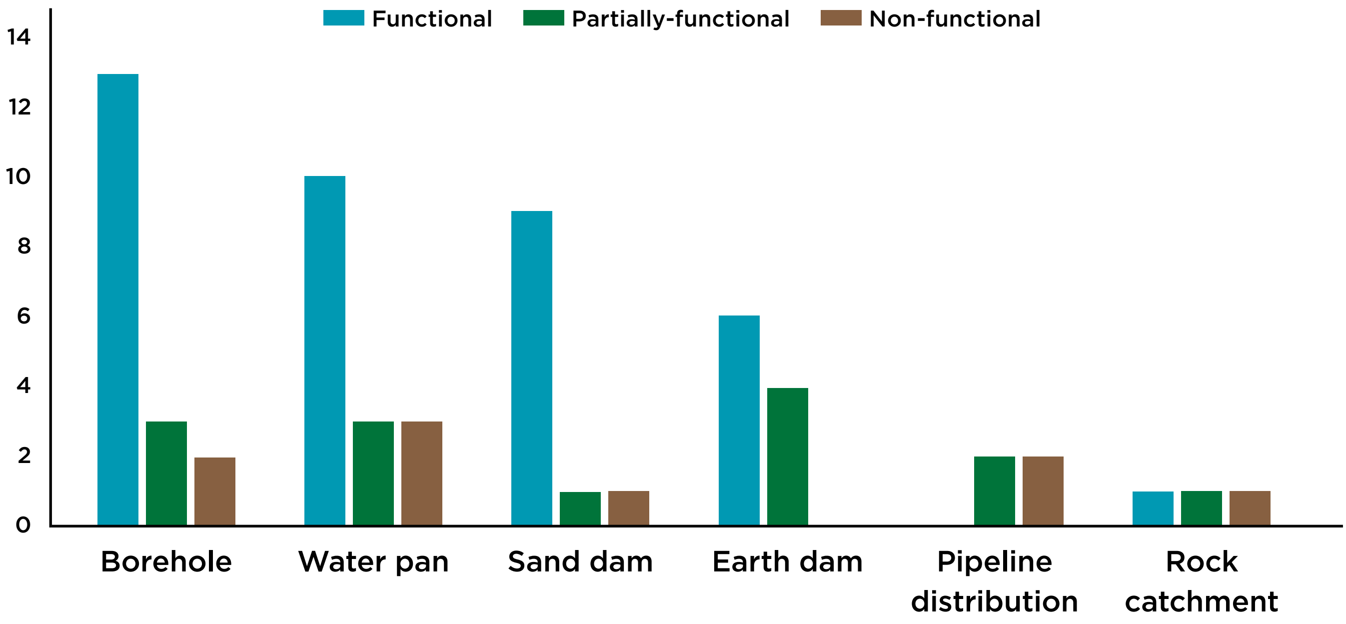
Note: The not-in-use status is grouped with functional status, since these investments were either seasonal water pans (Isiolo and Wajir) or had dried up due to inadequate rainfall (Kitui) but otherwise functional. One Weir is grouped with sand dams.

	Total	Functional		Partially-functional	Non-functional
Borehole	18	13	72%	3	2
Water pan	16	10*	63%	3	3
Sand dam (including one Weir)	11	9	82%	1	1
Earth dam	10	6**	60%	4	0
Pipeline distribution	4	0	0%	2	2
Rock catchment	3	1	33%	1	1
TOTAL	**62**	**39*** **	**62.9%**	**14**	**9**

*Includes 5 not in use investments **Includes 2 not in use investments ***Includes 7 not in use investments

Figure 5 Functionality status per investment water point type

Note: The not-in-use status is grouped with functional status, since these investments were either seasonal water pans (Isiolo and Wajir) or had dried up due to inadequate rainfall (Kitui) but otherwise functional. One Weir is grouped with sand dams.

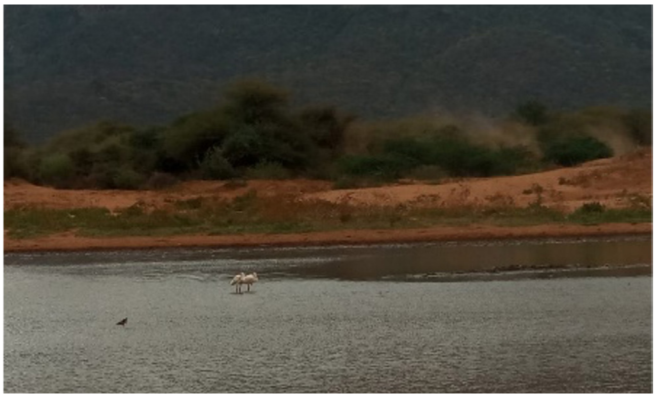


The functional investments

The functional investments (32) were operating well and communities were able to access water. None of these investments had been out of service in the past 30 days. Box 2 gives examples of well-functioning investments as reported by women in the Garissa and Wajir workshops respectively. These examples describe both functional water systems in terms of the components applied as well as good management and governance systems.

Most functional investments however showed signs of emerging or anticipated problems. This included, in the case of water pans and earth dams, silt accumulation which would lower the water harvesting capacity. These would require regular desilting to increase capacity and to ensure the inlets and outlets allow the free flow of water in and out of the pan or dam. In the case of boreholes, issues raised included the operation of a single genset for long hours which may lead to failure and would require spare parts for repairs, and where borehole pipes and pumps had not been serviced for a long time. These issues would be particularly problematic for boreholes located in drought-reserve areas that are heavily used by large numbers of livestock during dry and drought spells. In addition, for all types of investments, a few of the structures such as water kiosks and sanitation facilities showed signs of wear and tear and needed repainting or minor repairs.

Kwa Lai sand dam, Makueni – functional
© Adaptation Consortium



Bamba mega pan, Wajir – functional
© Adaptation Consortium

Urura borehole livestock trough, Isiolo – functional
© Adaptation Consortium

Shimbirey borehole water kiosk, Garissa – functional
© Adaptation Consortium

Box 2: Functional Investment examples

Abaqdeera borehole, Garissa County

In Garissa, women considered Abaqdeera borehole to be a successful investment because of the optimal benefit they drew from it. They said the CCCF constructed two water kiosks, one trough and a system piping water from the river closer to their homes. The facility was operating well and communities were cooperating with the site management committee to maintain the facility. The committee was functioning well and met frequently to discuss any issues arising over management of the water point.

Jehjeh water pan, Wajir County

In Wajir, women from the Wajir Bor community described how before the CCCF investments were implemented, they suffered from water shortages and poor water quality. Water from shallow wells was saline and not fit for human and livestock consumption, so the community relied on surface water from the Jehjeh water pan. However, the pan was not protected and open to contamination. The CCCF financed the fencing of the Jehjeh water pan to protect water quality and reduce the risk of contamination posed by unregulated use, including from wildlife. The pan was fenced with concrete poles and chain link to assure longevity, rather than wooden posts that are prone to termites. A piping system and pump propel water to the storage tank and livestock troughs. The women reported how the water is now clean and fresh. A management committee of four men and two women manage the water pan and were provided on the job training on water management. They now manage the use of the pan, tariff collection and the pan assets. They spoke how the project benefits the entire population of Wajir Bor division (about 17,046 people) and many more pastoralists from adjacent wards.

The non-functional investments

In the nine investments assessed as non-functional, the waterpoint was not operational and the community were unable to access water. Factors contributing to non-functionality for each investment are given in Table 10 and were assessed to be due to a range of reasons including; poor design and workmanship, poor siting, and damage from floods, wind or other causes. These factors are discussed further in Section 4.3 and the underlying causes explaining poor functionality in Section 4.4.

Table 10 Main factors contributing to the non-functional status of investments

	Investment name (type)	Factors contributing to non-functional status	Period non-functional
Isiolo	Drilling Kobe Dadach Guracha borehole (*construction*)	Poor siting of borehole: borehole collapsed during drilling due to rocks, water was saline; the project was halted	Investment never established
	Mokori rock catchment (*rehabilitation*)	Poor design and workmanship: rock catchment surface area too small, faulty distribution channel (inlet to tank and outlet to tap stand) so no water in the tank. Piping system damaged by elephants as investment originally sited along a migration route.	Since inception
Wajir	Adan Awale water pan (*rehabilitation*)	Poor workmanship, especially the fencing. Tank, kiosk, piping and fence damaged by wind; no maintenance	1 year
	Basanicha water pan (*rehabilitation*)	Poor workmanship of the pump house, fencing and water kiosk, which were damaged by wind	7 months
	Buruka water pan (*rehabilitation*)	Poor siting: the soil is sandy and does not hold water. Investment unviable	1 year
Kitui	No non-functional investments	N/A	N/A
Makueni	Ngai Ndethya sand dam (*construction*)	Power cable washed away by floods so submersible pump unable to function	6 months
	Ngamba pipeline distribution (*construction*)	The distribution line was sited too close to the road and damaged by road construction, so water was unable to reach the kiosk	10 months
Garissa	Equipping Nunow Borehole (*rehabilitation*)	Pump breakdown and no repairs, so no water to the kiosk.	2 months
	Kamuthe piping equipping borehole (*rehabilitation*)	Poor siting: Piping system and engine washed away by floods.	6 months

The partially-functional investments

In the 14 investments assessed as partially functional, water was still accessible at the water point, but often in a limited capacity, and some of the infrastructure had collapsed or was broken. This was due to factors such as poor design and workmanship, poor siting, vandalisation, and lack of repairs and maintenance (Table 11). These factors are discussed further in Section 4.3 and the underlying causes explaining poor functionality in Section 4.4.

Masue rock catchment, Makueni, broken pipeline – partially-functional © Adaptation Consortium

Yatta borehole, Wajir, solar panel technical problem – partially-functional © Adaptation Consortium

Lanqood borehole, Wajir, mainline piping system needs repair – partially-functional © Adaptation Consortium

Table 11 Main factors contributing to the partially-functional status of investments

County	Investment name (type)	Factors contributing to partially-functional status	Period partially-functional
Isiolo	Har Buyo water pan (*rehabilitation*)	Vandalised infrastructure (fence, piping, water tank, guard house, latrine and pump) during cross-border conflict. Water source open to contamination	4 years
Wajir	Yatta borehole (*rehabilitation*)	Solar system developed a technical problem and needed repairing. Power switched to genset	6.5 months
	Lanqood borehole (*rehabilitation*)	Piping system from tank to kiosk not working as tank inlet and outlet needed repairing	2 months
	Dadhantalai water pan (*rehabilitation*)	Poor siting along a main stream and piping system washed away by floods; genset needs repair	10 months
	Laghbogh water pan (*rehabilitation*)	Poor siting along a main stream and piping system and tank washed away by floods; pump and tap stand vandalised; no repairs	2 months
Kitui	Kwa Mboo earth dam (*construction*)	Poor workmanship – dam too shallowly excavated; poorly designed inlet resulting in little water entering the dam	5.5 months
	Kyandeve earth dam (*construction*)	Poor siting - embankment wall partially washed away by floods so dam does not harvest adequate water; poorly designed spillway; draw-off system, livestock trough and tap stand washed away; vandalised fence	4.5 months
	Mutethya Nzaini earth Dam (*construction*)	Poorly designed spillway causing siltation and breaching of the dam wall; high siltation; vandalised fence	1 month
	Iiani kwa ndungu pipeline (*construction*)	Only one of three water kiosks working because the rising main installed by the county government is not functional and needs repairing	Since inception
Makueni	Masue rock catchment (*construction*)	One of three distribution lines was vandalised and does not deliver water to the kiosk and needs repairs	2 years
	Kwa Kilii sand dam (*construction*)	Poor siting/design: One side of dam wall washed away by floods when upstream water reservoir broke its banks	14 months
	Kwa Atumia earth dam (*construction*)	Poor design: draw off system, piping system and trough not well gravitated; sanitation facility sunk; fence destroyed by ants; distribution line, kiosk and livestock trough vandalised	8 months
	Kaseve pipeline distribution (*construction*)	One line has a tank burst due to high pressure and needs repairing so water is not being pumped to the kiosk; fence damaged by ants; sanitation facility vandalised	4 months
Garissa	Bula Traffic borehole (*rehabilitation*)	Infrastructure vandalised as pipe connections not fenced and water kiosk sited too close to road; water storage tank burst; worn out and broken infrastructure and no repairs	1 year

The not-in-use investments

Another seven investments were categorised as not in use; five water pans in Isiolo or Wajir and two earth dams in Kitui. These investments did not hold water at the time of the survey (during the dry season) due to low or inadequate rainfall. They were in good condition otherwise and had been functional during the previous wet season. In the case of Wajir and Isiolo, the water pans were constructed for seasonal use only in the wet season, thus were not in operation during the time of the survey (dry season). In the case of Kitui, the two earth dams were not being used due to inadequate rainfall. At some of these investments, infrastructure was showing signs of wear and tear but this would not affect the operation of the water point or availability and access to water. Also, a couple of the pans would need desilting soon.

4.3. Management of water investments

Table 12 gives the management characteristics for the investments visited in the five counties. Each investment had a management system in place, except for Kobe Dadach Guracha Borehole in Isiolo since it was never successfully established due to its poor siting in rocky ground. For the majority of investments, site management committees were responsible for the day-to-day management of the CCCF investments.

Site management committees are drawn from the WCCPCs and usually reside around the site to oversee the implementation of the investments. In a few cases, project management committees, which are similar to the site management committees but may incorporate non-WCCPC members, have later taken over the management of the investment once it is fully operational. Other forms of management included the *Deedha* customary institution and a rangeland user association (in Isiolo) and the county water service provider (a borehole in Wajir).

The committees are tasked with setting and enforcing water use and access rules, preparing schedules and priority rules for water use, ensuring order during use, collecting water fees and keeping records of the finances, and ensuring good relations with other pastoral groups or users. Committees can open a bank account in which water fees are saved and running costs (fuel, operator salary) withdrawn. In the majority of cases, management was considered to be active, except for a few of the non-functional investments.

In terms of committee membership and gender across the 5 counties, 38% of committee members were women compared to 62% men. The CCCF mechanism strongly encourages the inclusion of all stakeholder groups, and regulations governing the composition of the WCCPCs (from which the management committees are formed) demand a minimum number of women and youth. In Garissa, there were more women than men on the committees, and in Kitui and Makueni approximately half of committee members were women. In Wajir and Isiolo, approximately 30% of committee members were women.

In Kitui, Makueni and Garissa, all committees reported having received training, where as 44% of committees in Isiolo and just 9% in Wajir reported any training. Training was part of the CCCF mechanism for all WCCPC and CCCPC members, but this is not necessarily the case for all those now involved in managing the investments.

The management committees are responsible for carrying out certain repairs to the investments. Commonly, minor repairs (servicing pumps and gensets, repairing fencing) were done by the committees themselves or through local technicians. Minor repairs are financed through user fees or beneficiary contributions although there were challenges associated with limited funds to finance repairs due to lack of community users' contributions. Minor repairs were generally reported to be repaired in less than a week.

In contrast, major repairs (e.g., repairing gensets, replacement of submersible pumps, pan desilting) are more technical and expensive, and are carried out and financed by the county water departments. Major repairs could take much longer than a week due to reported slow response times by county departments and finance issues. The issue of lack of availability of spare parts in the local markets in what can be remote rural areas where investments are located was raised as a challenge for carrying out repairs, both major and minor.

Table 12 Summary of management characteristics of the CCCF water investments

County		Isiolo	Wajir	Kitui	Makueni	Garissa	**Total**
No. of investments		9	23	12	13	5	**62**
Management type		3 site comm 3 *Deedha* council 1 Project manage-ment 1 Range-land users association 1 None	22 Site comm 1 WA-JWASCO	7 Site comm 5 Project manage-ment	13 site comm	5 site comm	
Active management per functionality status	**Functional**	100%	100%	100%	100%	100%	
	Not in use	100%	100%	100%	N/A	N/A	
	Partially functional	100%	100%	100%	100%	100%	
	Non-functional	50%	67%	N/A	100%	0%	
Committee membership	**Men**	63	105	53	64	10	**295 (62%)**
	Women	19 (30%)	45 (30%)	52 (50%)	53 (45%)	15 (60%)	**184 (38%)**
Committee received training		44%	9%	100%	100%	100%	

4.4. Main factors contributing to non- and partially functional water investments

This section summarises the main factors contributing to the non and partially functional investments given in Tables 9 and 10. The factors are overlapping, such that in many cases more than one factor contributed to an investment being non or partially functional.

Poor or problematic siting of the water investments

In the majority of cases, investments across the five counties were well sited. Workshop participants discussed how the investments' siting and design were informed by local knowledge and endorsed through public participation. This led to water being extracted from areas that had previously not been thought possible, such as the rock catchments, as well as investments that better serve the needs of the communities. However, for approximately 10 investments, poor or problematic siting resulted in the investment becoming non-functional where the community were unable to access water, or partially-functional where at least some water was available. There were a range of issues related to siting, some of which applied to the development of the CCCF investment and others to the siting of the existing water point, in the case of the rehabilitation investments.

In two cases, investments were sited in ground that made the investment unviable; siting Kobe Dadach Guracha borehole, Isiolo, in rocky ground and Buruka water pan, Wajir, in sandy soil (Table 10). In the case of Kobe Dadach Guracha borehole, rocks caused problems during drilling, which failed three times and the project was never established. Water was also found to be saline. However, it was discussed that the siting of the investment did take into account local knowledge and experience, and the site was favoured by pastoralists who wanted to open up the area for grazing. This indicates a mismatch between the siting that was preferred according to the needs of the pastoralists, but not technically appropriate. In the case of Buruka water pan, the intention of the investment was to desilt and expand a natural water pan to increase its capacity, however the soil was sandy and thus could not hold water.

A common factor related to siting that contributed to non or partial functionality was floods washing away infrastructure. In the case of the non-functional investments, floods washed away a power cable at Ngai Ndethya sand dam, Makueni, and the engine and piping system at Kamuthe borehole, Garissa (Table 10). For the partially-functional investments, floods washed away sections of the embankment walls at two earth dams in Kitui and one sand dam in Makueni, as well as the piping systems at two water pans in Wajir (Table 11). In the case of Kyandeve earth dam in Kitui, workshop participants said how poor siting was due to not taking account of the risk posed by the upstream Kwa Nzungu earth dam that burst is banks during heavy rains, and led to the destruction of the Kyandeve earth dam downstream.

In some of the cases given above, poor siting was related more to the original siting of the investment, and not specifically the CCCF investment. We consider in these cases to more appropriately refer to 'problematic' siting so as to highlight the existing condition of the water point rather than attribute it to the CCCF implementation. For example, the two rehabilitated water pans in Wajir were sited along a main stream and hence prone to flooding, which was not adequately considered during the initial siting of the pans. These water pans were constructed a number of years ago, and only rehabilitated under the CCCF, and now faced problems due to siltation and damage to their embankments due to flooding from the streams. Similarly, the Kamuthe borehole investment in Garissa, was a rehabilitation involving the addition of a piping system, kiosks, and trough to an existing borehole. Nevertheless, proper assessments of existing infrastructure should highlight these problems before any rehabilitation of an investment is given the go ahead.

Other siting factors that contributed to non and partial functionality were where an investment was damaged because some of the water structures were situated too close to the road, and either vandalised by people (Bula traffic, Garissa) or destroyed by road construction (Ngamba pipeline, Makueni). In another case, the Mokori Rock Catchment in Isiolo, was positioned along an elephant wildlife migration route and hence elephants destroyed the piping system, although the investment was a rehabilitation of an original construction in 1990 (Isiolo County Government 2017).

Poor design and/or workmanship

Factors related to the poor design and workmanship of investments applied to at least six non- and partially-functional investments. This included the non-functional Mokori Rock catchment in Isiolo, where a faulty distribution channel and small surface area of the catchment resulted in no water reaching the water tank and reservoir. At Basanicha and Adan Awale water pans in Wajir, infrastructure such as the fencing, water tank, kiosk and pump house had been poorly executed and needed replacing, despite the investments being well-designed. The infrastructure was then blown away by strong winds, rendering the investment non-functional.

In the case of the partially-functional investments, Kwa Mboo earth dam, Kitui, was too shallowly excavated by the contractor and the inlet poorly designed. These problems resulted in insufficient water being collected and held in the dam. It was suggested in the Kitui workshop that a technical assessment was needed to help fix the problem, such as an additional inlet to harvest enough runoff. Other examples included, a poorly designed spillway at Mutethya Nzaini earth dam in Kitui, causing siltation and breaching of the dam wall, and a poorly designed draw off system and trough which was not gravitated so water could not flow to the trough.

Damage to investment due to vandalisation or conflict

Another main factor that applied particularly to the partially-functional investments (eight cases), was damage to an investment due to vandalisation or conflict. Vandalisation was often a secondary factor alongside another contributory factor, such as poor siting or design, except in severe cases such as the cross-border conflict at Har Buyo water pan, Isiolo, where most of the infrastructure was damaged and conflict was solely responsible for the investment being partially-functional.

Infrastructure typically vandalised included fences, distribution lines, sanitation facilities and water kiosks. At Bula Traffic borehole, Garissa, reasons given for vandalisation included the piping connection not being fenced, and the water kiosks sited too close to the road. In the Isiolo county workshop, it was explained that often components such as doors, windows, roofs, and concrete fences are removed and stolen.

Lack of repairs and maintenance

Another set of factors that contributed predominately to the partially-functional investments, included cases where a technical fault had occurred or there had been damage to an investment post-design and construction, but repairs had not been carried out. In these cases, the community were able to access some water, but not at the optimal level. For example, at Yatta borehole in Wajir, a technical fault in the solar system occurring six months previously, had not yet been repaired so the pump had to switch to a generator supply. Respondents during the functionality survey said there was a need for a highly skilled solar technician to help with the repairs. At Kaseve pipeline, Makueni, repairs were needed on one of the distribution lines that had a burst tank preventing water from being pumped to the kiosk, although the other line was still functional. In the case of non-functional Nunow Borehole in Garissa, the pump had broken down two months previously and the community were still waiting for repairs to be done.

The need for repairs can be highlighted by the long periods of time reported in the survey that investments had been either partially or non-functional, ranging from one month up to four years, or even since the inception of the project. Many investments had been partially or non-functional for at least a year, and efforts to make the investments fully-functional again had either not been made or not been successful.

4.5. Underlying causes of poor functionality

In this section, we examine the underlying causes of poor functionality that give rise to the main contributory factors given above. The underlying causes emerged from discussions during the stakeholder workshops, and is supplemented with insights from the literature. The matrix in Table 13 shows how each of the contributory factors can be explained by a number of different underlying causes of poor functionality across a range of issues. These include technical, social, institutional, environmental and governance issues that are often cross-cutting and closely interlinked. For each underlying cause given we try and understand what drives these failures or deficiencies.

Table 13 Matrix showing the relationship between the main contributory factors and underlying causes of poor functionality

Underlying causes	Contributory factors			
	Poor siting	Poor design & workmanship	Vandalisation	Lack of repairs & maintenance
1. Inadequate use of climate or hydrological information	X	X		
2. Weak technical capacity in county water department	X	X		X
3. Poor supervision of contractors	X	X		
4. Cross-border conflict			X	X
5. Weak capacity of the community management committees			X	X
6. Unclear roles and responsibilities – and lack of ownership		X	X	X
7. Unavailability of spare parts				X
8. Absence of a preventative maintenance schedule				X
9. Low users' willingness to pay for water				X
10. Absence of an effective water resource monitoring framework	X	X		X

1. Inadequate use of climate or hydrological information in siting and design

Poor siting | Poor design & workmanship

An underlying cause of the poor siting and design of investments is the inadequate use of climate or hydrological information at the planning and design phases of the water projects. In some cases, siting had occurred before the investment was rehabilitated through the CCCF, so this issue should be viewed broadly in the context of water investments in the drylands. For example, the poor siting of Dadhantalai and Laghbogh water pans in Wajir were attributed to little consideration of climate information when designing and excavating the pans a number of years before they were rehabilitated by the CCCF, as well as minimal community involvement.

Climate information services (CIS) provide climate information to help inform decision-making and manage risk. Accurate climate information can help to guarantee the proper siting of investments and ensure the viability of investments over the time span of decades. As one of its four key components (section 1.1), the CCCF mechanism integrates CIS from the Kenya Meteorological Department (KMD) at the county level into resilience assessments to ensure wards and counties develop investments that enhance communities' resilience to climate risks. One of the operational features is County CIS Plans and the CCCF mechanism supports the development and validation of county-level CIS plans for all five counties. In a synthesis of learning on the CCCF investments, Crick et al (2019) found that investments that did include CIS in their designs (i.e., designed in consultation with county meteorological officers) were better able to withstand major storms than those that did not.

An inadequate use of climate or hydrological information when developing an investment means an investment may be unable to provide the supply for which it was designed. This was illustrated by the KMD Officer present at the Garissa workshop who explained that site run-off should be considered for any water investment otherwise water pans or dams may remain empty even when it rains. Investment design should also take account of extreme rainfall, flooding events and the highest potential rainfall, so as to estimate the largest possible flood a spillway will be required to manage. Inadequate rainfall data can result in spillway design that is unable to handle extreme rainfall events and risk a dam wall collapsing. This was the case for two earth dams in Kitui and a sand dam in Makueni where the embankment walls were partially washed away by floods.

As well as climate information, there is typically limited understanding and data on the water resources, especially groundwater resources, for implementing water investments in the drylands (Mtisi and Nicol 2013). When siting investments that tap groundwater supplies – i.e., boreholes, springs and wells –a good understanding of the available groundwater resources and the hydrogeology is needed as this has implications for the sustainability of groundwater abstraction *(WASH Cluster Somalia 2020)*. The correct siting of boreholes should be informed by an understanding of the environmental conditions so technology decisions are matched to the groundwater conditions.

In the county workshops it was explained that it is the role of the county water departments to ensure the appropriate siting of investments, however, few resources are allocated to water resources and assessment. This can be illustrated in the case of Wajir, where the draft Wajir County Water Policy 2017, describes how the county government lack adequate information and data on the county's water resources. The county government have little access to information on where the resources are, in what quantity and quality, and how variable it is likely to be, to support effective planning and design of water investments, although national government agencies such as the Water Resources Authority (WRA) and the National Drought Management Authority (NDMA) may have some data on this *(Wajir County Water Policy, draft 2017)*.

Although KMD has supported the five counties to develop their CIS plans these are yet to be fully implemented, and there are concerns that CIS still needs to be mainstreamed into county planning processes *(Crick et al 2019)*. Crick et al (2019) found that one of five key challenges in scaling out the CCCF includes the integration of climate information into the design of investments. Although efforts have been taken by KMD to identify the nature of CIS needed for different types of investments and the implications for technical investment design, CIS information has not yet been systematically integrated into the design of all investments *(Crick et al 2019)*. The KMD officer at the Garissa workshop explained that KMD was creating county specific websites to provide climate information to help meteorological data be incorporated into the design of investments.

2. Weak technical capacity of county water department in investment siting, design and maintenance

Poor siting | Poor design & workmanship | Lack of repairs & maintenance

An issue commonly raised during the functionality survey and workshop discussions was the limited county government capacity in the siting, design and maintenance of water investments. Since it is the role of the county water department to ensure the appropriate siting and design of investments, and to carry out major repairs, this is a key issue contributing to poor functionality.

In all counties, technical capacity gaps were reported when it came to designing water facilities, for example in drawing the Bill of Quantities (BoQ). In Kitui, the men's focus group reported a lack of county government capacity in technical aspects of siting and design, maintenance, as well as the quality of materials used. They gave examples of inadequate design at the partially-functional Kwa-Mboo Earth Dam, leading to an additional inlet being required, and anticipated problems at the functional Kalikuvu Earth Dam due to erosion of the spillway, where redesigning might soon be required. It was also raised that there were no clear guidelines on the implementation of project design in order to avoid conflicts of interest between the contractor and engineer, as well as inadequate involvement of the site management committees at this stage.

Technical capacity gaps within county government were attributed to a shortage of skilled staff, but moreover there was a shortage of staff at the appropriate level. In Makueni, it was reported there was inadequate technical capacity in the water department with only one engineer doing the design and siting for over 40 sand and earth dam projects, although there were efforts being made to recruit engineers to work at all six sub-counties. Similarly, in Isiolo, a key issue reported for assuring quality investments was that the investments are completed at particular sites within the ward level, but the staff engineers are not located at the ward or sub-county level. This means there was little follow-up when it came to technical supervision of service providers during project implementation (see below).

Proximity of the county water department to the investment level was also raised in terms of carrying out repairs and maintenance. A common challenge reported in carrying out repairs (especially major repairs) was slow response times from the water department, partly due to technical staff being based at county headquarters. In all counties, limited county technical capacity to carry out repairs and maintenance was attributed to the lack of technical staff at the subcounty level. For example, in Wajir, a workshop participant noted there were 272 boreholes in the entire county, but only one maintenance team to respond to all emergencies. Delays were thus common in response to breakdowns, such as an average of 10 days to respond to genset and pump failure.

3. Poor supervision of contractors during construction

Poor siting | Poor design & workmanship

A related issue to the county water department's limited technical capacity concerned the lack of supervision of works by contractors or service providers during the design and implementation of investments. In all counties, workshop participants mentioned that contractors get away with doing sub-standard work because county engineers are not supervising the project sufficiently from the start leading to poor workmanship during implementation. For example, at the non-functional Basanicha water pan, Wajir, technical assessment during the functionality survey found that infrastructure (pump house, concrete post fencing, and water kiosk) was poorly executed and blown away by strong winds and all needed replacement, despite the investment being well-designed. This technical failure was related to a lack of supervision of the contractors during implementation. An example was given by the women's focus group in Kitui, who mentioned that the engineer drawing the BoQ did not even visit the investment site. They further explained how the engineer and contractor may differ on how they interpret the BoQ, and the contractor interprets it according to his own thoughts, rather than the engineer's advice.

As part of the CCCF mechanism, the WCCPC and site committee members also play a role in the supervision of contractors during the implementation of investments, especially since they originate from the areas where the investments are implemented. Crick et al (2020) report how this feature gives the WCCPC better oversight of the project and its delivery by contractors. It also helps reduce supervision costs which can be key drivers of costs in the implementation of investments in the remote areas such as in many of the CCCF investment sites *(Crick et al 2020)*.

One problem raised in Kitui in relation to the lack of supervision concerned the county government practice to have the budget to facilitate the engineer held by the contracted service provider, which compromised the independent supervision of the work, as the engineer is then dependent on the service provider. They thought this arrangement needed to change as it gives the contractor too much power to decide when technical supervision can happen and how often. It was also thought that poor supervision and workmanship occurs because investments are completed hurriedly to meet donor timelines and the government rushes to spend money before the financial year closes. As a result, there is not enough time for inspection of works to check on the quality or process. Community members expressed how they wanted to get further involved in supervision and know when construction and inspections would occur. They also wanted basic knowledge of interpretating the BoQs, such as in measurements and the quality of materials used, to ensure good quality work was carried out.

4. Cross-border conflict

Vandalisation | Lack of repairs & maintenance

One of the main underlying causes of the vandalisation of investments was cross-border use of water resources and conflict with people from other counties. Conflict was described in Isiolo as livestock entered from neighbouring Wajir and Garissa during the dry season. For example, at Har Buyo water pan in Isiolo, cross-border conflict occurred with pastoralists from Garissa and led to the vandalisation of infrastructure and subsequent partial-functionality of the pan. Components such as the water tank, pump, and livestock troughs were broken and fencing around the pan destroyed, meaning that water was open to contamination. Cross-border conflict also previously affected the Belgesh water pan in Isiolo, although by the time of the survey the water management committee had reinstated the damaged infrastructure and the investment was functional again.

Cross-border conflict was particularly associated with water pans located at the border regions, often situated far from settlements. Conflict was accentuated by drought and the subsequent overcrowding at water points. In Garissa, cross-border conflict was reported to occur during drought when livestock migrated between water points in Garissa and Isiolo. Consequently, local pastoralists, particularly women, said they avoided both water and pasture resources that they would otherwise use during drought.

As a way to stop conflict and prevent pastoralists from neighbouring areas using the Yamicha pan, Isiolo, the *Dheeda* council blocked the inlet bringing water to the pan. Access to water in the pan encouraged pastoralists to migrate to the pan and subsequently graze in the neighbouring drought reserves. By blocking the inlet, the *Dheeda* wanted to control access to water and ensure water and the surrounding pasture was only used during drought times.

In Isiolo, cross-border conflict raised issues over the sustainability of investments. Since investments are usually far from settlements, there is little access to spare parts or technicians to ensure quick repairs and maintenance. Investments prone to cross-border conflict are also difficult to manage due to insecurity concerns and their distance from settlements. These investments thus tended to be managed by men since it was unsafe for women to participate in management, and their domestic duties limited their ability to travel far to remote investments.

Women participants in Isiolo emphasised that if cross-border conflict cannot be resolved, then there should not be investments located in the border regions as they will not be sustainable. They thought it made little sense investing in the protection of water pans if the framework for cross-border engagement and resource access was not addressed. They thought it was important to have clearly laid out procedures for access to these investments, especially as pastoralists from neighbouring counties also use them. They suggested continuous peace building across the counties, as well as through the national government to prevent future conflict.

5. Weak technical and management capacity of community management committees

Vandalisation | Lack of repairs & maintenance

An issue widely raised to explain the poor functionality of investments was the lack of technical expertise of the community management committees to maintain the water investments, as well as their management capacity to effectively run the facilities. This contributed to the poor operation and maintenance (O&M) and governance of investments.

As described in the management of investments (section 4.3), major repairs are usually carried out by the county water departments whereas minor repairs are usually done by the management committees themselves or through the use of local technicians. Some investments, such as boreholes, require more specialist technical skills that may be beyond the capacity of the committees to maintain. For example, in Garissa it was explained how the committee do minor repairs to the boreholes (such as fuelling, replacing broken pipes, batteries and oil) but there were no highly skilled personnel at the community level for repairs beyond this. A government technician may sometimes come to carry out repairs but this was expensive as the community pays for the vehicle, fuel, allowances and spare parts. This also increased the response time for repairs; the best time recorded in Garissa was two days from reporting an incident.

Additionally, the management committees lacked the capacity to effectively manage the investments, including aspects of project and financial management. In Kitui, respondents during the functionality survey thought that weak capacity of the committee in the management and leadership of investments resulted in conflict during decision-making. Poor management of the investments was also thought to contribute to problems of vandalisation and theft of infrastructure. For example, Kitui workshops participants viewed it as the responsibility of the management committees and wider community to stop vandalism and theft at the water points. In Kitui and Isiolo, participants added that management would improve and prevent vandalism and theft if there was greater community ownership of the investments (see below).

Why is the capacity of community management committees low? Although, many of the committees had received training in water governance and O&M – 100% for Kitui, Makueni and Garissa, 44% for Isiolo, but only 9% for Wajir (Table 12), it was considered by workshop participants across the counties to be insufficient and the management committees were unable to effectively manage the investments. There was also limited external support from the private sector, with little in the way of a local private sector to provide skilled and accessible technicians on demand when required for O&M.

In Makueni, the issue of facilitation costs was raised since committee members may live far from the investments and therefore incur travel expenses. These costs made it difficult for them to perform their duties and were thought to contribute to a lack of motivation to carry out their roles. It was suggested a facilitation fee would help cover these costs and increase motivation.

The capacity of committees to effectively maintain and manage investments was thought to be a key aspect of a sustainable water investment (see Box 4 for a summary of the characteristics of a sustainable water point as defined by workshop participants). In Garissa, some workshop participants stated that if the community do not have the capacity to maintain the investments and ensure its sustainability, then the projects should not go ahead until this capacity was achieved. However, women in the workshop did not agree and noted that challenges surrounding management should not be used as a reason to deny communities access to water.

Box 4: Characteristics of a sustainable water investment as defined by workshop participants

Sustainable investments were understood across the five counties as investments that "last for a long time" and are able to maintain and finance themselves continuously. There were some differences in how sustainability was viewed by policy makers versus by the men and women's groups. For the policy makers, terms such as "accessible'', ''reliable'' and ''affordable" were used. They considered them as ''investments that will outlive them and benefit the communities immediately and afterwards, and that the community have ownership in the management."

Community members focused on elements of sustainability that define community ownership of projects as well as transparency and honesty of the management committee members. The issues of good management capacity and ownership emerged consistently as key elements of sustainability shared by both the men and the women's groups across the five sites. In addition, women highlighted characteristics that included, clean water, a peaceful environment, harmony between users, and the security of investments and users.

6. Unclear roles and responsibilities – leading to a lack of 'ownership'

Poor design & workmanship | Vandalisation | Lack of repairs & maintenance

During workshop discussions, the weak capacity of the management committees to maintain and manage investments was suggested to be a symptom of the unclear roles and responsibilities in the O&M of investments. As described above, there can be overlapping roles in maintenance and repairs, where the county water department carries out repairs or the site committees do these themselves or through local technicians. It is not always clear what is the responsibility of the community management, notwithstanding what they can feasibly manage in terms of cost and skills, and what is the responsibility of the county water department.

Some workshop participants thought management committees do not clearly know their roles and responsibilities since they do not follow a constitution or bylaws and this led to poor management practices. It was explained that site management committees are answerable to the WCCPCs and usually have informal rules that guide their operations, which are enforced through good will with the help of the local chiefs. One site committee member at the Kitui workshop pointed out that their committee had developed their own by-laws and had registered themselves as a community-based organisation with the Department of Social Services. Nevertheless, they still struggled to run their affairs and deliver their mandate. Many other committees do not follow a constitution or bylaws, and as viewed by some participants in Wajir, this led to the problem of committee members serving for too long and a gender imbalance of members.

The unclear or overlapping roles can contribute to a lack of ownership of the facilities by both communities and the county government so they feel it is not their responsibility to manage and maintain the investments. This is illustrated by a participant from NDMA at the Isiolo workshop, “when they [the investments] are functional they belong to the community, when it gets spoilt or broken down, it belongs to the government.” The management committees struggle to raise the funds to pay for even minor repairs, or if they do raise the funds, they have difficulties in finding someone skilled to carry out the repairs. They often thus rely on the county government or donors to fund and carry out repairs. In Makueni, community participants linked development projects to whoever funded them or were involved in their implementation. Therefore, many viewed the CCCF investments as projects of ADSE, the implementing partner, who accordingly should be responsible for their maintenance and repair. In contrast, workshop participants in Garissa thought that leadership of the borehole management committees should be an employee of the county government, and in Isiolo, participants thought that the county government should take over the management of the boreholes. Given the purpose of the CCCF is to localise climate finance and the management of investments, these views are likely expressed as a result of the frustration in O&M and management of the water investments. The feelings of lack of ownership occur despite positive findings on the inclusivity of the investments and how both men and women considered themselves to be involved in the decision-making of the CCCF investments (see below).

Ownership of the investments emerged consistently as a key element of a sustainable water investment (Box 4). One participant in Garissa asked, “what does lack of ownership mean?” The response given was a lack of commitment from the county or the community to undertake repairs and O&M. Other participants complained about the lack of transparency and accountability in the management of the water resources, and that the government was not honouring its mandate of being responsible for basic service provisions like water. Community members also suggested there should be an official handover at the investment site where the county engineers and contractor handover the investment to the community to increase the feelings of ownership.

7. Unavailability of spare parts

Lack of repairs & maintenance

A recurrent issue raised in all counties was the access and availability of spare parts for investments. This prevented timely repairs and maintenance, and contributed to the poor functionality of investments. In particular, a key issue was a lack of spare parts at the local level meaning they are not readily available at the sub-county or wards levels when needed. In Wajir, spare parts, particularly for major repairs, are not locally available and have to be accessed from Wajir town or even Nairobi. In Isiolo, access to spare parts was reported a problem for major and minor repairs as boreholes are located far from the nearest spare parts stockists. Similarly, in Kitui, spare parts are available at county headquarters but there is no mechanism to deliver these to the subcounties, and in Garissa, it was reported there was no sustainable spare parts system set up in the county and major spare parts are sourced on demand which is risky in emergencies. Poor basic infrastructure in the ASALs makes it difficult for suppliers to stock and quickly make available spare parts.

The absence of a sustainable spare parts system was thought to be part of the lack of capacity of county government to store spare parts at the sub-county level or ensure engineers were available to install them. As a result, communities had to rely on actors beyond the county government to access parts. For example, in Isiolo they relied on private hires such as David and Shirtliff for spare parts, and in Garissa, they relied on donor and project funds. Spare parts can be costly for communities to buy due to water points not generating insufficient income through water fees. This relates to a broader systemic issue of inadequate financing within county government and insufficient funds within the county government departments or adequate decentralisation and timely disbursement of funds to buy spare parts and other equipment.

8. Absence of a preventative maintenance schedule

Vandalisation | Lack of repairs & maintenance

Another issue raised in all five counties that contributed to the lack of maintenance of investments and their poor functionality was the absence of a preventative maintenance schedule to ensure routine maintenance of the investments. Instead, maintenance was described as reactionary in response to breakdowns. This is highlighted above in the case for spare parts, where spare parts are not stocked as preventative, but rather sourced in response to breakdowns. In Kitui, it was reported that there was some routine maintenance provided for boreholes, but there was no such plan for the seasonal facilities like water pans which needed regular desilting. As a result, many of the pans and earth dams were expected to become non-functional soon, either because of silting or inlet blockages. In Kwa Mboo earth dam in Kitui, the community reported how they are managing the desilting themselves[5] rather than relying on the county government.

In the case of boreholes, engines may work for long hours but there is no proper schedule for regular O&M. In Garissa, frequent borehole breakdowns due to pump and generator failure were reported, especially during the dry season when there is increased demand for water by livestock. This is particularly the problem for boreholes since during drought, surface and shallow groundwater sources fail, leaving the boreholes abstracting water from deep groundwater bodies. These sources begin to fail as increased demand is put on them as neighbouring water sources dry up.

Community members blamed this lack of planning in O&M on the poor oversight by the county government and the absence of an overarching sustainability plan or adherence to a quality assurance framework. Common elements suggested to be included in such a framework were; regular routine maintenance, a sustainable spare parts system, strict adherence to the BoQ, effective supervision of contractors, structured community participation, and further technical and environmental assessments. Shortage of staff and technical capacity gaps at the county level also limited planning for the routine maintenance of investments and the ability to implement a quality assurance framework.

9. High costs of running investments and user's willingness to pay for water

Lack of repairs & maintenance

A key issue contributing to the lack of maintenance and poor functionality of investments concerned revenue collection and payment for the use of water. The high costs of running investments, in particular boreholes (e.g., purchasing spare parts and fuel, and paying technicians for repairs), made it

5 Each water user removes two basins of sand from the site before they drew water from the dam to ensure there is no silting before the next rains.

difficult for communities to effectively operate and maintain investments. The management committees said it was difficult to raise the funds to cover the costs of O&M despite the collection of water fees since many water users have a low willingness to pay for water and accrue 'water debts'.

Payments for water varied across the counties. In Kitui, approximately one-third of projects involved payment for water use. In Isiolo, communities were paying for water in all but three projects, where as in Wajir, payments for water use were required at all water sites.

The issue of water fees was mixed among the users of water. Committee members pointed out that if the community does not pay for water, then there will be no money to fund repairs or buy spare parts and fuel. Community members largely agreed with this, however they raised issues concerning those who could not afford to pay or just refused to pay. In Garissa and Makueni, women committee members indicated that they let poor households' access water for free. In Isiolo, pastoralist respondents during the functionality survey viewed water as a free commodity from God, especially from the water pans and hence they should not pay. A workshop participant in Isiolo stated that "*Maji lazima Ikuwe rahisi*" or "water should be affordable'' and said that payments should be just enough to finance O&M but not so that anyone could profit. The poor management of water fees by the management committees was a recurrent issue during the workshops that was thought to lead to the problem of inadequate revenue generation for O&M, with participants describing how committees were not able to account for the money they collected.

Another challenging issue for revenue collection was that it was not uniform across sites or even among types of livestock. In Isiolo, there had been instances of conflict due to discrepancies in the charging of livestock to access water. For example, calves of cattle and camels less than two years of age were not charged for accessing water even though goats were charged. Community members thought these costs should be rationalized and agreed upon by the community as it was pointed out that a goat drinks less water than a baby camel. Similarly in Garissa, women thought there needed to be a common understanding of the different water fees charged for the different livestock. In Makueni, participants highlighted how the community agrees on the tariffs they are supposed to be charged in public *barazas* under the moderation of the committee members and the county water officer. This was important to avoid any issue of conflict with regard to the payment of water.

10. Absence of an effective water resource monitoring framework

Poor siting | Poor design & workmanship | Lack of repairs & maintenance

An underlying issue that influenced all stages of the project from design, implementation and management is the absence of an effective water resource monitoring framework. This includes assessment and data on water resources and investments, such as surface and groundwater availability, water usage, water quality, and their temporal and spatial variability. Water resource monitoring is necessary to ensure there is an effective understanding of the water resources on which investments will rely, to inform their siting, design, management and use.

The issue of inadequate use of hydrological information in the siting and design of investments was covered above, however it also concerns post-implementation and management phases. In Kitui, participants reported how water monitoring had not been done since the implementation of the investments, leading to poor management of water usage. One workshop participant asked why the mechanism to manage water use was lacking, and the response given was that this was not just an issue of low capacity of the management committees, but there is also no available data to inform this. For example, there is no data on water usage vis-a-vis water capacity that could help in better planning and management of the investments. There was also little information on the number of local users and those from neighbouring areas who are likely to use the water, especially during drought. Participants suggested water monitoring tools so that the management committees could plan appropriately for water usage based on the seasons. The issue of water quality at the earth dams was also of concern to Kitui workshop participants due to upstream micro-irrigation and the use of fertilisers. Yet, there was no framework within the county government for water quality checks at the earth dam, with greater attention being given to boreholes.

The lack of water monitoring data is a widespread issue beyond that of CCCF investments. For example, the draft Wajir county water policy 2017 describes the need for more information and data to support the management of water facilities at the community level, such as on the number of water sources, management and ownership status, capacity requirements, and reliability of water sources, but there is little information in place to support decision-making at the county level *(Wajir County Water Policy, draft 2017)*. This type of information is a necessary part of water resources and environmental impact assessment as required by ministries in charge of water resources, but as illustrated is often lacking in practice. Improving water resources assessment to obtain more accurate data on water and groundwater resources is a key objective of Kenya's Water Resources Authority Strategic Plan 2018-2022 *(WRA 2019)*.

More broadly, regular monitoring and evaluation (M&E) will also help ensure continued learning on the effectiveness of the CCCF in delivering climate resilient investments. One of five key challenges reported in scaling out the CCCF is improving quality assurance and M&E processes *(Crick et al 2019)*. M&E components of investments have been under-budgeted and insufficient to cover county-wide monitoring. This challenge is particularly pertinent to large counties, such as Garissa, where distances between investments are significant and there is under budgeting of M&E components to cover county-wide monitoring *(Crick et al 2020)*.

4.6. Sustainability drivers

A number of drivers of sustainability of the CCCF water investments also emerged from the study. These can be viewed as positive elements that contribute to the long-term functionality of the water investments and provide lessons on good practice in planning future sustainable investments in the drylands.

The majority of investments are rehabilitations of existing facilities

The majority of CCCF investments are rehabilitations and upgrades of existing facilities rather than new constructions. More of the rehabilitations were assessed as functional compared to the new constructions. A long-standing challenge to the sustainability of water investments in the drylands has been the emphasis on hardware outputs and the construction of new water points rather than improved outcomes in the management and maintenance of existing points (see Table 4). Water sector budgets in the drylands have been dominated by development funds with most spending on construction rather than maintenance. There is also greater political capital to gain from the construction of water points.

With the CCCF investments, the emphasis on establishing more water points rather than rehabilitating old ones has shifted. One of the technical criteria to prioritise CCCF investments at the ward and county levels is to ensure that the project is not duplicating others planned. This helps to avoid the construction of investments when not needed. It also reduces the potential to disrupt the water-pasture balance if a number of new water points are developed but not balanced with livestock grazing and mobility patterns in pastoral areas.

In a study on the functionality of rural water points in Tanzania, the construction of new water points without sufficient attention given to O&M was linked to a high incidence of water point failure *(World Bank 2017)*. The study recommended where functionality rates are low, attention should first focus on rehabilitating existing water points and second, on constructing new water points in areas where none exist *(World Bank 2017)*.

Separation of domestic and livestock water collection points

Almost all the investments added elements such as piping, storage and distribution, improving access to water for different users and uses. Water kiosks and livestock troughs improve access to domestic and livestock water respectively. These facilities have not only reduced waiting times and congestion but have also improved water quality. The fencing of facilities has also allowed the management of livestock use and prevented unregulated livestock access and contamination of water. Water storage facilities have also allowed water to be stored and to last longer into the dry season. These elements when in good working condition contribute to the functionality and sustainability of the water investments.

Locally prioritised and relevant water investments

The CCCF investments are purposefully designed to be inclusive, and this was positively recognised across the five counties during the study. The CCCF mechanism puts the community at the centre of decision-making, a departure to the norm in county planning. The process of establishing CCCF projects is community-led and WCCPCs are empowered to prioritise investments against a set of strategic criteria through community participation with the principle of subsidiarity that enables decisions on investments to be made at the most appropriate and lowest level.

These principles ensure the investments are community prioritised and reflect local needs. It ensures the choice of infrastructure and technology is matched to community needs and their livelihoods. Across the county workshops, communities said their priorities were being included in the design of water investments which help build their resilience to a changing climate. This includes among others, better access to domestic water for women, separation of livestock and domestic water, fencing of water points to improve water quality, new distribution and access points, and storage facilities to increase water availability. These aspects contribute to functional and sustainable investments according to the needs of the local communities.

The bottom-up approach has also safeguarded the projects from politics. Inclusivity within the CCCF mechanism helps prevent political interference in establishing and siting of water projects for political gain. In each county workshop, it was highlighted there can be political influence from the Member of County Assembly (MCA) or the Member of Parliament (MP) who want water projects to be awarded to their supporters and water points sited at new settlements within wards in order for them to gain political mileage. There can also be political interference in the appointment of site committee members as politicians want their supporters to take on management roles. The CCCF mechanism reduces the opportunity for political interference due to transparency and accountability in the process, and community involvement throughout the project cycle including siting, procurement and management.

Inclusion of women across all levels of the project cycle

The CCCF mechanism encourages the inclusion of all stakeholder groups, including women. There is a requirement that a minimum number of women are members of WCCPCs and the site management committees, and women are elected to executive positions such as treasurer or chairwoman of these committees. In workshops, women confirmed that they were involved from the onset and all through the project cycle. A number of examples were given of where women are fully and successfully involved in the identification, prioritisation, implementation and management of the investments. For example, women in Wajir said their views on domestic water were captured and included in the design of the CCCF investments and as result they greatly benefited from them. By prioritising elements such as distribution and piping systems, and storage facilities, this allowed water to become more accessible, especially to women.

Taking into account all the investments visited during the survey, representation of women in the management committees was 38%, (Table 12). Representation of women in management is significant because women are the primary users and managers for domestic water. In Kitui, there were an equal number of women and men on the site management committees and more women were said to attend community meetings. In Garissa, it was noted that for the first-time, women were on water management committees and there were more female members than men. They gave the example of Abaqdeera borehole in Nanighi ward, where there used to be bad management and ineffective repairs and maintenance. When women took over the management it greatly improved and it is now considered the best managed investment in the county. This illustrates how participation of women can improve the functionality and sustainability of investments.

In Wajir and Isiolo, representation of women in management was lower at 30%. Here cultural norms and practices still limit women's participation. This was illustrated during the focus group discussions in Isiolo; when the group were located close to the men, women were reluctant to talk compared to when the women were separate from men and they became more open. Participation must also go beyond simple numbers and look at whether women's voices were actually being heard. In Isiolo and Wajir, it was highlighted that there may be women represented in committees and in the project cycle process, but if these women did not actually participate due to cultural issues and/or a lack of confidence then there was no real inclusivity.

Despite successes on the inclusion of women, it was recognised there is a need to include other social groups, such as youth, the poor, people with disabilities, and other minorities. It was noted there were few elements for people with disabilities considered in design of investments, such as ramps or accessible toilet facilities. Thus, to ensure functional investments for all groups, there is need to design water points and sanitation facilities for ease of access for all.

Sheep and goats drinking from a water trough in Sericho ward, Isiolo County © Adaptation Consortium

5. Implications

Water investments in the drylands, such as those implemented under the CCCF, are critical for ensuring water security. Furthermore, water security is essential to food security, livelihoods and wellbeing. The CCCF water investments are focused on increasing the availability and access to water for domestic, livestock and other productive uses. Investments are prioritised by communities so respond to their needs for water and food security. Other studies have shown how the investments provide a number of benefits to beneficiary households and communities that ultimately lead to improved water and food security, improved livelihoods and greater climate resilience *(Table 2; Ada Consortium 2018; Bonaya and Rugano 2018; Crick et al 2019, 2020; Tari et al. 2015)*.

This study concentrated on the functionality and sustainability of investments and did not look directly at the outcomes of the investments on households and communities. Nevertheless, achieving these outcomes will require functional and sustainable investments that provide access and use of water for which they were intended. The functionality rate across the investments was 62.9% overall if including the functional and not-in-use investments. This compares positively to functionality estimates given in previous studies in the drylands (Section 2.3). Yet, 14.5% of investments were non-functional and thus not operating at all, and another 22.6% partially functional. The main factors contributing to non-functional investments were technical problems (e.g., poor siting, poor design and workmanship), while both technical and management (e.g., lack of repairs and maintenance, and vandalisation) problems contributed to the partially-functional investments (Tables 10 and 11). This suggests improving the management and O&M of facilities could help partially-functional investments regain their functional status.

Further investigation into the underlying causes of poor functionality show that the technical and management problems can be explained by a mix of governance, institutional, capacity, technology, and financial deficiencies. This range of issues, many closely interlinked, capture the complexity of the situation underlying water provision in the rural drylands. Many of these issues are systemic within the rural water sector in Kenya and are symptomatic of a wider governance system that is under resourced and lacks capacity. In Kenya's drylands, they also exist beyond the water sector as the ASALs have historically suffered from marginalisation and a development deficit compared to higher rainfall regions.

The majority of CCCF investments are rehabilitations of existing water points and/or provide supporting infrastructure to improve the access and availability of water to communities based on communities needs and priorities. This is especially the case in the more arid pastoral counties (Wajir, Isiolo and Garissa), which have allowed better access to water for domestic and livestock uses, at the same time as ensuring water points closely support livestock grazing and mobility strategies and take care not to disrupt the pasture-water balance (Section 1.2). In the semi-arid counties (Kitui and Makueni), they are more new constructions which have provided better access and availability of water for crop and livestock production, domestic use, as well as new livelihood opportunities, such as kitchen gardens and tree planting.

Overall, the functionality rate of the rehabilitation investments was higher than the new-construction investments, suggesting that simply increasing access to water points in rural drylands is not the solution to sustainable water provision. Water points also need strong management and governance systems in order to stay functional and continue to reliably provide water for enhanced resilience and water and food security outcomes. Devolution in Kenya and the decentralisation of public services has resulted in large increases in funding to counties, including county water sector budgets. Emphasis has focused on water development infrastructural investments, whereas the development of an appropriate institutional framework for community water provision, good governance practices, O&M, and the 'software' aspects, have lagged behind. The development of infrastructure must be accompanied by the development of good governance and a strengthened capacity of state and local institutions to effectively implement and manage water investments.

Choosing the most appropriate type of water investment and its associated technology is an important consideration in developing rural water investments in the drylands, and can influence functionality rates *(Wilson et al., 2016; MacAllister et al 2020)*. In this study, boreholes, water pans and earth and sand dams had higher functionality rates than pipeline distributions and rock catchments, however the sample size of each investment type, especially the latter two was low, so this study is unable to decipher the main factors that contribute to poor functionality of the different types of water investment.

However, the hardware and software components of functionality are inherently interrelated *(Whaley and Cleaver 2007; Walters and Javernick-Will 2015)* and must be considered together in the choice of water point type or technology for community use and management. This should involve careful decision making over the investment or technology choice with appraisal of different options given the existing technical and management capacity, cost, availability of spare parts, community needs, and in the drylands, the pasture/water pasture balance to ensure new water points do not disrupt the existing grazing strategies and lead to pasture degradation. Since the CCCF investments are community prioritised through the CCCF mechanism, they directly respond to community needs and help ensure the most appropriate water point type and technology is decided upon with community input and matched to local water user requirements.

MacAllister et al (2020) suggest having a portfolio of water sources and technology types can improve overall rural water supply in the drylands, especially during drought, and lead to greater resilience at the community level. Through access to a range of water sources, households are able to meet their diverse domestic and production water requirements, in response to variations in rainfall, water availability and quality, and water source performance.

Community-based water management (CBWM) is the dominant approach to the management of the CCCF water investments, as it is to rural water supply in Kenya. In this study, a number of the underlying causes of poor functionality relate to the challenges faced by the CBWM model, including: weak technical and management capacity of the management committees; unclear roles and responsibilities; poor supervision; lack of maintenance schedules; unavailability of spare parts, and difficulties in water revenue collection. CBWM can become more sustainable when communities are provided support by strong local institutions, such as local government, NGOs and the private sector *(Harvey and Reed 2007; McIntyre and Smits 2015)*.

This study found there is weak external support to community water management from the county government as well as from the private sector. There is limited oversight from the county government, with overlapping roles between communities and county government in maintenance and repairs, shortage of county staff, and the lack of a sustainability plan in maintaining investments. There is also little in the way of a private sector approach through local mechanics or suppliers of spare parts to help with regular maintenance and repairs.

This raises the question whether communities should be responsible for managing and sustaining functional water delivery systems many years into the future? If the functionality of a water point is considered to be dependent on the functionality of its community management system *(Whaley and Cleaver 2017)*, improving the functionality of water investments will require more support to the communities who are expected to manage those investments. Communities need strong support systems if they are to successfully manage sustainable water systems long after an investment is established. In the case of O&M, especially where higher technical skills are required for borehole repairs and maintenance, this role might be better outsourced to a more developed and skilled private sector.

A clearer model of who is responsible, possibly with a more developed and integrated private sector to supplement community management and support the maintenance of investments, could help improve the functionality of water investments. In such a model, investments would be clearly owned by communities but with the O&M or just maintenance, outsourced to the private sector and the community in control of decision-making, managing community access and use to the water point, collecting fees as necessary, and ensuring peace. Designating these clearer roles and responsibilities, and outsourcing the more technical jobs could improve feelings of ownership of the investments and provide a more sustainable and responsive water service delivery. Other studies assessing the functionality of rural water supplies in Kenya and other countries, suggests engaging the private sector in the provision of water service can enhance the overall sustainability of water supply services and improve reliability, access, affordability and water quality *(SNV undated; Kleemeier and Lockwood 2015; Obosi 2017)*.

The CCCF investments are increasing the availability and access to water and helping build communities' resilience to climate change. For example, the investments provide infrastructure such as water storage, piping and distribution at water points improving water availability during drought, thus reducing the impact of climate shocks. However, to ensure effective adaptation to climate change, investments need to be resilient to existing climate variability and future climate change. This study found that climate information services are not being systematically integrated into the siting and design of investments resulting in their poor functionality, especially due to flooding and the washing away of infrastructure. Integrating relevant climate information into the siting and design of investments will be vital to withstand such climate shocks and ensure their long-term functionality.

There is also limited information and understanding on the water resources upon which investments rely. This has implications for the sustainability of water investments, especially as climate variability and climate change impact on the water resources. This information is key to inform the correct siting and design of investments and ensure their technical feasibility. It is also important in the management and monitoring of investments so communities are able to plan usage of their water resources based on the different seasons and to observed and anticipated changes in climate.

Evaluating the functionality of water investments is an increasingly common assessment in the evaluation of water projects and an essential step in ensuring the long-term sustainability of water supply systems. This study co-developed and implemented a functionality survey to evaluate the functionality of a sample of CCCF investments and subsequently explored the contributory factors and underlying causes behind poor functionality with stakeholders. This study was only a snapshot during the dry season and seasonal changes in functionality could not be ascertained. It would be useful to repeat a survey during different seasons to examine potentially different causes of failure. Repeated monitoring of the investments over time would also help understand how and why functionality status changes over time. Further technical assessments could include water yield, quality and reliability *(Carter and Ross 2016; Bonsor et al 2018)* to determine extended definitions of functionality status.

This study was limited in the extent of the views incorporated, and further enquiry could include a wider set of users beyond the surrounding community members, to include the voice of seasonal users or cross-border users. Further and repeated studies will be needed to build evidence over time of the outcomes and impacts of the CCCF water investments on communities' resilience and water and food security. This is especially important as the CCCF mechanism is scaled out further within the five pilot counties as well as to other areas.

6. Recommendations

The following recommendations are given in response to the underlying causes of poor functionality found during the study. They emerged from discussions with respondents at the survey sites and the stakeholder workshops. They are suggested for consideration to improve the functionality and sustainability of water investments in the further scale out of CCCF in the pilot counties and beyond. They do not address all aspects of the CCCF mechanism, but are given in relation to the functionality of community-managed water investments in the drylands. They are also given more generally as considerations for the implementation of water investments in dryland environments.

1. Better integration of climate and hydrological information in siting and design

There is need for further hydrological, biophysical and meteorological assessments in the development and siting of water investments. This includes climate information services, water monitoring, and an evaluation of the groundwater. As well as important information for the siting and design of investments, this type of information is required to ensure the sustainability of investments and ensure their resilience to climate change. This can be supported by having trained hydrologists and hydrogeologists conducting the siting of investments. Further mainstreaming of CIS into county planning processes will facilitate the integration of climate information into the design of each investment and should also focus down on identifying the nature of CIS needed for different types of water investments. This information if provided at the outset of project design and development will help to mitigate the risks of climate shocks adverse impacts on the functionality of water investments.

2. Strengthened technical county capacity and resources

Strengthen the technical capacity of the county government by increasing the number of skilled staff and the number of staff at the subcounty and ward levels. This can support better siting and design of facilities, as well as improve response times for repairs and maintenance. Having engineers or water officers based at the ward or subcounty level will also increase the speed of response. This would require further resources to be devolved to the subcounty and ward levels. There is also opportunity for local NGOs to support and provide technical expertise when implementing investments. Local NGOs (many of whom maybe already working on water issues) are already represented on the CCCPCs, and may have qualified engineers and expertise to contribute. These could be further utilised to support county governments in the siting and design of investments, as well as communities in the management of investments.

3. Better supervision of contractors by county government and the community

To improve the supervision and workmanship of contractors, ensure the tendering process/contractual conditions for involving contractors in investments is clear and being implemented by the county departments responsible. This can include through, for example, clear milestones and when they need to be achieved, and specifying payment conditions and when to pay contractors, possibly retaining a portion till the investments are functional for a period of time. County water officers and engineers responsible for supervision also need to be provided with the necessary resources to allow them to do so effectively. Increase the role of site management committees in the supervision of contractors, through an enhanced understanding and interpretation of the BoQ. This can enable committees to track progress and ensure a high quality of work is achieved. Communities can record and share progress with the county government as to whether satisfactory works is completed in order to process payment.

4. Strengthened capacity of water management committees

Strengthen management and technical capacity of the water management committees through regular, appropriate, and targeted training, particularly on post-handover management, financial management, conflict management and vandalisation. This should be supported by clear policies in place to guide the management of investments, with clear roles and responsibilities of the committees vis-à-vis the roles and responsibilities of the county government and other actors, to avoid overlapping roles and improve feelings of ownership of investments. This should be guided by a constitution that govern operations of water management committees and limit the service for those in leadership to a specified period. Build on successes in inclusivity by ensuring there is meaningful engagement of women in decision-making in all counties, with more women taking on leadership roles. Also broaden inclusivity to other social groups, such as the youth, the poor, and people with disabilities, and consider elements for people with disabilities in the design of investments to ensure functional investments for all. Furthermore, involve beneficiaries in determining water payments, so that it does not exclude the very poor and vulnerable. As standard, establish a community consultation process to generate common understanding of water fees charged at different water points or for different uses or different types of livestock.

5. More external support to community management

In addition to the capacity development of committees, there is need for regular, structured external support to community-based water management. Communities subcontracting O&M to a more skilled and accessible private sector can lead to increased efficiency, speed of response, and lower prices in the maintenance and repairs of investments. A private sector approach could facilitate essential and immediate spare parts positioned and available at the sub-county level, so as to ensure fast moving spare parts for each water investments and reduce delays in response to breakdowns. County governments need to provide the enabling environment, like roads and other basic infrastructure, for a private sector approach to O&M, to make it attractive/feasible to suppliers of spare parts in the ASALs.

6. Strengthen cross border conflict mechanisms

To prevent cross-border conflict, greater support could be given to developing shared investments across borders. Although the CCCF includes provision (20% of funding) for investments to occur at the county level, such as where wards share resources, there is need to develop this for investments where communities might share resources across borders through mobility. Clear guidelines on the utilisation of investments across borders is key. Strengthen conflict resolution mechanisms within site management committees and WCCPCs, and use customary forms of conflict resolution where appropriate, such as the *Dheeda* in Isiolo.

7. Improved water resources monitoring and data

All counties require access to information on their water resources, including an improved understanding of surface and groundwater sources. Some of this data could be accessed from national institutions such as the Water Resources Authority (WRA) and NDMA. It could also be through linkages with local institutions like the Water Resource User Associations (WRUA). Having a broader understanding of the groundwater resources (e.g., properties, depth, recharge) upon which the investments depend, will help provide a vital component in implementing and ensuring sustainable and climate resilient water investments. For broader monitoring and evaluation of the CCCF investments, it will be important for each investment to have monitoring data on water use, quality, and yield.

8. Development of a quality assurance framework

Ensure a quality assurance framework is set up and adhered to in the design, implementation and management of all investments. A framework could set up and reinforce good technical supervision and project management, participatory consultations, routine schedules for effective O&M, sustainable spare parts systems, contingency planning for drought, and be anticipatory rather than reactionary. It could also be used to ensure the relevant technical assessments are completed before any proposed investment is implemented – for example, all investments must undertake the necessary technical surveys and statutory assessments (e.g., Environmental Impact Assessments) before being given the go-ahead to proceed. Such a framework should be embedded within the county government systems so it is integrated into county processes rather than as an add on. This will be essential for maintaining the accountability of institutions and ensuring they continue to adhere to the principles of the CCCF mechanism. A quality assurance framework would also serve to ensure that climate information continues to be integrated into the design and siting of investments, and includes minimum standards for investments to be climate-smart, such as through the use of solar power, water harvesting, and water conservation measures.

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8. Annex

CCCF investments functionality survey tool

A. General Information

Project ID:

Name of Enumerators/officers: Date: / /

County: Subcounty:

Ward: Village:

Project name/Description:

Year CCCF project implemented:

GPS:

Longitude: Latitude:

Respondent/s relationship to the project? *(indicate no. and gender)*:

1. Site committee member:

2. User:

3. WCCPC member:

4. Other, specify:

Photos taken at site *(tick)*: ☐ Yes / No ☐

B. Functionality *(looks overall at the investment, key components come later)*

1. Is the water investment currently functional *(choose one option and explain why)*?

☐ Functional ☐ Partially functional ☐ Non-functional ☐ Not currently in use as seasonal

☐ Other (specify):

Describe the condition/reason:

If the investment is ***partially functional*** or ***non-functional***, answer:

2. Number of months/days the investment been partially functional or non-functional?:

Months: Days:

3. What efforts are being made to repair it?

If the project is ***functional***, answer:

4. Are there any emerging problems that might lead to non-functionality in the future?

☐ Yes / No ☐

If yes, Describe the problem that might lead to non-functionality in the future:

5. Has the project been out of service in the last month?

☐ Yes / No ☐

If yes, Number of days: Reason:

Repairs:

6. How are repairs usually carried out? *(tick all that apply)*

☐ Reliant on county water department ☐ Minor / ☐ Major

Details:

☐ Reliant on private company ☐ Minor / ☐ Major

Details:

☐ Reliant on a trained local technician ☐ Minor / ☐ Major

Details:

☐ Other ☐ Minor / ☐ Major

Specify: Details:

☐ Do not know

7. How long does it usually take to carry out repairs?

8. Who usually pays for repairs? *(tick all that apply)*

☐ User committees from water fees ☐ Minor / ☐ Major

Details:

☐ County government ☐ Minor / ☐ Major

Details:

☐ Water users (from contribution) ☐ Minor / ☐ Major

Details:

☐ Other ☐ Minor / ☐ Major

Specify: Details:

☐ Do not know

9. What challenges are faced in carrying out repairs? *(tick all that apply)*

☐ Slow response times from county government, private company or technician ☐ Minor / ☐ Major

Details:

☐ Limited or no funds ☐ Minor / ☐ Major

Details:

☐ Lack of available spare parts ☐ Minor / ☐ Major

Details:

☐ Other ☐ Minor / ☐ Major

Specify: Details:

☐ Do not know

10. Was the investment appropriately sited?

☐ Yes / No ☐

Describe process *(eg. did it take on local knowledge, was it participatory, or where most convenient etc)*?:

C. Project Specific Components *(to be filled out by engineer/technical team)*

1. Was the investment a new project or rehabilitated project?

☐ New / Rehabilitated ☐

Project components (tick all that apply)	***Condition: 1=good; 2=poor; 3=not in use; 4=other (specify)**
☐ 1. Excavation / Drilling	☐ Components funded by CCCF?
Quantity or capacity:	What is the component condition:*
Describe the condition, technical workmanship:	
What repairs do you think are needed?:	
At what costing?:	
☐ 2. Desilting (pan)	☐ Components funded by CCCF?
Quantity or capacity:	What is the component condition:*
Describe the condition, technical workmanship:	
What repairs do you think are needed?:	
At what costing?:	
☐ 3. Draw off system	☐ Components funded by CCCF?
Quantity or capacity:	What is the component condition:*
Describe the condition, technical workmanship:	
What repairs do you think are needed?:	
At what costing?:	

☐ 4. Piping distribution system ☐ Components funded by CCCF?

Type:

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 5. Distribution/Collection Chambers ☐ Components funded by CCCF?

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 6. Concrete wall ☐ Components funded by CCCF?

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 7. Gutters (rock) / Inlet-outlet (pan) ☐ Components funded by CCCF?

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 8. Abstraction/SUMP well ☐ Components funded by CCCF?

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 9. Pump / power house ☐ Components funded by CCCF?

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 10. Pump ☐ Components funded by CCCF?

Type:

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 11. Power ☐ Components funded by CCCF?

Type:

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 12. Fencing	☐ Components funded by CCCF?
Type:	
Quantity or capacity:	What is the component condition:*
Describe the condition, technical workmanship:	
What repairs do you think are needed?:	
At what costing?:	
☐ 13. Guard/operator house	☐ Components funded by CCCF?
Quantity or capacity:	What is the component condition:*
Describe the condition, technical workmanship:	
What repairs do you think are needed?:	
At what costing?:	
☐ 14. Tank 1	☐ Components funded by CCCF?
Type:	Capacity:
Quantity or capacity:	What is the component condition:*
Describe the condition, technical workmanship:	
What repairs do you think are needed?:	
At what costing?:	
☐ 15. Tank 2	☐ Components funded by CCCF?
Type:	Capacity:
Quantity or capacity:	What is the component condition:*
Describe the condition, technical workmanship:	
What repairs do you think are needed?:	
At what costing?:	

☐ 16. Water kiosk / tap stand ☐ Components funded by CCCF?

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 17. Livestock troughs ☐ Components funded by CCCF?

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 18. Sanitation facility ☐ Components funded by CCCF?

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

☐ 19. Other ☐ Components funded by CCCF?

Specify:

Quantity or capacity: What is the component condition:*

Describe the condition, technical workmanship:

What repairs do you think are needed?:

At what costing?:

2. Do the components deliver what the project intended?

☐ Yes / No ☐

If no, explain:

3. Do you think the project meets the required standards?

☐ Yes / No ☐

If no, explain why:

4. Do you have any other technical observations?

☐ Yes / No ☐

If no, explain:

D. Investment Management *(to be filled out with site committee/users)*

1. Who is responsible for management of the project?:

2. Is the management entity currently active?

☐ Yes / No ☐

If no, why not?:

3. What year was the committee established?

4. How many members are on the committee?

5. What is the composition of the committee?

Men: Women:

6. Have the committee received any training?

☐ Yes / No ☐

Details:

Was this funded under the CCCF? ☐ Yes / No ☐

Details:

7. Are there any challenges/problems with project management?

Please explain / list:

8. What are the suggested solutions to these challenges

E. Investment Use *(to be filled with site committee/users)*

1. What is the water used for? *(tick all that apply)*

☐ Domestic

Details:

☐ Livestock

Details:

☐ Micro-irrigation – gardening

Details:

☐ Afforestation within the compound

Details:

☐ Other

Details:

2. How many households use the water point?

Wet season: Dry season:

3. How many heads of animals are served by the water point?

	Wet	Dry
Cattle		
Sheep/goat		
Donkey		
Camel		

4. How is the water yield for domestic, livestock or other productive uses, in the wet and dry season?

1 = Adequate, 2 = Inadequate, 3 = Water point not in use, 4 = Do not know

	Wet	Dry
Domestic water		
Livestock water		
Other productive use 1 *(specify)*:		
Other productive use 2 *(specify)*:		

Is there a schedule for water access for domestic, livestock or other productive use?

	No	If Yes, please describe
Domestic water	☐	
Livestock water	☐	
Other productive use 1 *(specify)*:	☐	
Other productive use 2 *(specify)*:	☐	

6. Do households pay for water for domestic, livestock or other productive use?

		No	Yes, how much (Ksh)?	Who do they pay?
Domestic water	(per 20 litres)	☐		
Livestock water	Camels	☐		
	Cows	☐		
	Sheep/goats	☐		
	Donkey	☐		
Other productive use 1 *(specify)*:		☐		
Other productive use 1 *(specify)*:		☐		

7. If there is another mode of payment apart from cash, please give details? *(payment type, frequency, agreement etc)*

8. What is the water quality for domestic or livestock drinking?

☐ Domestic drinking ☐ Good / Poor ☐

Give details:

☐ Livestock drinking ☐ Good / Poor ☐

Give details:

9. Does the design and spacing allow for multiple users?

☐ Yes / No ☐

Describe:

Carrying out the functionality survey at lanqood borehole, Wajir County © Adaptation Consortium

The County Climate Change Fund (CCCF) mechanism implemented by the National Drought Management Authority through the Adaptation Consortium is supporting county governments to mainstream climate change in planning and budgeting and prepare them to access climate finance from different sources. The CCCF mechanism has been piloted successfully in five counties — Isiolo, Garissa, Kitui, Makueni and Wajir — and is being scaled out in Vihiga, Nandi, Bomet, Kisii, Kakamega, Kisumu, Bomet, Narok, Siaya, Taita Taveta, Tharaka Nithi, Embu, Machakos, Kilifi and Kwale.

Ada Consortium is scaling out the CCCF mechanism under the leadership of a steering committee and a technical committee composed of the National Drought Management Authority, Council of Governors, Climate Change Directorate, Kenya Meteorological Department, and National Environment Management Authority. The Consortium works in partnership with County governments, international NGOs (Christian Aid and the International Institute of Environment and Development) and local NGOs (Anglican Development Service – Eastern and Western (ADS-E and W), WomanKind Kenya, Merti Integrated Development – Programme (MID-P), Arid Lands Development Focus (ALDEF), Community Rehabilitation and Environmental Programme (CREP), and Lifeskill Promoters (LISP). The Consortium is funded by UKaid, and the Government of Sweden.

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Cover image: *Livestock drinking water from a trough in Sericho Ward, Isiolo County* © Adaptation Consortium

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