



Climate Action in the Water Sector in Kenya – Sector Roadmap

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GNI^{plus}
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Foreword

Water has a high economic value in Kenya as nearly all the country's key economic sectors rely on freshwater resources to function efficiently. Food security, wealth and employment creation, and poverty reduction can be achieved through accelerated development and improvement of irrigation-based systems that allows for production throughout the year

However, the impacts of climate change are a major challenge to the water and food security sectors in Kenya, disrupting livelihoods and business operations, having adverse consequences on many other aspects of human society and the natural world. Impacts of climate change on water resources have affected nearly all sectors, including, among others, agriculture through unpredictable rainfall patterns, human health through water-borne diseases during flooding, as well as trade through destruction of road and telecommunication infrastructure during extreme weather events. These impacts are further exacerbated by adverse anthropogenic factors.

Given the significant role water plays in the socio-economic development and wellbeing in Kenya; climate change has the potential to inhibit the Government's commitment to achieving the actions set out in the National Climate Change Action Plan (NCCAP) 2018 – 2022, as well as other development agendas, such as the Vision 2030. In the NCCAP, water and the blue economy are targeted as one of the government's seven priority areas in addressing climate change mitigation and adaptation issues.

Further recognizing the importance and benefits of water to the socio-economic wellbeing and development of the country, the Government of Kenya, through the Ministry of Water, Sanitation and Irrigation, has launched a number of initiatives to support in meeting the country's targets. The National Water Masterplan 2030 was a critical step in assessing Kenya's water resources and meteorological conditions to facilitate planning for the development and management of the sector. The findings from this assessment have supported the Ministry and its parastatals to develop meaningful implementation action plans to support a wide range of development needs.

Furthermore, the Water Act 2016, the Irrigation Act 2019 and Irrigation Regulations 2020, Water sector regulations, sessional paper No 1 of 2021 on the National Water policy and the National Irrigation policy 2017, the National Water Resources Strategy (2020-2025), the Guidelines for Promotion, Development and Management of Irrigation in Kenya, the Water Services Regulations, 2021, the National Irrigation Service Strategy 2022-2026 and the National Water Sanitation Strategy (2020-2025) all outline the way forward with actions and areas of opportunity to strive towards more efficient and effective management and use of water as well as measures to adapt to a changing future environment.

The Water Sector Roadmap Report and Tool highlights the need for and provides a concerted implementation pathway for resilient climate action projects that can help deliver Kenya's commitments in its NDC, SDGs achievement, and Vision 2030 target. It is hoped that this work will help to signal and attract private sector actors', NGOs and investors participation on the ambitions and direction of the Ministry, to enhance the investment and market finance options for the sector; whilst also acting as a tool for tracking and evaluating relevant projects.



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Executive Summary

Water is life. It is one of the most critical resources that holds the day-to-day social-economic fabric of every society. Water has a high economic value in Kenya as nearly all the country's key economic sectors rely on freshwater resources to function efficiently.

The water sector in Kenya is still in its developmental stage. It faces many challenges, including climate change, which affects both surface water and groundwater resources availability and supplies; this is brought about by long persistent drought, unpredictable and unprecedented rainfall patterns and destruction of water supply infrastructures. Additionally, piped water supply is unevenly distributed due to limited infrastructure, with rural areas receiving little or no water supply from the water supply distribution network. The underdevelopment of the water sector can significantly hinder the country's overall socio-economic growth and development.

Findings from the Climate Change Action in the Water Sector Status Review Report (AECOM, 2021) (hereafter referred to as the "Climate Action Report"), showed that the water sector has been underfunded over the years and so the priority for all water-related projects is high. This issue was also validated and reinforced by numerous stakeholders who were consulted through the development of this water sector – Roadmap Report. There is an urgent need for both rapid intervention and investment in constructing new climate-resilient water supply and distribution infrastructure, as well as better maintenance and proper operations of existing infrastructure to increase their efficiency, reduce water losses, and improve water availability and coverage. This will also help to advance water availability for sanitation and irrigation.

The Government of Kenya (GOK) has prioritised climate change adaption and mitigation in the water sector in its National Climate Change Action Plan (NCCAP) 2018 – 2022, and as part of its updated (2020) Nationally Determined Contribution (NDC)¹ and efforts to meet its water-related Sustainable Development Goals (SDGs) and the Kenyan Vision 2030 objectives. Within the NCCAP, Strategic Objective 3 focuses on water and the blue economy with several proposed Strategic Actions (i.e. interventions) to enhance the water sector's resilience, whilst also ensuring adequate access to water through efficient water use for agriculture, manufacturing, domestic, wildlife and other purposes. This commitment by the GOK has led to several water resources development, management and protection projects across various water-related sectors, with the Ministry of Water Sanitation and Irrigation (MoWSI) as the key driver, supported by its parastatals, relevant stakeholders, including international financial institutions, bilateral donors, development partners, non-governmental organisations (NGOs), private sector and others with interest in the water sector.

Between 2020 and 2021, GNI^{plus} undertook a Climate Change Action review of the Water Sector in Kenya as part of its efforts to support the GOK commitment to the Paris Agreement. One of the key findings from the Climate Action Report was that despite the measures by the government to overcome the many challenges/barriers facing the water sector and to deliver on its climate change commitment, there is a general lack of a concerted and detailed implementation roadmap that all relevant stakeholders can follow to deliver on its climate change commitment and development of the water sector. Coupled with this is the resulting difficulty in evaluating the impact and progress of these ambitious plans and targets. The aim of this Water Sector – Roadmap Report is to set out a blueprint and implementation pathway to support the GOK towards delivering against its water commitments in its NDC, SDGs achievement, and Vision 2030 target. It aims to also help attract investors and market finance for investments in the water sector, whilst also acting as a tool for tracking and evaluating relevant projects in the sector.

¹ The country's commitment under the Paris Agreement

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List of Acronyms

BGS	British Geological Survey
FAO	Food and Agriculture Organisation
GBP	Great Britain Pounds
GDP	Gross Domestic Product
GHG	Greenhouse Gas Emissions
GNI ^{plus}	Global NDC Implementation Partners
GOK	Government of Kenya
JICA	Japan International Cooperation Agency
KFS	Kenya Forest Services
KPI	Key Performance Indicators
MCA	Multi-Criteria Analysis
MCM/Year	Million Cubic Meter/Year
MoWSI	Ministry of Water, Sanitation, and Irrigation
NCCAP	National Climate Change Action Plan 2018 - 2022
NEMA	National Environment Management Authority
NGO	Non-Governmental Organisation
SDG	Sustainable Development Goals
UN	United Nation
UNICEF	United Nation Children Education Fund
USAID	United States Agency for International Development
USD	United States Dollar
WASREB	Water Services Regulatory Board
WRA	Water Resources Authority
WSTF	Water Sector Trust Funds

1. Introduction

1.1 Country and Sector Background

Water is life. It is one of the most important resources that hold the day-to-day social-economic fabric of every society. Water is a finite resource with no substitute and therefore needs to be used wisely.

In Kenya, water supply coverage is estimated at 57% and per capita water availability is estimated at approximately 647m³ per person per year (FAO, 2020), **which is significantly lower than the UN's benchmark of 1,000 m³ per capita per year.** Furthermore, only around 34% of households in the country have access to piped potable water as the main source of drinking water. This compares to 57% of **the world's population that has access to drinking water from piped connections** (WHO, 2020).

Water has a high economic value in Kenya as nearly all the key economic sectors rely on freshwater resources to function efficiently. Water is also critical for livelihoods - for sustainable food production and water, sanitation, and hygiene (WASH) purposes. However, water supply infrastructure in Kenya is still in the developmental stage, many challenges facing the water sector are yet to be resolved, and a lack of investment has hindered the provision of adequate and sustainable clean water supply to all. Climate change is compounding these issues, particularly in the agricultural and water sectors, given their sensitivity to climate variability. Climate change affects both surface water and groundwater resources availability, and thus operation of water supply systems, due to changing rainfall patterns, lengthening drought, and flooding (damage) caused by increasing rainfall intensity. There is an urgent need for investment in new and upgraded climate resilience water source infrastructure, water supply and distribution infrastructure, and improved/adapted operations to deliver sustainable, efficient and resilient water supply systems whilst expanding water availability and coverage.

In a bid to overcome these challenges and as part of efforts to meet its water-related Sustainable Development Goals (SDGs) and its updated (2020) Nationally Determined Contribution (NDC) commitment, the Government of Kenya has prioritised climate change adaption and mitigation in the water sector in its National Climate Change Action Plan (NCCAP) 2018 – 2022. Within the NCCAP, Strategic Objective 3 focuses on water and the blue economy with several proposed Strategic Actions (i.e. interventions) to enhance **the water sector's** resilience whilst ensuring adequate access to water through efficient water use for agriculture, manufacturing, domestic, wildlife and other purposes. The NCCAP also reflects **Kenya's commitment** towards the Paris Agreement, of which water is considered under the adaptation and resilience category. Furthermore, the Government of Kenya has set several targets in the water sector, including universal access to clean drinking water by 2030 through its Kenya Vision 2030 plans, leading to multiple water resources development, management and protection projects across water sector and water-related sectors in the country.

While the Government of Kenya has set out these ambitious strategies, plans and targets to overcome these challenges and deliver on its climate change commitment in the water sector, there is a general lack of a concerted and detailed implementation roadmap that all relevant stakeholders can follow to support the plans. This is coupled with the resulting difficulty in evaluating the impact and progress of these ambitious plans and targets. Therefore, this Water Sector Roadmap Report sets out a pathway and implementation plan to support the Government of Kenya towards developing the water sector to deliver its NDC commitment, SDGs and Kenya Vision 2030 target. It can be used to attract investors, implementing partners and finance for investments in the water sector, whilst acting as a valuable tool for tracking and evaluating relevant projects. It also acts as a monitoring tool for evaluating progress and impact in delivering on national climate change strategies in the water sector.

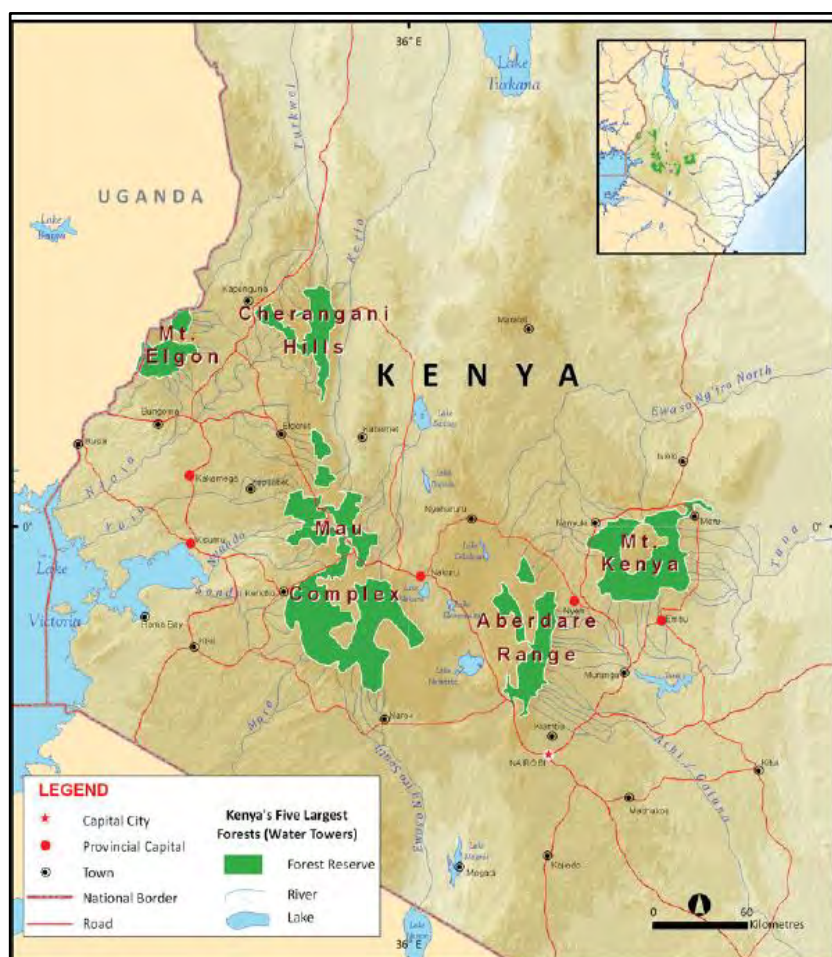
1.2 Structure of the Water Sector in Kenya

1.2.1 THE SOURCE OF WATER SUPPLY IN KENYA

Most of Kenya's water originates from its five main gazetted "water towers"²: the Aberdare Range; Mount Kenya; the Mau Forest Complex; Mount Elgon and the Cherangani Hills (Figure 1). They are the most extensive montane forests in the country and form the upper catchments of the main rivers in Kenya (except the Tsavo River that originates from Mount Kilimanjaro (FAO, 2015). These water towers provide approximately 75% of Kenya's freshwater resources used for irrigation, agriculture, industrial processes, and installed hydro-power plants (FAO, 2015).

The main rivers in Kenya form the primary surface water catchments and drainage network of the country. They are hydraulically connected to the main groundwater catchments, which also contribute to the country's water supply sources. The most densely populated areas in Kenya are found close to, and downstream of, the montane forest locations because of their water resources supply potential to support intensive agriculture and urban settlement (Akotsi, Gachanja, & Ndirangu, 2006).

Figure 1. Location of the Five Water Towers in Kenya



Source: Kenya Forest Service (KFS) 2010

² A water tower is an upland area with characteristics to support reception, infiltration, percolation and storage of rainfall and gradually releases it into a drainage basin. Gazetted water towers in Kenya are those that are under the Government's control and are managed by the Kenya Water Towers Agency.

1.2.2 SURFACE WATER SUPPLY IN KENYA

Surface water constitutes the primary source of water supply in Kenya used for domestic, agricultural, and industrial purposes. An estimated 75% of surface water originates as precipitation runoff from five “water towers” (see Figure 4) in central and western Kenya (KwTA, 2020). The main surface water resources are distributed within six major surface water catchments - Tana, Athi, Ewaso Ng’iro north, Rift Valley and Lake Victoria Basin North, and Victoria Basin South (Figure 2) (Figure 4). About 57% of Kenya’s renewable surface water resources falls within transboundary waters (i.e. river basins shared by two or more countries), which means that there must be clear treaties and collaborations between neighbouring countries sharing the resource to ensure its sustainability. Total renewable surface water resources was estimated at 20,637 MCM³/year in 2010 (WASREB, 2013).

Surface waters in Kenya characteristically have naturally high organic carbon content, especially at the end of the rainy season, due to large amounts of contamination from untreated sewage, agrochemicals leached, and increased nutrient/sediment transport (typically as a result of increased deforestation and land degradation activities causing erosion). This, along with other nutrients in the water, can cause issues such as eutrophication⁴.

Rapid population growth and urbanisation has also led to a decline in water quality, with sanitation and waste management being the critical problems. Climate change is also contributing to reductions in water quality due to greater rainfall intensities, coupled with land use changes, increasing soil erosion rates, and mobilising greater sediment loads.

Figure 2. The Six Main Surface Water and Groundwater Catchments in Kenya



Source: JICA, 2019

1.2.3 GROUNDWATER SUPPLY IN KENYA

Groundwater constitutes about 10% of the total renewable water resources in Kenya (NEMA, 2010). It is the main water supply source in areas that receive low rainfall and runoff, such as the Ewaso Ng’iro basin. Groundwater is also used in urban areas to supplement supply due to augment surface water resources to meet municipal demands.

Groundwater resources and availability in Kenya are characterised by the country’s underlying geology, consisting of Precambrian metamorphic rocks, Tertiary- Quaternary sedimentary and volcanic rocks (Figure 3). The aquifers (water-bearing zones) in the volcanic rocks tend to occur at depths >90m, with high piezometric pressures. In contrast, the aquifers in the sedimentary formations usually occur at shallower depths (<90m) (Paverlic, Giordano, Keraita, Ramesh, & Rao, 2012). The aquifers in both the volcanic and sedimentary rocks are heavily exploited for groundwater supply due to their high yielding potential and regional distribution (Figure 3). Other minor aquifers provide a vital local resource in addition to the aquifers identified as strategic or major aquifers. Annual renewable groundwater resources was estimated at 21,470 MCM/year in 2010 (WASREB, 2013).

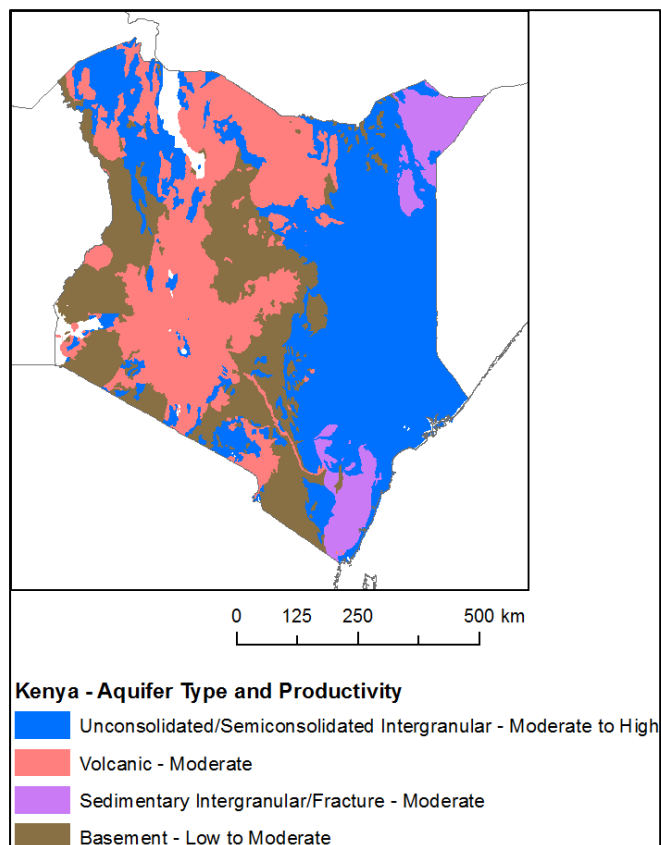
³ MCM/Year – Million Cubic Meter/Year

⁴ excessive richness of nutrients in a lake or other body of water, frequently due to run-off from the land, which causes a dense growth of plant life.

The Water Resources Authority (WRA) of Kenya⁵ has classified the various aquifers in the country into broad categories based on their level of importance, as outlined in

Table 1. The classification was introduced to categorise the quality and quantity of water in each aquifer, considering its value and vulnerability to different management practices (NEMA, 2010).

Figure 3. Simplified Geological and Hydrogeological Map of Kenya



Source: BGS, 2019

Table 1. Groundwater Aquifers Classification by the Water Resources Authority of **Kenya's** Aquifers

Class	Description	Examples
Strategic aquifer	Aquifer used to supply significant amounts/proportions of water in each area and for which there are no available alternative resources, or where such resources would take time and money to develop.	Tiwi, Nakuru, Nairobi, Sabaki, Lake Naivasha and Lamu Island
Major aquifer	High-yield aquifer systems with good water quality	Daua and Mt. Elgon volcanic rock aquifers
Minor aquifer	Moderate-yield aquifer with variable water quality	Mandera-Jurassic (Mesozoic Palaeozoic)
Poor aquifer	Low-to negligible-yield aquifer system with moderate to poor water quality	Basement system

⁵ Previously known as the Water Resources Management Authority (WRMA)

Special aquifer Aquifer system designated as such by the Authority Isinya

Source: (NEMA, 2010)

Groundwater quality in Kenya varies by area and depth of boreholes and connectivity between surface water systems. Generally, groundwater quality in western, central, Nyanza and Nairobi is satisfactory with low dissolved solids of less than 500 mg/l. However, the Nairobi aquifer has high (over 10 mg/l) (Coetsiers, 2008) fluoride concentrations, mostly exceeding the WHO standards of (1.5 mg/l), especially towards the Embakasi area. Along the coast, the water quality is poor due to the high (over 8000 $\mu\text{S}/\text{cm}$) electrical conductivity of the water arising from saline water intrusion. Additionally, shallow wells are often unprotected and therefore have significant bacteriological contamination (Paverlic, Giordano, Keraita, Ramesh, & Rao, 2012). Other related groundwater quality issues are as summarised below:

- The Lotikipi Basin Aquifer in the northwest region of Kenya is very saline with conductivity exceeding 8000 $\mu\text{S}/\text{cm}$ (Barasa, 2018)
- The Mombasa Island Pleistocene sands and limestones and related aquifers are impacted by anthropogenic pollution and saline intrusion.
- The Mumias Granite Aquifer is impacted by mostly anthropogenic pollution and salinisation (Barasa, 2018).

1.2.4 WATER PRODUCTION

Water production is mainly from surface water sourced from the six drainage basins: Lake Victoria North and South, Tana, Athi, Ewaso Ng'iro and Rift Valley (Figure 2). Groundwater is also a crucial source for water production, particularly in rural and urban areas such as Mombasa, Nakuru, and Nairobi. The Water Resources Authority grants and regulates water abstraction permits from both surface water and groundwater sources.

1.2.5 WATER STORAGE AND DISTRIBUTION

Water storage in the country is generally achieved through large and medium-sized dams. However, it is estimated that there are over 6,000 water pans and small dams spread across the country both on public and private land (National Irrigation Authority, 2022). These smaller water reservoirs historically, have served as the sole source of water supply for diverse communities since before the **Kenya's Independence, and remain critical** in rural water supply. The Ministry of Water, Sanitation and Irrigation has also developed water pans, sand dams and small dams in various parts of the country achieving over a 2.5 million m^3 of water storage through these smaller structures. In the rural and some urban areas, at the household level, water storage is achieved through rainwater harvesting, while overhead water tanks are used to store piped water supply and water from private water supply boreholes. Underground water tanks are also common and are used for collecting rainfall or piped water supply (Seidel, 2021).

1.2.6 WATER SUPPLY AND DISTRIBUTION

Publicly owned Water Service Providers (WSPs) are responsible for the treatment, distribution, and sale of water to consumers. Under the 2016 Water Act, water and sanitation service provision was devolved to the County Governments, who own the majority of the WSPs (WASREB, 2020). Tariffs are set and regulated by the Water Service Regulatory Board (WASREB, 2013).

There are currently 88 devolved WSPs in Kenya, either publicly owned by County Governments or privately owned. Public utilities serve a wide range of customers across all income demographics, whereas the two privately owned utilities serve a smaller population of medium to high-income customers. These WSPs source their water mainly from surface water with additional groundwater supplies and are regulated and licensed by WASREB. There are two privately-owned WSPs regulated by WASREB: Runda Water Company and Kiamumbi Water Project. There is also a small proportion of unauthorised/unregulated WSPs utilising the resource.

Generally, the WSPs only operate in urban areas. Outside of their coverage areas, water is supplied informally through community and rural water supply schemes relying on springs, wells, boreholes, rainwater, streams, pans, small dams, etc. In the arid rural regions, drinking water is mainly sourced

from groundwater, and during times of scarcity, water is sold and distributed by water tanker trucks (WASREB, 2013).

There is therefore an urgent need for rapid expansion in water production, storage, and distribution infrastructure to ensure the mandate of the Kenya Vision 2030 plans – access to water for all – can be achieved.

1.2.7 WATER SECTOR POLICIES, REFORMS AND REGULATIONS

Based on the policy of the Kenya Vision 2030 and Water Service Strategic Plan 2009 prepared by MoWSI, the targets for water supply development were set as follows:

- Increase coverage of improved water supply to 100% for both urban and rural areas,
- Increase coverage of piped water supply by registered water service providers (WSPs) to 100% for urban population, and
- Increase unit water supply amount to suitable national standard level.

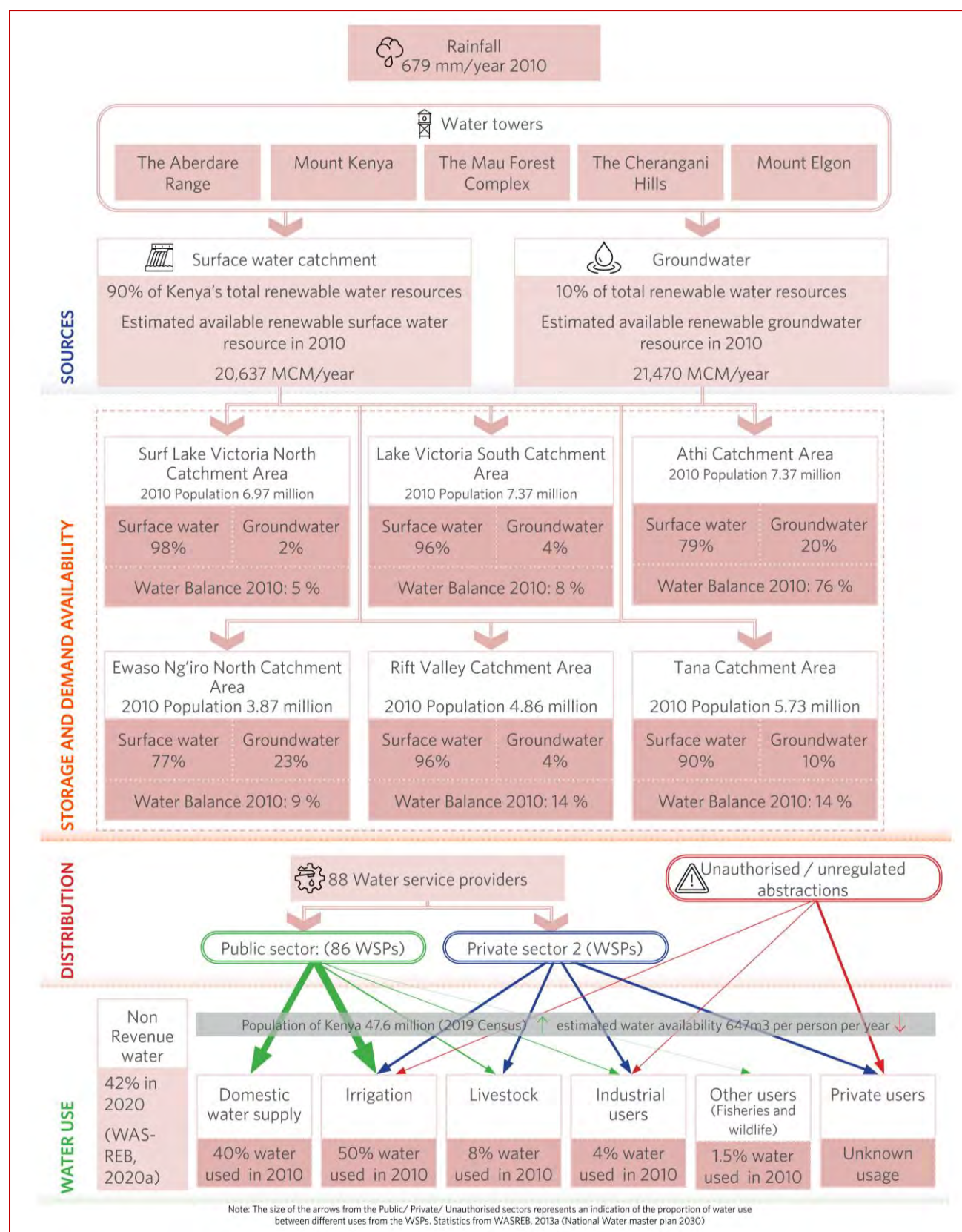
The water sector in Kenya has undergone several reforms, the latest being the enactment of the Water Act 2016, made operational in April 2017. Furthermore, the new law aligned national water management and water services provision with the requirements of the Constitution of Kenya 2010, particularly on the clauses devolving water and sanitation services to the county governments. More information on the legislative framework, policies and regulations of the water sector is discussed in the Climate Action Report (AECOM 2021).

A schematic summary of the structure and interrelations of the water sector in Kenya is presented in Figure 4.



Photo by Adobe Stock

Figure 4. Structure of the Water Sector in Kenya – Source, Storage, Distribution, Supply and Demand



Source: Modified from (WASREB, 2013).

1.3 Current Status and (non-climate) Challenges in the Water Sector

1.3.1 ACCESS TO WATER CHALLENGES

Access to water and sanitation in Kenya has not kept pace with population growth, as only 58% of Kenyans have access to potable drinking water and 30% have access to basic sanitation (World Bank, 2018). This has been attributed to several factors, including lack of investment in water source development or water distribution capacity, aging infrastructure, poor maintenance, rising population, increasing water demand; overexploitation (poor management); eutrophication (contaminated water); degradation of wetlands and the wider catchments resulting in polluted water resources (NEMA, 2010).

1.3.2 WATER QUALITY CHALLENGES

Surface water quality and contamination are significant challenges, and many water sources are contaminated from inadequately treated industrial and domestic effluents, pollution associated with agriculture, and salination in coastal areas. The biggest challenge comes from poor sanitation and wastewater treatment, and inadequate solid waste management, resulting in indiscriminate contamination of surface water bodies.

1.3.3 KNOWLEDGE GAP AND WATER RESOURCES MANAGEMENT CHALLENGES

There is limited information and understanding of the available groundwater resources in Kenya; a lack of scientific knowledge about location and volumes indicates only an estimated 5% of the nation's overall water endowment is understood, meaning that the full potential of the available groundwater resource is unknown. The development, management and control of groundwater in Kenya are still in the early stages and there is an urgent need for control and protection of these aquifers. There is a general perception that water, in particular groundwater, is a "private" resource belonging to those who own the land or have water abstraction permits, therefore encouraging unsustainable groundwater use (EWP, 2018). Some hold firmly to this perception owing to Article 43 ("Every Kenyan has right to clean and safe water in adequate quantities and to reasonable standards of sanitation as stipulated in Article 43 of the constitution") and Article 46 ("....the use of water under a permit, or the method or point of diversion or other manner in which the water is so used causes...") of Kenya's Water Act (2016), which implicitly allows water resources to be controlled by private individuals or companies through the acquisition of water permits. In the coastal areas, over-abstraction of groundwater not only increases the cost of borehole construction and water pumping due to declining water levels, but it can also result in degradation in the water quality due to mobilisation of existing contaminants in some cases due to saline water intrusion into coastal aquifers, or reversal in the groundwater flow direction.

WRA's groundwater levels study between 2017-2018 in the six main groundwater catchments observed that groundwater level trends in the **Athi and Ewaso Ng'iro North basins** were generally stable. However, evidence of declining levels was found in the Rift Valley Basin, especially the Rongai Aquifer. In the Nairobi area sub-basin aquifers, many areas indicated declining water levels, which could be attributed to over-reliance on abstracted water (WRA, 2018). The groundwater levels were found to fluctuate along the coastal aquifer due to several factors, including prolonged dry weather resulting in reduced aquifer recharge and continuous water pumping and discharge from the wells owned by the Mombasa Municipality (WRA, 2018).

1.3.4 NON-REVENUE WATER

A key challenge and issue in Kenya's water sector is Non-Revenue Water (NRW)⁶. NRW in Kenya currently stands at 42% as a result of ageing infrastructure, leakage, limited operation and maintenance, and limited metering and knowledge of water distribution systems. However, the government has set a national target to achieve an average NRW ratio of less than 20% by 2030 (JICA, 2019).

⁶ Non-revenue water (NRW) is produced, clean water that is lost in the water distribution system, never reaching the final consumer.

1.3.5 FINANCE GAP

According to Kenya's National Water Master Plan 2030, it is estimated that \$14 billion in water supply and \$5.4 billion in investment in urban sewerage infrastructure is needed over the next 15 years to address the main water sector challenges. Presently, over 60 % of the Kenya's water sector financing comes from donor funding, from development partners such as the African Development Bank, World Bank, USAID, and Water Sanitation and Hygiene (WASH) finance projects which aim to close financing gaps (USA, 2017). There is an urgent need to mobilise new funding sources, including commercial and private sector investment, public funding, and expanded market finance for infrastructure investments.

1.4 Future Water Challenges in the Water Sector – Demand and Supply

Based on the 2019 census data, the projected population for the year 2030 is estimated to increase to 63.8 million (KNBS, 2017), a 34% growth from the current population of 47.6 million. Other estimates suggest the population could double by 2050, while it is estimated that 30 million Kenyans (48% of the population) are expected to live in urban areas by 2030 (USA, 2017).

In the development of the National Water Masterplan 2030, water demand for domestic use, irrigation, livestock, wildlife, and inland fisheries was predicted to increase by 719% by the year 2050 compared to the 2010 baseline irrigation data (WASREB, 2013). Whilst all the sub-basins show water surpluses in 2010, by 2030 and 2050, stressed catchments and water deficits are predicted for some sub-basins, notably in Athi and Tana sub-basins (WASREB, 2013). A sustainable water balance plan considering water requirement and availability through integrated water resources management is required.

1.5 Barriers to the Water Sector

In addition to the challenges mentioned above, there are several other barriers in the water sector that are hindering the goal of achieving universal water access, water conservation and sustainable management efforts in Kenya. The key barriers, summarised in Figure 5 are discussed in more detail in the Climate Change Action in the Water Sector Status Review Report (AECOM, 2021).



Figure 5. Barriers within the Water Sector

Financial and Economic

- High import duty and tariff on water-saving technology equipment.
- High public debt reducing funds allocated to Water Ministry.
- Low levels of cost recovery from maintenance.
- High water treatment cost as a result of anthropogenic pollution.
- Lack of understanding of the economic value of water in all productive uses, the impact of climate change and the resulting cost of inaction in the sector.
- Lack of incentives or tax relief by the Government for water efficiency practices.
- There is a general culture in the country that water services should be financed by the Government and not by the private sector. This is because water is a fundamental right, as outlined in the Constitution. This therefore makes it less profitable to the private sector to invest.

Social-economic

- Low ability and willingness to pay for water resources by most of the populace.
- Increase in population has resulted to increased water demand for household and industrial water use. The increasing population has also impacted sanitation services.
- Over-abstraction from depleting aquifers.
- Increasing industrialisation and urban development rates have resulted in demands for more water.
- Water conflicts that arise from transboundary water sharing and lack of cooperation.
- Unequal development of water resources among the 47 counties.
- High poverty levels in some regions make it hard for some residents to construct simple pit latrines.

Environmental and Climate Change

- Natural disasters (e.g. flooding) negatively impact water resources such as the destruction of dams and other water infrastructure, including underground water distribution pipes and sewerage systems.
- Severe droughts cause little or no rain hence water shortages that have direct and/or indirect impacts on many businesses and households.
- Deforestation negatively impacts water catchments in terms of water quality, quantity and flow.
- Sedimentation and pollution of water resources.
- The rising water levels of inland lakes are a major challenge impacting livelihoods and communities.

Legal and Institutional

- Lack of institutional coordination and unclear/overlapping mandates between national and county governments and their agents has resulted in stalled projects. Limited data and information flow among the institutions is also a major challenge.
- Lack of enforcement of regulations in line with the Water Act 2016, NCCAP and the Climate Change Act, and failure to develop requisite strategies and plans.
- The rule of law challenges lead to poor implementation of existing legislation.
- Lack of control and enforcement of regulations - drilling of boreholes and water abstraction without a permit, indiscriminate discharge of wastewater to surface water bodies.
- The process of acquiring a water-use permit from the Government authorities is long.
- The Constitution is not clear on the roles of the County Government concerning water management.
- Limited technical capacity of staff working in water, sanitation and irrigation.

Physical (Infrastructure), Technological & Technical

- Poor maintenance of existing water and sewerage infrastructure.
- Deteriorating water and sewerage infrastructure results in increased water leakages and, hence, high Non-Revenue Water.
- High cost of technological innovations that inhibit the purchase of innovative water-saving technologies or water-efficiency products.
- Lack of sufficient data to quantify the current and future climate change impacts on water resources in Kenya.
- Inefficient management of irrigation schemes, thus reducing crop yields.
- Lack of sufficient water storage facilities to tap into surface run-off water.
- Water Service Providers still rely on traditional water infrastructure approaches such as centralised water distribution pipes that are very expensive and difficult to maintain and monitor.
- Project implementers and policymakers based their actions on the old routines for water infrastructure development. Deployment of smart technologies, circular economy and water recycling should be incorporated in infrastructure development and policies.

Source: Climate Change Action in the Water Sector in Kenya: Status Review (AECOM, 2021)

1.6 Impacts of Climate Change on the Water Sector in Kenya

The climate in Kenya is very varied. The coastal region is characterised by higher rainfall and temperature throughout the year. The average annual rainfall is 679 mm (WASREB, 2013), with a variation from less than 200 mm in northern Kenya to over 1800 mm on the slopes of Mount Kenya (Owuor, 2019).

Future climate change projection models show that mean annual rainfall in Kenya will increase to 750 mm and 801 mm in the year 2030 and 2050 respectively. As a result, there is expected to be an increase in the total renewable surface water resources – which was estimated at 20,637 MCM⁷/year in 2010, increasing to 24,894 MCM/year by 2030 (WASREB, 2013). This does not directly translate into usable surface water resources as all climate models show that by 2100, there will be heavier rains during wet seasons, resulting in more severe flooding events (WASREB, 2013). Increased runoff indirectly affects surface water quality as a result of increased soil erosion in surface water catchments. Flood risk will increase, in terms of both frequency and magnitude, due to increasing rainfall intensities as a result of climate change. Flooding presents a direct threat to water resources (intakes, pipelines, dams) and water supply infrastructure (treatment plants, pipelines). The economic cost of seasonal flooding events in Kenya is huge, with the long-term fiscal liability equivalent estimated at 2%-2.8% of the country's annual GDP. Therefore, there is an urgent need for actions to address these climate-related risks on Kenya's economy.

About 80% of Kenya lies within the arid and semi-arid ecological zones, rainfall is highly variable, and is designated as a water scarce country (WRI, 2021). Climate change is expected to result in greater variability in precipitation patterns, resulting in changes to the "traditional" rainfall seasons currently experience. The arid and semi-arid areas experience frequent drought, and these areas are likely to experience increases in duration, frequency and/or intensity of droughts (Haile, et al., 2020). Increasing likelihood of drought has direct impacts on livelihoods and the economy. Agriculture is the backbone of Kenya's economy, it contributes 33% of its gross domestic product (GDP) (GOK, 2019). Water is the key input to agricultural productivity, and it is therefore particularly sensitive to water resources availability. Any increases in the frequency, intensity, duration, or geographic coverage of drought could significantly affect the economy of the country.

Climate models indicate a global temperature increase of 1.4–5.8 °C by 2100. Kenya will also experience an increase in surface air temperature, with an increase of around 1.4 °C by 2030 and 1.7 °C by 2050 (BMZ, 2021). Predictions from climate change analysis models indicate there will be sharper increases in evapotranspiration due to the increase in temperature, resulting in a decrease in annual surface water runoff from 2030 to 2050. The combination of increased runoff rates and increased evapotranspiration will result in reduced groundwater recharge. Accordingly, based on the FAO Penman-monteith evapotranspiration method, analysis of potential evapotranspiration show that the annual renewable water resources in Kenya was estimated at 42,107 MCM/year (consisting of 20,637 MCM/year of surface water runoff and 21,470 MCM/year of Groundwater) for the year 2010 with a future predicted estimate of 44,301 MCM/year (consisting of 19,407 MCM/year of groundwater and 24,894 MCM/year of surface water runoff) for the year 2030 (WASREB, 2013). Furthermore, the associated reduction in groundwater levels and sea-level rise will cause more saline water intrusion into coastal aquifers (BMZ, 2021). Increasing evapotranspiration, resulting from rising temperatures, also indirectly affects water resources by increasing irrigation demands.

In Kenya, the impacts of climate change on water availability are further compounded by deforestation activities, unsustainable/poor agricultural practices that result in high water consumptions and unnecessary wastages, low storage capacity, as well as an increase in water demand from population growth (GOK, 2018).

The Agriculture, Water, Energy and Transport sectors are usually the first and most severely impacted sectors as a result of climate change. All stakeholders must incorporate comprehensive, practical climate risk management and adaptation measures that should be integrated into future projects' design and implementation plans across these sectors to mitigate future climate change-related risk.

⁷ MCM/Year – Million Cubic Meter/Year

Climate change and its impacts on the water sector in Kenya are discussed in more detail in the Climate Change Action in the Water Sector in Kenya: Status Review (AECOM, 2021).

1.6.1 CLIMATE CHANGE RESILIENT IRRIGATION SYSTEMS

In Kenya, there has been a steady rise in temperatures and erratic rainfall regime, increased frequency and severity of drought and floods, causing the scarcity of water resources for irrigation and damage to irrigation and water infrastructure, respectively. Climate change affects irrigation in many ways, including driving increased strong ocean currents, resulting in severe beach erosion, sedimentation and debris flow, shifting rainfall patterns, and diminishing rainfall intensities. Also, human activities, including deforestation from inappropriate land-use practices, de-vegetation, overstocking, wastewater, mining, and many others, often lead to land degradation that weakens the capacity of the land to conserve and release water and build organic and mineral content to support irrigation. And these are further exacerbated by the effects of climate change.

There is an untapped potential for greater use of climate-resilient irrigation techniques in Kenya. Therefore, considering the potential adverse impacts of climate change on irrigation, developing sustainable, climate change resilient irrigation production systems will contribute to the stabilisation and growth of agricultural production. To mitigate the effects of climate change on irrigation, several measures will be required including:

- Harnessing agricultural water resources and storage infrastructure to reduce flood and drought disasters, and environmental damages arising from climatic variations
- **Enhancing crop, aquaculture, and livestock farming systems' resilience through appropriate agricultural water management using water-efficient technologies and production methods**
- Promoting increasing use of renewable energy solutions to support sustainable irrigation activities

Furthermore, the National Irrigation Policy obligates the National Government and County Governments, in collaboration with various stakeholders, to:

- Promote and ensure integration of climate change adaptation and mitigation measures, including environmental protection, soil and water conservation, agro-forestry, renewable energy, water harvesting and storage
- Encourage efforts by development agencies and private sector organisations to support Government initiatives for climate change adaptation and mitigation
- Provide and support targeted incentives, creating a supportive investment climate and subsidies for special groups (e.g. pastoralists, persons with disabilities, youth and women, etc.).

2. Climate Change Strategic Objectives for the Water Sector in Kenya

The Government of Kenya has set out several climate change mitigation, adaptation and resilience strategic objectives with associated actions/targets in its NCCAP 2018 – 2022. These include many ambitious water sector-related projects designed to continue developing the sector while trying to overcome the challenges and issues mentioned in the earlier chapters.

These strategic objectives and associated projects are also designed to deliver on the government's commitments to the Paris Agreement (*i.e. the country's NDC*), and to achieving the SDGs targets. They are also closely aligned to the Kenya Vision 2030 development agenda which aims to ensure that improved water and sanitation are available and accessible to all by 2030.

The contexts of the main water sector overarching Strategic Objective and other water-sector related actions/initiatives are summarised in the following sections.

2.1 National Climate Change Action Plan, 2018 – 2022

Within the NCCAP 2018-2022, Strategic Objective 3 is focused on Water and the Blue Economy through which the Government of Kenya aims to *“Enhance the Resilience of the Blue Economy and Water Sector by Ensuring Adequate Access to and Efficient Use of Water for Agriculture, Manufacturing, Domestic Use, Wildlife and Other Uses”*. Within this overarching Strategic Objective are set eight climate change adaptation and mitigation Strategic Actions expected to be completed by 2023 as outlined in Figure 6.

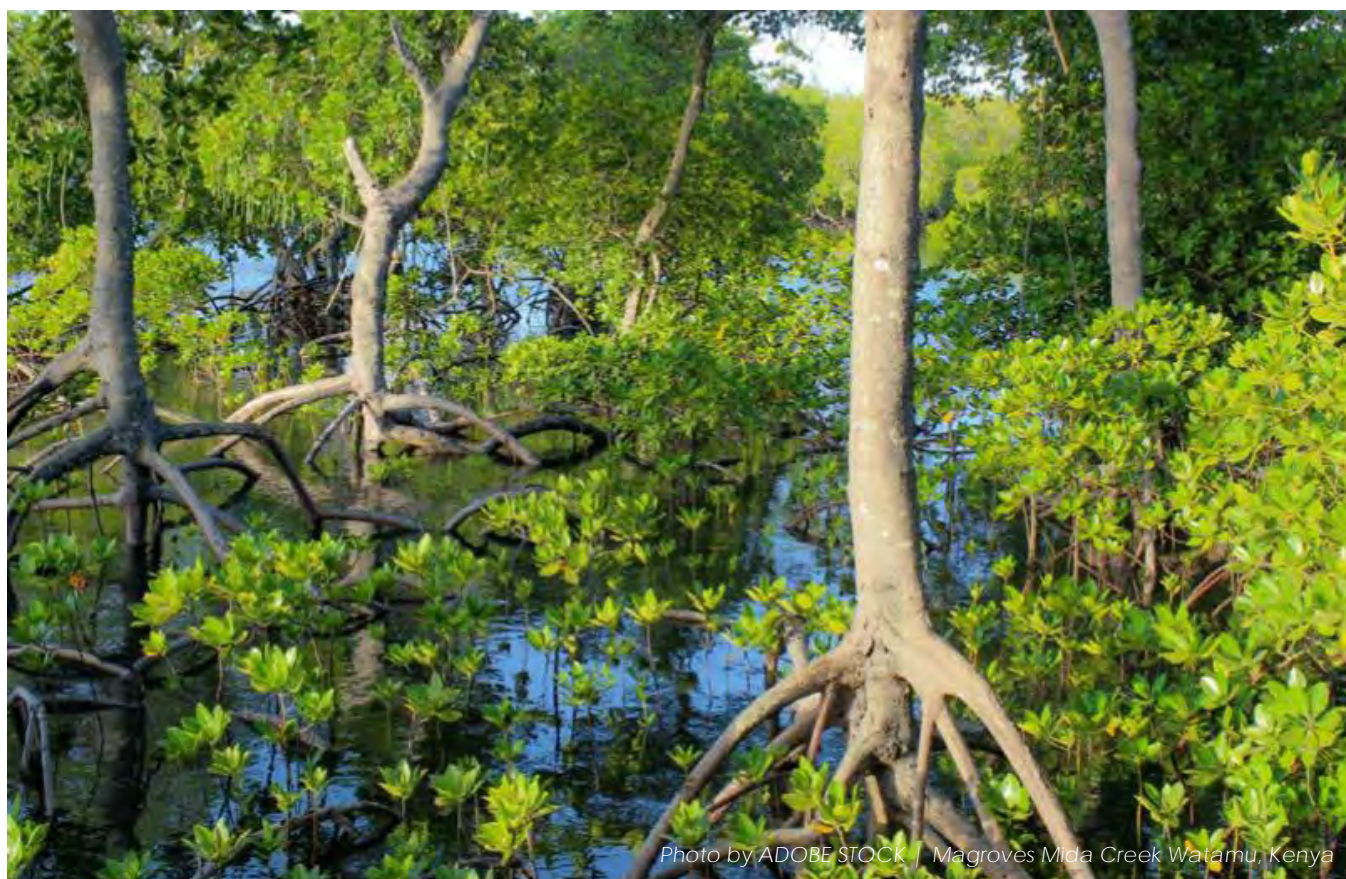


Photo by ADOBE STOCK | Mangroves Mida Creek Watamu, Kenya

Figure 6. Breakdown of the Actions Under the National Climate Change Action Plan's (2018 – 2022) Strategic Objective 3



2.2 Linking the Water Sector Roadmap to the Climate Change Strategic Objectives

In addition to the above strategic actions, Strategic Action 9 Financing Mechanisms has been identified following the recommendations of the Climate Change Action in the Water Sector in Kenya: Status Review Report (AECOM,2021), as this is vitally important in the development of the water sector and in achieving the overall aims of Strategic Objective 3 of the NCCAP. This ninth strategy has been considered in this water sector Roadmap Report and has been incorporated into the water sector roadmap tool.

In addition to the many other water-related initiatives/projects and the recommendations in the Climate Change Action in the Water Sector in Kenya: Status Review Report (AECOM,2021), these Strategic Actions, are fundamental to the development of the water sector and are crucial to the delivery of the **Government of Kenya's climate change commitments**. All of these have been considered to inform the development of the water sector roadmap presented in Section 3 below.



Photo by Adobe Stock Aberdare Ranges Dam, Kenya

3. Water Sector Roadmap and the Development Process

3.1 Purpose and Objective of the Roadmap

The Water Sector Roadmap is designed to support the Government of Kenya, particularly the Ministry of Water, Sanitation, and Irrigation (MoWSI) and other key stakeholders, to draw a path towards achieving the country's NDC, NCCAP, Kenya Vision 2030, and Goal 6 of the UN Sustainable Development Goals (SDGs). It provides a high-level concerted strategic implementation pathway to guide the short-term and long-term holistic development of the water sector and the blue economy.

The Roadmap uses the NCCAP as its basis, combining the water-related strategic actions and associated water projects with other key water-related projects (both proposed and ongoing projects) not included within the NCCAP. These were identified through a desk-based literature review, and takes into consideration other government initiatives, including the objectives of Kenya Vision 2030. It also takes into consideration the key recommendations from the Climate Change Action in the Water Sector in Kenya: Status Review report (AECOM, 2021) (hereafter referred to as the "Recommendations"). The recommendations are considered to be vital in the development of the water sector, meeting the overall aim of the NCCAP and the Government of Kenya climate change commitment and SDG goals.

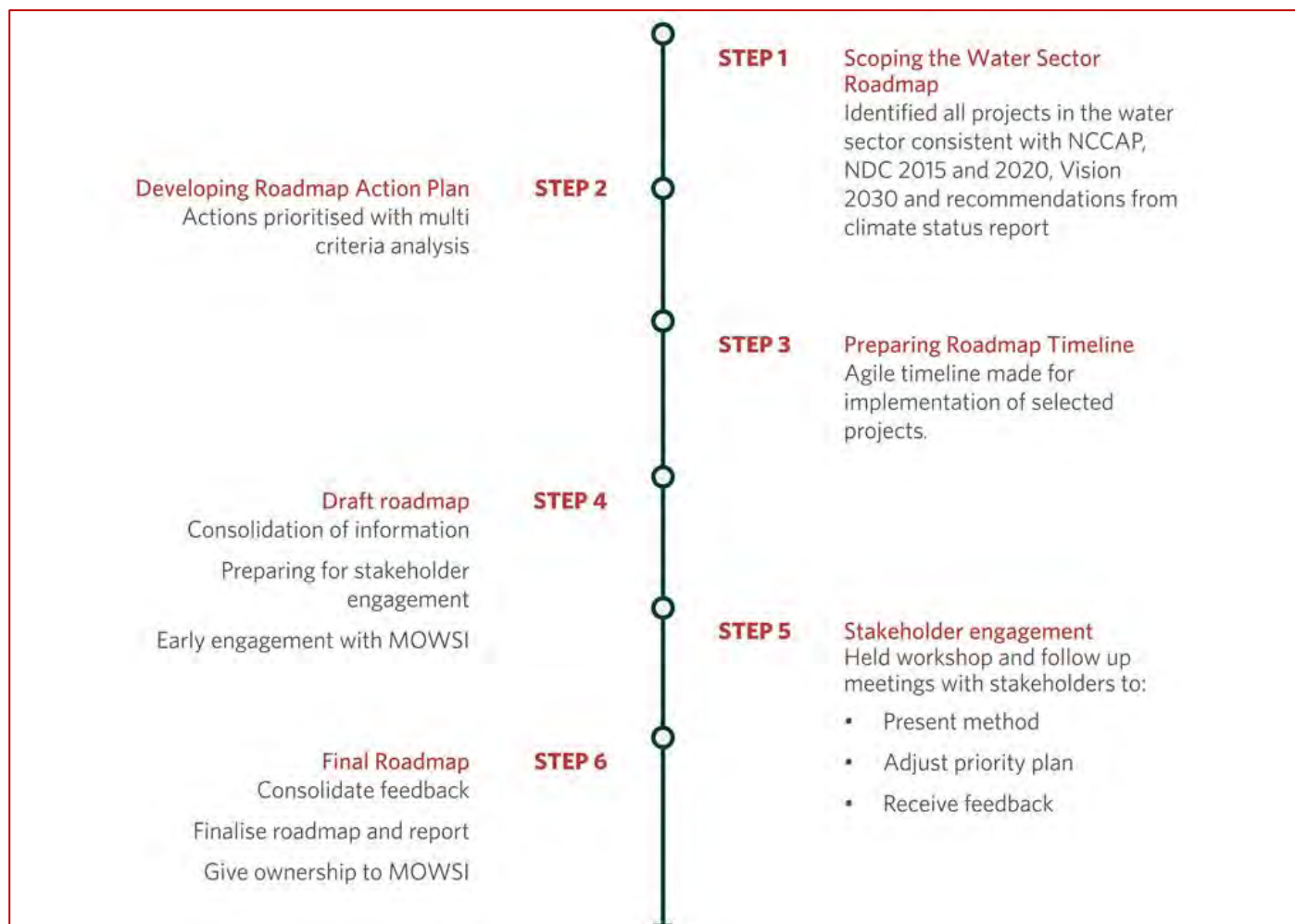
This report is accompanied by a Microsoft Excel file that contains the water sector implementation Roadmap Tool that provides a template that can continuously be updated with new/progress of existing projects and will serve as a one-stop high-level, holistic monitoring, tracking and evaluation of the progress of all proposed and ongoing essential water sector-related projects by all relevant stakeholders.

3.2 Roadmap Development

Developing and implementing a Roadmap is an iterative process. This current version is a high-level strategic implementation plan designed around the water-related projects associated with the eight Strategic Actions of the NCCAP and the ninth Strategic Action – Financing Mechanism, which is one of the key recommendations from the GNI^{plus} Climate Change Action in the Water Sector in Kenya: Status Review Report (AECOM, 2021). It can be amended and revised by the relevant stakeholders in Kenya to reflect changing priorities, ongoing processes, newly planned activities, and the status of many water sector sub-projects (proposed, ongoing and/or already achieved).

The development of the Roadmap followed six steps, as shown in Figure 7.

Figure 7. Overview of the Process used to Develop the Water Sector Roadmap



Source: AECOM, 2022

3.2.1 STEP 1 – SCOPING THE WATER SECTOR ROADMAP

Aim of the step: identification of projects for inclusion in the water sector roadmap

The first step of developing the Roadmap involved a process of identifying all key water projects that are consistent with the NCCAP, NDC, Kenya's Vision 2030, and scoping the extent of the Roadmap.

As mentioned earlier, the eight strategic actions of the NCCAP, including the ninth Strategic Action (i.e. the "**Recommendation – Financing Mechanism**") from the Climate Status Report, were taken as the basis for the Roadmap development, particularly those focussing on the water sector. Additionally, key water-related projects and initiatives were identified through a desk-based literature review of other key Government of Kenya development plans, strategies and policies.

A review of the recommendations and opportunities chapter of the Climate Change Action in the Water Sector in Kenya: Status Review Report (AECOM, 2021), developed as a precursor to this report, was also undertaken to identify possible projects for inclusion into the Roadmap. These initiatives were identified previously to help overcome barriers to achieving the NCCAP.

Key projects from these documents were combined into one consolidated list of projects to take into the roadmap. The projects were then compiled in Microsoft Excel and checked and linked against the NCCAP Strategic Actions with duplicate projects removed and key water projects consistent with the NCCAP identified and added to the finalised list.

At the end of this step, the main output was a long list of projects that could be taken forward for inclusion into the Roadmap.

For future iterations of the Roadmap, additional sources of information can be used to identify other projects for inclusion in an updated version of the Roadmap.

3.2.2 STEP 2 – DEVELOPING THE ROADMAP ACTION PLAN

Aim of the step: developing a project ranking methodology, ranking the projects included in the roadmap, and developing a list of prioritised activities

In order to prioritise the many ambitious water-related projects/sub-projects identified in step 1, a multi-criteria analysis (MCA) was used to evaluate, rank and prioritise each enlisted project in the Roadmap. The sets of criteria used in the MCA are outlined in Table 2. Each criterion has been reviewed and validated through a series of consultative workshops and meetings held between October and November 2021, with members of the Ministry of Water, Sanitation and Irrigation, as well as a number of its parastatals. This stakeholder consultation was vital to ensuring the criteria developed communicate the priorities and interests of the communities, MoWSI, and other stakeholders.

A score range of 1 – 5, as in 1 being “very low” and 5 being “very high”, was assigned to each criterion. Percentage score weightings were assigned to each criterion, based on professional judgement, with the criteria: “Priority”, “Ease of implementation” and “Functional Effectiveness” having the highest weightings given their importance by definition (see Table 2). The score for each project was then calculated by the total of all the criterion scores multiplied by its weighting. This helped to demonstrate the relevance of the criterion in **reaching the stakeholders’ objectives**. This was decided by the GNI^{plus} team following discussions and agreement with relevant stakeholders during the stakeholders’ engagement meetings.

Conducting the MCA resulted in an overall score for each project. Depending on the score given, this then helped to prioritise a project as either a “High”, “Medium”, or “Low” priority. Furthermore, based on the overall score of each project within a Strategic Action, this helped in the final prioritisation of each Strategic Action as either being of “High”, “Medium”, or “Low” priority.

Furthermore, in the Microsoft Excel water sector implementation Roadmap Tool, the climate change status (i.e. whether climate “Mitigation”, “Adaptation” or “Enabling”) is assigned to each prioritised projects in the implementation display dashboard.

Table 2. Criteria for Calculating and Evaluating the Priority of a Project

Criteria	Definition	Score from 1 – 5	Criterion Score weighting
Priority	The significance of the need for the opportunity/project to meet the overarching aims of the Strategic Objective 3 of the NCCAP. E.g.: A major climate-proofing infrastructure project that increases water availability, storage and supply coverage to rural areas or support major irrigation scheme.	1: very low – 5: very high	30%
Ease of implementation	Barriers and opportunities to implement the opportunity and construct assets E.g.: Human capital, availability of materials, existing technical skills	1: very low - 5: very high	20%

Criteria	Definition	Score from 1 – 5	Criterion Score weighting
Duration for implementation	How long it will take to implement? E.g.: Short-term/ Medium-term/ Long-term	1: very long (more than 8 years) 2: long (4-8 years) 3: moderately long (1 to 4 years) 4: short (6 to 12 months) 5: fast (less than 6 months)	5%
Indicative costing	Indicative cost required to implement this opportunity	1: very high - 5: very low	5%
Enabling potential	An opportunity that must be performed in order to make it possible to deliver or implement other value adding opportunities/projects. E.g.: A hydrogeological assessment study is a prerequisite/enabling potential for the development and management of groundwater resources.	1: very low potential – 5: very high potential	15%
Functional effectiveness	Number of people / end beneficiaries, number of sectors the project will benefit? E.g.: Over 100,000 people is low effectiveness. Over 500,000 people medium effectiveness. Over 1 million high effectiveness	1: very low - 5: very high	20%
Conflict mitigation	An opportunity that can be performed and/or has the potential to mitigate conflict across stakeholders and communities. E.g.: The management of transboundary water sources <i>This criterion was added following guidance and suggestions received during the stakeholder engagements workshops.</i>	1: very low potential – 5: very high potential	5%

3.2.3 STEP 3 – PREPARING THE ROADMAP TIMELINE

Aim of the step: developing a roadmap timeline to provide overview and tracking tool of progress towards NCCAP goals.

Step 3 involved the preparation of estimated timelines for the implementation of each selected/prioritised project within each Strategic Action, using an Agile timeline prepared on Microsoft Excel.

The Roadmap is based on a simplified GANTT / Agile Chart. The priority and timescale of each opportunity and status are combined with tracking progress towards achieving each Strategic Action. The Roadmap is a continuous project tracking, evaluation and monitoring tool that needs to be updated periodically by MoWSI and relevant stakeholders when new projects are initiated and or when the statuses of an existing project changes.

The implementation Roadmap provides a tracking overview of the progress of each Project and Strategic Action of the NCCAP towards achieving the overall objective of Strategic Objective 3 of the NCCAP. As an example, sub-projects have been included for Strategic Actions 1 and 2 to demonstrate how the Roadmap could function as a project implementation tracking, progress monitoring and evaluation tool for the tool users. The detailed Roadmap provides a blueprint which MOSWI and its Project Managers, as well as other stakeholders, can continue to update periodically with existing and future projects and sub-projects in the sector.

3.2.4 STEP 4 – DRAFT ROADMAP REPORT

Aim of the step: consolidate information and document the roadmap process for stakeholders' engagements.

All information gathered was consolidated and drafted during this step, including the steps in developing the Roadmap, into the draft Roadmap report. The draft Roadmap report was then circulated amongst the relevant stakeholders within the Ministry of Water, Sanitation, and Irrigation for preliminary review and to gain their interest and approval to continue to the next phase of stakeholder engagement.

3.2.5 STEP 5 – STAKEHOLDER ENGAGEMENT

Aim of the step: to align the water sector roadmap and ranking with needs and priorities of the MOSWI and to gain interest and backing for water sector roadmap project.

The water sector Roadmap development consultation phase involved a series of forums and smaller workshops held in October/November 2021 with MoWSI and other relevant consultation groups/stakeholders, including the Water Resources Authority (WRA), Water Sector Trust Fund (WSTF) and other government agencies.

During this stage, projects within the Roadmap were aligned with the needs and priorities of the represented bodies. This was undertaken through the receipt of feedback from stakeholders on the draft methodology for developing the prioritises projects. The findings, feedback and suggested improvements from the stakeholder engagement workshops were then fed into the Roadmap. It was noted however, that given the current state and underdevelopment of the water sector over the years, the priority for all water-related projects is high.

The consultation phase resulted in some amendments to the original ranking criteria, including the addition of a new criterion centred around "conflict mitigation". There was a general consensus across the stakeholders for this criterion to be added as a majority of Kenya's water supply sources fall within transboundary waters which has resulted in local and regional conflicts. This is therefore a very important issue to address. Furthermore, during the stakeholder engagement meeting with the WSTF, additional water-related sub-projects were identified within some Strategic Actions which have also been included in the revised Roadmap. All feedback from these sessions was considered when finalising the Roadmap.

The final prioritisation and ranking of the Roadmap projects were completed during a final stakeholder engagement workshop held in November 2021, with the WSTF and representative from MOSWI.

3.2.6 STEP 6 – FINAL ROADMAP REPORT

Aim of the step: development of final report and communication of findings to key stakeholders

The final step was to consolidate the feedback, finalise the Roadmap and the report, and present the findings to the Ministry of Water, Sanitation, and Irrigation. The final Roadmap and findings and conclusions for the process are presented in Sections 3.3 and 3.4.

Training material and documentation have been produced to support users on using the Excel implementation Roadmap Tool and help them understand and effectively apply the Roadmap in their planning practice. This includes details of how to add information into the detailed Roadmap to track the progress of projects and how the statuses of existing and new projects in the Roadmap can be updated.

3.3 Water Roadmap at a Glance

The following sections provide an overview of the water sector roadmap based on the results of the MCA project prioritisation process.

This Roadmap is a high-level strategic implementation plan. It should be noted that it is not an exhaustive list of all the many projects within the overarching projects listed within the NCCAP. It provides a blueprint upon which other sub-projects roadmaps can be developed by the ministry or other project managers. It is an ongoing implementation roadmap that can be modified periodically as new projects/opportunities are initiated within the water sector.

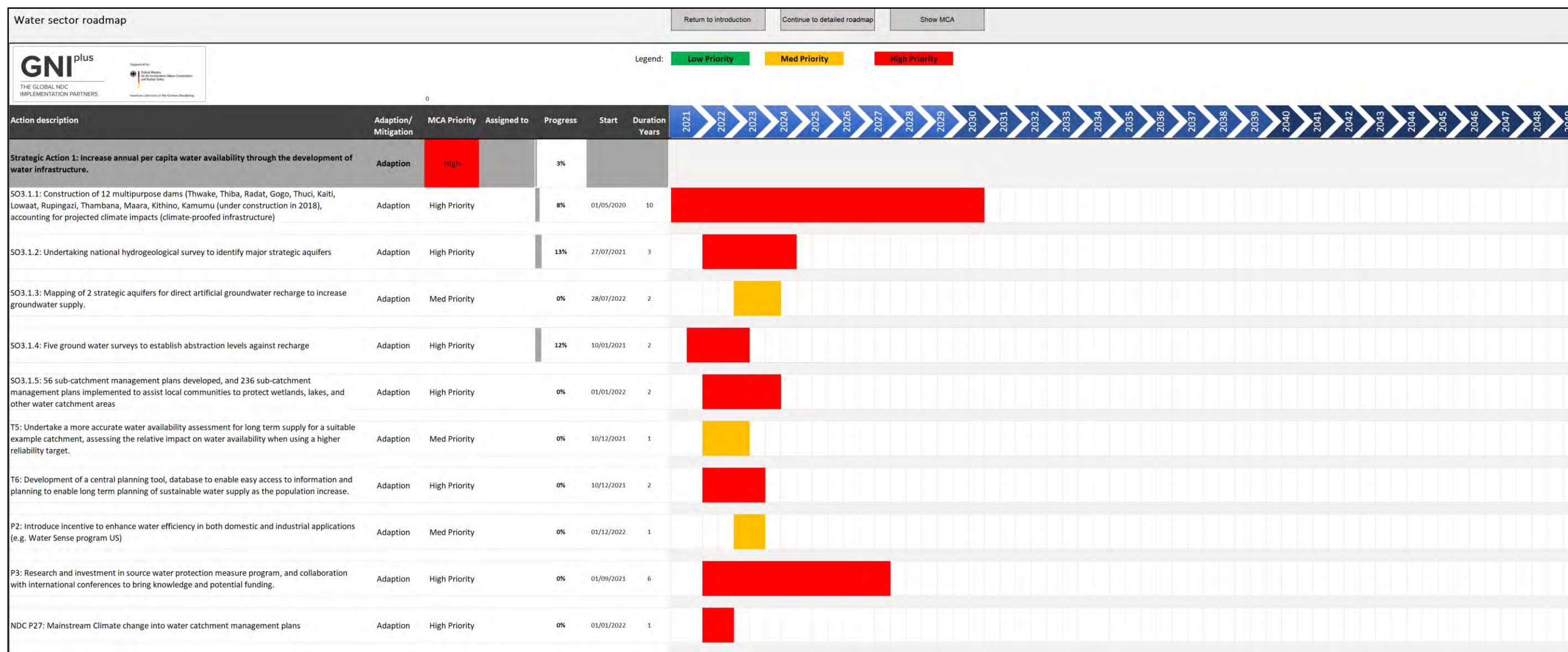
The Microsoft Excel roadmap tool is a more detailed tool to help track the progress of projects towards each of the Strategic Actions in the high-level implementation roadmap. The sub-projects presented are based on the authors' technical opinion only to give an example of how the Strategic Actions can be divided up into smaller trackable projects. The intention is that MOWSI and other stakeholders would further develop this detailed Roadmap to include all current and future projects and sub-projects in the water sector.

The following sub-sections aim to provide example overview of how the water sector implementation Roadmap Tool shows how the projects implementation and progress tracking view for Strategic Actions as presented in the Roadmap Tool. Refer to Appendix B for the Roadmap Tool.



Strategic Action 1 focuses on the increase in annual per capita water availability through water infrastructure development. It has been ranked as a "High" priority action from the MCA process taking into consideration the overarching aim of Strategy Objective 3 of the NCCAP. Within this strategic action, several projects and example sub-projects (not included in Figure 8) have been proposed, these are outlined in the detailed roadmap. Figure 8 provides an overview of the roadmap and the associated projects as extracted from the Microsoft Excel implementation roadmap programme. Refer to Appendix B for the Roadmap Tool.

Figure 8. Strategic Action 1 roadmap overview

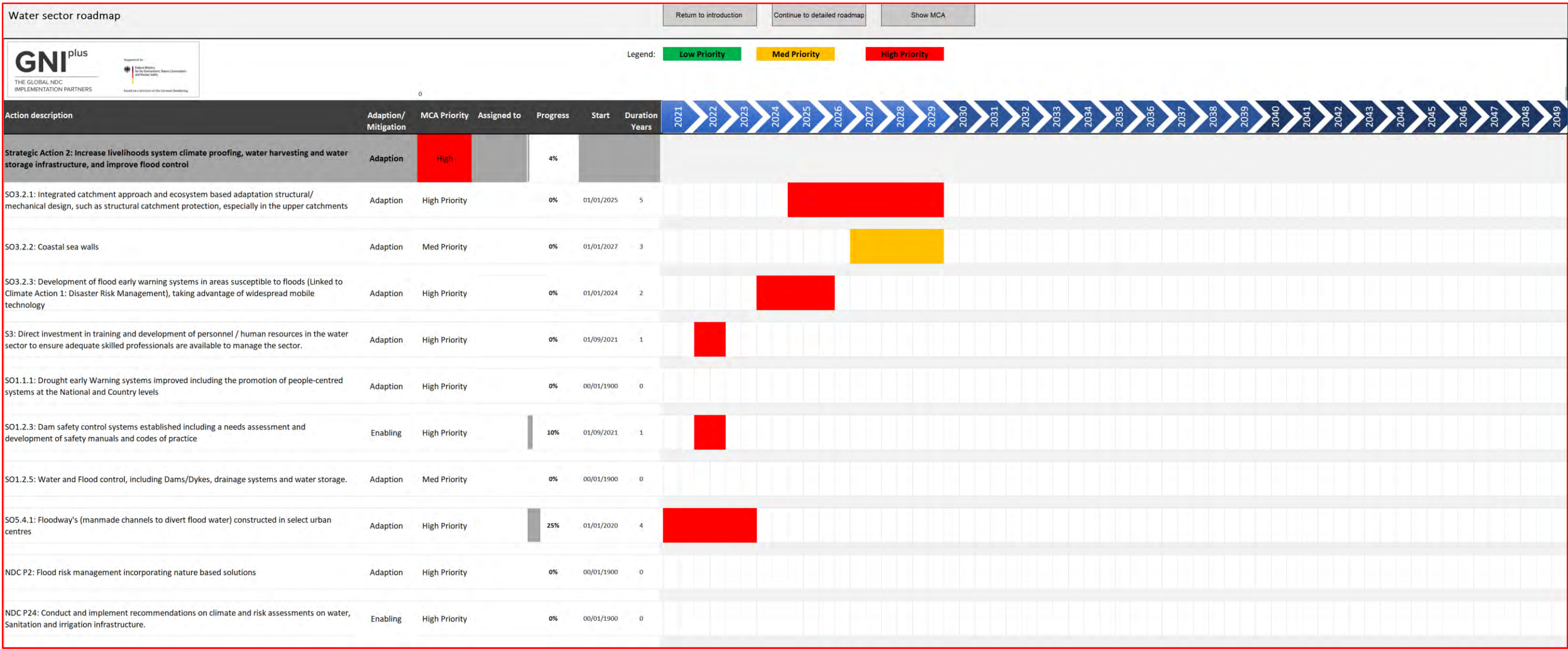


Source: Roadmap Tool (AECOM, 2022)

3.3.2 STRATEGIC ACTION 2

Strategic Action 2 focuses on improving livelihoods system climate proofing water harvesting and water storage infrastructure and improving flood control. It has been ranked as a "High" priority action from the MCA process taking into consideration the overarching aim of Strategy Objective 3 of the NCCAP. Within this strategic action, several projects and example sub-projects (not included in Figure 9Figure 8) have been proposed. Figure 9 provides an overview of the roadmap and the associated projects as extracted from the Microsoft Excel Implementation roadmap programme. Refer to Appendix B for the Roadmap Tool.

Figure 9. Strategic Action 2 roadmap overview



Source: Roadmap Tool (AECOM, 2022)

4. Project concepts

During the roadmap development and stakeholder consultation process, it was identified that the water sector lacked water-related project-specific concept notes that could be used to attract private sector investment and involvement in water projects. A project concept note template was developed, aligned with project investment review criteria typically used by various international financial institutions. The key information incorporated in the template includes:

- Project purpose and rationale
- Key stakeholders and beneficiaries
- Project status
- Alignment with national and international strategies and frameworks
- Alignment with the UN Sustainable Development Goals
- Project Financial information
- Project risks and mitigation measures

Given the numerous projects and many years of under-development of the water sector, the outcome of the MCA ranking process resulted in a high priority for most of the prioritised water-related projects. Accordingly, concept notes could not be developed for all the high priority projects; instead, example project concept notes were prepared for three selected projects. The projects selected for the example concept notes of different project types based on professional judgment, considering the potential costs, purpose, outputs, key beneficiaries, critical activities required to deliver the project, risks factors, climate change resilience and mitigation potentials, and ease of implementation.

The title of the three projects that had concept notes created were:

1. Water sector training to deliver resilient water resources, promote water use efficiency and manage the sustainable expansion of water supply services in Kenya.
2. Installation of 300,000 farm ponds in selected rural communities across Kenya to provide climate resilient access to water for irrigation.
3. Infrastructure improvements for the water sector – Implementing GIS, district metered areas and innovative leak detection programs.

These projects are aligned with Strategic Objective 3 of the NCCAP. Refer to Appendix A for the completed examples of concept notes.

The template and examples have been developed to steer the preparation of future concept notes for other water sector projects listed in the roadmap. The template can easily be adapted or modified to target the criteria of different interested donors, investors, and development partners interested in supporting water projects towards further growth and development in the water sector in Kenya.

All concept notes were prepared by the consultant team. Any views, opinions, assumptions, statements, and recommendations expressed in them are those of the consultant and do not necessarily reflect the official policy or position of the Ministry of Water, Sanitation and Irrigation or the donor. Any quantitative estimates should be regarded as approximations based on information available at the time of writing. It is proposed that the concept notes are further refined by the Ministry if it decides to prioritise the related projects – in that case, the concept notes would typically be followed by a scoping and pre-/feasibility study.

5. Conclusions and Recommendations

Climate change is a significant challenge to the water sector, which plays an essential role in Kenya's socio-economic well-being and development. The water sector faces many climate change-related challenges that impact water supply availability and access. These include prolonged, persistent droughts, unprecedented rainfall patterns and destruction of water supply infrastructure. Therefore, climate change has the potential to inhibit the Government of Kenya's drive to deliver its Strategic Objective 3 of the National Climate Change Action Plan (NCCAP) – which focuses on water and the blue economy.

Key findings from the roadmap development process, climate action report, and numerous stakeholder consultations show that the water sector has been under-funded and under-developed. Hence, the priority for all water-related projects turns out to be high during the MCA project prioritisation process. Consequently, there is an urgent need for rapid intervention and investment in constructing and adapting infrastructure to create a climate-resilient water supply system for the sector. Therefore, investment in distribution infrastructure and maintenance of existing infrastructure to improve efficiency, reduce water losses, and improve water availability and supply coverage is essential.

However, findings from the Climate Change Action in the Water Sector in Kenya: Status Review report (AECOM, 2021) show that despite the measures taken by the Government of Kenya to overcome the many challenges/barriers facing the water sector and its ambition to deliver on its climate change commitment, there is a general lack of a concerted and detailed implementation roadmap that all relevant stakeholders can follow to support the plans. This is coupled with the resulting difficulty in evaluating the impact and progress of these ambitious plans and targets.

Therefore, this Water Sector Roadmap report has set out a blueprint and implementation pathway to support the Government of Kenya in its climate commitment through adaption and mitigation. It draws a path to achieving the commitments of the NDC, NCCAP, Kenya Vision 2030 and SDG goals and encompassing the recommendations of the Climate Action Report.

Whilst it is intended that the principal user of the Roadmap will be the relevant parastatals and Government Ministries of Kenya, it can have a broader use and benefit by other stakeholders, including private sector stakeholders and investors, as it outlines and highlights areas where support is needed for Kenya to meet its climate goals. Furthermore, the example project concept notes included in this Water Sector Roadmap Report also provide focus and direction to NGOs and private investors to inform their programme or project design better.

In conclusion, the following recommendations are proposed:

1. Immediate involvement and investments from all stakeholders in the water sector.
2. Rapid intervention in the water sector.
3. Use of concept notes to attract and mobilise project funds to the sector.

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Appendix A Project Concept Notes for Three Selected Projects

Water sector training to deliver resilient water resources, promote water use efficiency and manage the sustainable expansion of water supply services in Kenya

Introduction	
Project title	Water sector training to deliver resilient water resources, promote water use efficiency and manage the sustainable expansion of water supply services in Kenya
Purpose of the Project	The purpose of the proposed project is to deliver direct investment in training and development of skilled professionals working in the water sector in order to improve Kenya's management and investment planning of water resources .
Strategic Action – Link to the Sector Roadmap	S3: Direct investment in training and development of personnel / human resources in the water sector to ensure adequately skilled professionals are available to manage the sector.
Description	<p>Kenya experiences water shortages, frequent floods and recurring droughts. Climate change is affecting weather patterns which will intensify both flooding and drought and will impact both expansion, and sustainable operation, of water services. The sector also faces deteriorating water quality caused by land use changes and unregulated industrial expansion and poor sanitation, and severe under-investment in both assets and management. Poor maintenance of existing water and sewerage infrastructure results in water leakages, and inefficiency. These issues not only impact the water sector, because all sectors rely on a sustainable and quality water supply. For example, only 2% of arable lands are irrigated, affecting the productivity of Kenya's agriculture sector which remains highly vulnerable to drought. A lack of awareness of the impacts of climate change on the water sector inhibits the development of sustainable adaptation and mitigation solutions. The proposed project aims to build capacity for integrated water resources in Kenya through direct investment in training of 60 practitioners at both national and county levels.</p> <p>The trainings will cover the following topics:</p> <ul style="list-style-type: none"> • Integrated water resources management • Groundwater monitoring and management • Surface water monitoring and management • Effective financing of the water sector • Water quality management • Water safety planning and source protection • Climate-proofing water infrastructure • Climate change science and carbon markets • The roles and benefits of effective stakeholder engagement and participation in developing the water sector <p>The training should involve a local university in Nairobi, to embed some of the course content into future water resources and climate adaptation MSc courses to develop a pipeline of graduates into the sector. The training will be developed and delivered in association with an internationally recognised university or research organisation, with more practical content delivered by experienced consultants and/or practitioners (water utility staff, water and environmental planners and regulators). Bilateral grants are available for 'tailor made training' courses.</p> <p>Practical training for field implementation with a broader set of stakeholders could utilise a 'train the trainers' approach. To develop a set of trainers that can then deliver training to County staff, water service providers, private sector, NGOs and other stakeholders, as necessary, thus maximising the value for money of the training.</p>
Rationale	This project will build capacity of practitioners working in the water sector to understand key issues, best practices and existing tools and technologies integrated water resources management. This knowledge will further inform and strengthen investment planning in water resources, and help the government implement key actions and commitments under its Nationally Determined Contribution (NDCs) and National Climate Change Action Plan (NCCAP).
Project type	<input type="checkbox"/> Infrastructure investment <input checked="" type="checkbox"/> Capacity Building <input type="checkbox"/> Document/Plan/Strategy

Key stakeholders and beneficiaries							
Project owner	Ministry of Water, Sanitation and Irrigation, Water Sector Coordination Division						
Potential project partners/ key stakeholders	<p>National government:</p> <ul style="list-style-type: none"> - Ministry of Water, Sanitation and Irrigation, Water and Sanitation Directorate - Ministry of Water, Sanitation and Irrigation, Irrigation Directorate - Water Resources Authority - Water Resource Users Association - Water Works Development Agency - Water Service Regulatory Board - National Water Harvesting and Storage Authority - Water Sector Trust Fund - National Irrigation Authority - Kenya Water Institute - Water Tribunal - Water Services Providers Association - Climate Change Directorate <p>Local government:</p> <ul style="list-style-type: none"> - Environment, Energy, Water and Sanitation Departments of County Governments - Council of Governors (water thematic lead) <p>State-owned entities:</p> <ul style="list-style-type: none"> - Nairobi City Water and Sewerage Company <p>Civil society:</p> <ul style="list-style-type: none"> - Kenya Pooled Water Fund - University of Nairobi - Conservation International - The Nature Conservancy <p>Development partners:</p> <ul style="list-style-type: none"> - World Bank / IFC - African Development Bank - AFD French Development Agency - GIZ German Development Agency - KfW Development Bank - Danish International Development Agency (DANIDA) 						
Direct beneficiaries	<p>This table outlines details of those who will be participating in the training:</p> <table> <tr> <th>Group</th><th>Vulnerability characteristics?</th></tr> <tr> <td>Ministry of Water, Sanitation and Irrigation</td><td>To deliver on its mandate and fulfil its national and international commitments, the Ministry needs to enhance the staff capacity and capability in its sectoral institutions. However, at the moment, the Ministry does not have an up to date assessment of its staff's skills and competencies, making it challenging to prepare tailored capacity-building workshops.⁸</td></tr> <tr> <td>County Governments - Environment, Energy, Water and Sanitation Departments</td><td>As above, currently this information is not available. Once participants have been confirmed, this can be determined.</td></tr> </table>	Group	Vulnerability characteristics?	Ministry of Water, Sanitation and Irrigation	To deliver on its mandate and fulfil its national and international commitments, the Ministry needs to enhance the staff capacity and capability in its sectoral institutions. However, at the moment, the Ministry does not have an up to date assessment of its staff's skills and competencies, making it challenging to prepare tailored capacity-building workshops. ⁸	County Governments - Environment, Energy, Water and Sanitation Departments	As above, currently this information is not available. Once participants have been confirmed, this can be determined.
Group	Vulnerability characteristics?						
Ministry of Water, Sanitation and Irrigation	To deliver on its mandate and fulfil its national and international commitments, the Ministry needs to enhance the staff capacity and capability in its sectoral institutions. However, at the moment, the Ministry does not have an up to date assessment of its staff's skills and competencies, making it challenging to prepare tailored capacity-building workshops. ⁸						
County Governments - Environment, Energy, Water and Sanitation Departments	As above, currently this information is not available. Once participants have been confirmed, this can be determined.						
Impact measures and estimates	<p>Following the completion of the training sessions, participants will:</p> <ul style="list-style-type: none"> • Have enhanced knowledge and capacity in the training topic area with a record of the number of training sessions and modules undertaken as part of this project. • Commit to provide knowledge dissemination sessions to at least 5 members of staff. • Have enhanced ability to mainstream climate change mitigation, adaptation, and resilience into their professional activities. 						
Key benefits	The key benefits of this work are economic (in terms of generating cost savings) and enhanced technical expertise (enhancing the attendees ability to deliver and implement effective strategies). In particular, the training will:						

⁸ The Ministry recently published a tender for consulting services for water sector skills and competencies assessment and development of related framework. Available at <https://www.water.go.ke/tenders/>

	<ul style="list-style-type: none">• Increase skill and knowledge required to support sustainable water resources development, management, conservation and protection• Support water resources planning and projects' implementation strategies• Ensure availability and sustainable management of water and sanitation for all (SDG Goal 6)• Provide knowledge required to initiate, design and implement climate-resilience projects within the water sector• Challenge critical thinking toward best-practice procedures in the planning and execution of water sector projects• Raise awareness on the need for water conservation and management.																		
Location and scope of activities																			
Geographic scale and location	The project will target beneficiaries across the water sector in Kenya, and the training itself will take place in the form of in-person or online workshops/seminars, depending on attendees' preferences and subject to the ongoing situation with the coronavirus pandemic.																		
Status of preparation	<input checked="" type="checkbox"/> Project idea note <input type="checkbox"/> Concept note / pre-feasibility study <input type="checkbox"/> Full project proposal including feasibility study <input type="checkbox"/> Under implementation																		
Project preparation steps	<table><tr><th>Activity</th><th>Implementation timeline</th><th>Activity owner</th></tr><tr><td>1. Skills and Competencies Assessment for the government/municipal staff to identify gaps in skills and knowledge</td><td>2 months</td><td>Ministry of Water, Sanitation and Irrigation, supported by a consultant</td></tr><tr><td>2. Identifying the most relevant topics to be covered in trainings</td><td>1 month</td><td>Ministry of Water, Sanitation and Irrigation, supported by a consultant</td></tr><tr><td>3. Preparation of learning materials, determining venue and logistics, outreach and final preparations</td><td>2 months</td><td>Ministry of Water, Sanitation and Irrigation, supported by a consultant</td></tr><tr><td>4. Organisation and delivery of trainings and capacity-building workshops</td><td>2 months</td><td>Ministry of Water, Sanitation and Irrigation, supported by a consultant</td></tr><tr><td>5. Lessons learned, final report and evaluation</td><td>1-2 months</td><td>Ministry of Water, Sanitation and Irrigation, supported by a consultant</td></tr></table>	Activity	Implementation timeline	Activity owner	1. Skills and Competencies Assessment for the government/municipal staff to identify gaps in skills and knowledge	2 months	Ministry of Water, Sanitation and Irrigation, supported by a consultant	2. Identifying the most relevant topics to be covered in trainings	1 month	Ministry of Water, Sanitation and Irrigation, supported by a consultant	3. Preparation of learning materials, determining venue and logistics, outreach and final preparations	2 months	Ministry of Water, Sanitation and Irrigation, supported by a consultant	4. Organisation and delivery of trainings and capacity-building workshops	2 months	Ministry of Water, Sanitation and Irrigation, supported by a consultant	5. Lessons learned, final report and evaluation	1-2 months	Ministry of Water, Sanitation and Irrigation, supported by a consultant
Activity	Implementation timeline	Activity owner																	
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4. Organisation and delivery of trainings and capacity-building workshops	2 months	Ministry of Water, Sanitation and Irrigation, supported by a consultant																	
5. Lessons learned, final report and evaluation	1-2 months	Ministry of Water, Sanitation and Irrigation, supported by a consultant																	
Potential for replication	The project has a high potential for replication – capacity building and training activities have been undertaken as part of different projects and sectors in Kenya. Sustaining the program by engaging higher education institutions could enable annual replication through MSc courses (government officials could attend specific modules for a fee out of departmental training budgets).																		
Alignment with national and international strategies and frameworks	<p>This project is aligned with the following international and national strategies and frameworks:</p> <ul style="list-style-type: none">• Kenya's Nationally Determined Contribution (NDC) through building capacity to support the implementation of mitigation and adaptation solutions• The Kenyan Vision 2030• National Climate Change Action Plan (NCCAP) 2018-2022• National Climate Change Act• National Climate Change Response Strategy 2010• Water Act, 2016• National Policy on Climate Finance• Guidelines on Business Planning 2019• Disaster Preparedness and Mitigation Guidelines 2013• Agriculture Sector Development Strategy 2009-2020• Environmental Management and Coordination Act 2015																		

	<ul style="list-style-type: none"> UN 2030 Agenda and its Sustainable Development Goals.
Does the current legislative and policy framework allow for the implementation?	Yes – there are no barriers to the implementation of this project.
Sustainable Development Goals whose achievement will be supported by this project	<input type="checkbox"/> Goal 1: No poverty <input type="checkbox"/> Goal 2: Zero hunger <input type="checkbox"/> Goal 3: Good health and well-being <input type="checkbox"/> Goal 4: Quality education <input type="checkbox"/> Goal 5: Gender equality <input checked="" type="checkbox"/> Goal 6: Clean water and sanitation <input type="checkbox"/> Goal 7: Affordable and clean energy <input type="checkbox"/> Goal 8: Decent work and economic growth <input type="checkbox"/> Goal 9: Industry, innovation, and infrastructure <input type="checkbox"/> Goal 10: Reduced inequality <input type="checkbox"/> Goal 11: Sustainable cities and communities <input type="checkbox"/> Goal 12: Responsible consumption and production <input checked="" type="checkbox"/> Goal 13: Climate action <input type="checkbox"/> Goal 14: Life below water <input type="checkbox"/> Goal 15: Life on land <input type="checkbox"/> Goal 16: Peace, justice, and strong institutions <input type="checkbox"/> Goal 17: Partnerships for the goals
Financial information	
Indicative project cost	Total initial investment: \$120,000 CapEx: n/a OpEx: n/a Technical assistance: \$120,000
Are any costs covered by the project owner?	In-person training could be undertaken at Ministry offices.
Remaining financing need	\$120,000
Financing approach	Grants from bilateral donors
Revenue opportunities	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No [If yes, can further information be provided]
Is this a standalone investment?	Yes
Potential project barriers/risks	

Risk and barrier types and mitigation measures	Theme	Potential risk	Mitigation measure
	Social	Accessibility – Some attendees may lack access to technologies / skills necessary to access training in virtual format. Capacity gap – There is a wide variation on the level of knowledge among training participants. Gender/representation – Participation in the training may reflect the existing gender gap, or the lack of inclusivity of other groups (minorities, etc).	Accessibility – Conducting a survey with the Ministry to understand and anticipate potential access difficulties. Depending on the outcomes of a survey, an in-person training might be more suitable than a virtual one. Capacity gap – Consulting the existing skills and competencies assessment to understand the level and scope of existing skillset and tailoring the trainings accordingly. Gender/representation – Requesting the preliminary list of trainees from each organisation and devising gender or other quotas/targets for each training.
	Environmental	N/A	N/A
	Economic	N/A	N/A
Additional information			
List any additional relevant project information	n/a		

Installation of 300,000 farm ponds in selected rural communities across Kenya to provide climate resilient access to water for irrigation

Introduction	
Project title	Installation of 300,000 farm ponds in selected rural communities across Kenya to provide climate resilient access to water for irrigation
Purpose of the project	The project aims to increase drought resilience of small-scale agriculture by increasing access to water in rural communities by installing 300,000 community/farm ponds for irrigation.
Strategic Action – Link to the Water Sector Roadmap	Strategic Action S03.3.1: Installation of 300,000 farm ponds.
Description	<p>Small-scale agriculture accounts for over a third of the total value of Kenya's economy. It is strongly affected by the many challenges facing the sector, including water shortages, droughts, and variations in precipitation caused by the direct and indirect effects of climate change. The high cost of water storage and/or water source development makes it unaffordable for small-scale farmers to irrigate crops. As a result, agriculture is generally rain-fed and agricultural output is therefore highly vulnerable to drought.</p> <p>This project aims to improve household water access for small-scale farmers in rural Kenya by installing 300,000 farm ponds. This will help provide sustainable irrigation water supply and help mitigate the impacts of changing rainfall patterns and rising temperatures resulting from climate change. The project will have an important co-benefit in overcoming critical water-related local/regional conflicts amongst farmers that have plagued many rural communities over the years, particularly in water scarce areas.</p> <p>The program would employ appropriate technologies, which have been widely applied across Kenya, including ponds pans, tanks, and small earth dams to collect surface water runoff from the land, roads, rock outcrops, or large rooftops⁹. Determining the most appropriate approach and design for each farm or community will require analysis of catchment type, catchment area, soil type and geology, land availability. Pond storage volumes will be designed to provide water supply during the dry season, taking into account changing rainfall patterns and increasing temperatures on increased agricultural water demand. Ponds or dams should be designed so that they can safely discharge (without failure) runoff rates associated with increasing rainfall intensity as a result of climate change.</p> <p>GIS would be used to broadly identify and prioritise suitable locations for implementation, based on climate, topography, soil type, etc. Priority will be given to regions where changing weather patterns are impacting rain-fed agricultural productivity and thus livelihoods. This maximises the adaptation benefit of the program and increases the eligibility of the program for climate financing. Considerations should be given to reducing evaporative losses (i.e local planting to reduce wind speed at pond surface), drip irrigation systems deliver water to the root zone and minimize irrigation losses.</p> <p>Implementation arrangements would be determined in program design but likely to be implemented by County Government or a national NGO in close collaboration with communities who would be expected to contribute land and labour, in-kind. This involvement of community in planning, design, and construction, along with simple training, will provide the community with the basic skills required to operate and maintain storage and irrigation systems. Particular attention will be given to the gender considerations during the project, and women will be engaged through all aspects of planning and design. Application of appropriate technologies will deliver sustainable infrastructure where replacement parts can be sourced or fabricated locally.</p> <p>Climate finance (potentially grants) could be accessed where there is a clear climate change rationale for the project. For example, in areas where dry season length is increasing so that where rain-fed agriculture is becoming unviable as a direct result of climate change.</p>
Rationale	The low uptake of irrigation techniques and consequent dependence on rainwater makes the agriculture sector in Kenya particularly vulnerable to droughts and changing patterns of precipitation and temperature associated with climate change. Installing farm ponds that harvest and store surface runoff will provide water for irrigation, livestock feed, and help climate-proof the livelihoods and agricultural output of rural communities.

⁹ DANIDA. 2006. Water from Small Dams (see also other publications in the same series)

Project type	<input checked="" type="checkbox"/> Infrastructure investment <input type="checkbox"/> Capacity Building <input type="checkbox"/> Document/Plan/Strategy	
Key stakeholders and beneficiaries		
Project owner	Ministry of Water, Sanitation and Irrigation - Irrigation Water Harvesting and Storing Department	
Potential project partners/key stakeholders	<p>National government:</p> <ul style="list-style-type: none">- Ministry of Water, Sanitation, and Irrigation - Irrigation Directorate- National Water Harvesting and Storage Authority- National Irrigation Authority- Climate Change Directorate <p>Local government:</p> <ul style="list-style-type: none">- County-level local governments (Dept. water environment and natural resources, or equivalent) <p>Private sector:</p> <ul style="list-style-type: none">- Farming associations and unions <p>State-owned entities:</p> <ul style="list-style-type: none">- Water Sector Trust Fund <p>Civil society:</p> <ul style="list-style-type: none">- Kenya Pooled Water Fund- University of Nairobi <p>Development partners:</p> <ul style="list-style-type: none">- World Bank- African Development Bank- French Development Agency (ADF)- German Development Agency GIZ- German Development Bank (KfW)- Danish International Development Agency (DANIDA)- Swedish Development Agency (SIDA)- Food and Agriculture Organization of the United Nations (FAO)- European Union- United Nations Development Programme (UNDP)- United Nations Children's Fund (UNICEF)- Bill and Melinda Gates Foundation- Parliamentary/Treasury Appropriations- Equalization Fund	
Direct beneficiaries	Group	Vulnerability characteristics?
	Small-scale farmers and associated local food supply chain providers in rural areas.	Kenya's agriculture sector is dominated by small-scale producers, which account for 78% of total agricultural production and were estimated at 15.9 million in 2015. ¹⁰¹¹ The vast majority of Kenya's poor depend on small-scale agriculture for their survival, and their dependence on rain-fed agriculture makes sector-specific threats like droughts threatening to their livelihoods.
Impact measures and estimates	There is a strong economic case favouring investment in adaptation measures funded by international donors. According to existing studies ¹² that looked into the impact of an early humanitarian response and resilience-building in Turkana and Northeast Kenya found that investing in early response and resilience-measures (including proactive drought risk management) could yield benefits of USD 2.8 for every USD 1 invested. Small-scale farmers, who are a direct beneficiary of the proposed project, would directly benefit from increased productivity of agricultural sector.	
Key benefits	<ul style="list-style-type: none">• Increasing food security by climate-proofing the supply of irrigation water in rural areas• Providing habitat for aquatic biodiversity• Improving rural livelihoods and addressing poverty by reducing the vulnerability of agriculture to climate change impacts• Increasing economic resilience by sustaining productivity of the agricultural sector and famers' income	

¹⁰ Birch, I. (2018). Agricultural productivity in Kenya: barriers and opportunities. K4D Helpdesk Report. Brighton, UK: Institute of Development Studies.

¹¹ FAO (2015). The economic lives of smallholder farmers. An analysis based on household data from nine countries. Rome.

¹² USAID (2018). Economics of resilience to drought: Kenya analysis. Washington DC.

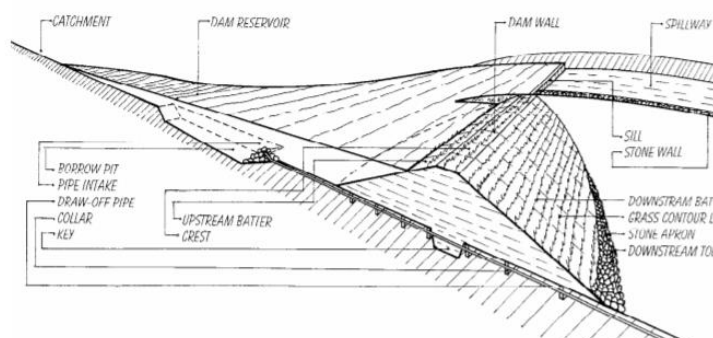
Location and scope of activities			
Geographic scale and location	Priority will be given to regions and counties where changing weather patterns are impacting rain-fed agricultural productivity and thus livelihoods. The priority counties will be determined in pre-feasibility stage.		
Status of preparation	<input checked="" type="checkbox"/> Project idea note <input type="checkbox"/> Concept note / pre-feasibility study <input type="checkbox"/> Full project proposal including feasibility study <input type="checkbox"/> Under implementation		
Project preparation steps	Activity	Implementation timeline	Activity owner
	Pre-feasibility and concept note (Technical Assistance)	3 months	Ministry of Water, Sanitation and Irrigation - Irrigation Water Harvesting and Storing Department
	Project design and feasibility, including implementing arrangements (Technical Assistance)	9 months	Ministry of Water, Sanitation and Irrigation - Irrigation Water Harvesting and Storing Department
	Funding/finance proposals and approvals	3 months	Ministry of Water, Sanitation and Irrigation - Irrigation Water Harvesting and Storing Department
	Packaging, procurement, disbursements	3 months	Ministry of Finance
	Pilot phase and refinement of implementation guidance documents (Technical Assistance)	12 months	Ministry of Water, Sanitation and Irrigation - Irrigation Water Harvesting and Storing Department County Government – Dept. of Water, Environment and Natural Resources
	Fully scaled implementation	6 years	Ministry of Water, Sanitation and Irrigation - Irrigation Water Harvesting and Storing Department
Potential for replication	The project has a high potential for replication. Farm ponds are scalable, affordable, and relatively easy to design and implement. The project will commence with a pilot phase to demonstrate and refine the approach and develop implementation and design guidance before scaling up. This piloting should deliver cost efficiencies for the wider project as many implementation and design challenges will be considered and resolved.		
Alignment with national and international strategies and frameworks	<ul style="list-style-type: none"> Water Act, 2016 – the overarching framework for water in Kenya that outlines water harvesting The Water Harvesting and Storage Regulations, 2021 National Climate Change Action Plan 2018-2022, in particular: <ul style="list-style-type: none"> Strategic Action 2: Increase livelihoods system climate-proofing, water harvesting, and water storage infrastructure and improve flood control with an expected result to increase the annual number of climate-proofed water harvesting, flood control, and water storage infrastructure from 700 to 2,000 by the year 2023 through several targeted projects Strategic Action 5: Improve access to good quality water with an expected result to increase the number of people and entities accessing good quality water for domestic, agricultural and industrial use from 58% to 65% by the year 2023 through several targeted projects The Kenya Vision 2030 and its targeted increase of coverage of water supply to 100% for both urban and rural areas Big Four Agenda and its focus on increasing the land under irrigation National Climate Change Act, which provides framework for Kenya's response to climate change 		

	<ul style="list-style-type: none"> National Climate Change Response Strategy 2010 that outlines adaptation measures to climate-proof the water sector National Policy on Climate Finance that highlights the need for enhanced water storage capacity to facilitate an increase in irrigated land Agriculture Sector Development Strategy 2009-2020 that underscores the need to develop and manage key enablers of agricultural production, including water UN 2030 Agenda and its Sustainable Development Goals, many of which directly relate to sustainable provision of water and its role in attaining food security
Does the current legislative and policy framework allow for the implementation?	The existing frameworks allows for the implementation of this project.
Sustainable Development Goals whose achievement will be supported by this project	<input checked="" type="checkbox"/> Goal 1: No poverty <input checked="" type="checkbox"/> Goal 2: Zero hunger <input type="checkbox"/> Goal 3: Good health and well-being <input type="checkbox"/> Goal 4: Quality education <input checked="" type="checkbox"/> Goal 5: Gender equality <input checked="" type="checkbox"/> Goal 6: Clean water and sanitation <input type="checkbox"/> Goal 7: Affordable and clean energy <input type="checkbox"/> Goal 8: Decent work and economic growth <input checked="" type="checkbox"/> Goal 9: Industry, innovation, and infrastructure <input type="checkbox"/> Goal 10: Reduced inequality <input type="checkbox"/> Goal 11: Sustainable cities and communities <input type="checkbox"/> Goal 12: Responsible consumption and production <input checked="" type="checkbox"/> Goal 13: Climate action <input checked="" type="checkbox"/> Goal 14: Life below water <input type="checkbox"/> Goal 15: Life on land <input type="checkbox"/> Goal 16: Peace, justice, and strong institutions <input type="checkbox"/> Goal 17: Partnerships for the goals
Financial information	
Indicative project cost	Total initial investment: \$1,225M CapEx: \$1,212M OpEx: (provided by community) Technical assistance: \$12.75M
Are any costs covered by the project owner?	Some project management costs/activities can be undertaken by the national implementing agency Communities will contribute \$264M in-kind in land and labour
Remaining financing need	\$970M
Financing approach	The current concept would be eligible for climate financing in areas where changing weather patterns are making rain-fed agriculture unviable. Due to the direct economic benefit of securing a resilient water supply through dry periods, and the efficiencies of drip irrigation (a number of growing seasons can be achieved annually), the payback period for these types of small ponds is relatively short, and risk is low. There is potential to fund this through debt, using a revolving fund or similar mechanism. A revolving fund is a self-sustaining fund where concessional loans are provided (to farmers) for capital investment (in ponds) and repayments (made possible by future sales) are used to fund the next round of borrowing. Capital is required to 'seed' the fund.
Revenue opportunities	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is this a standalone investment?	Yes
Potential project barriers/risks	

Risk and barrier types and mitigation measures	Theme	Potential risk	Mitigation measure
	Social conflict over resource availability – medium.	Without proper awareness-raising and stakeholder engagement activities, a conflict over available water resources can occur at both local and regional levels.	Early identification of all relevant groups, beneficiaries and affected population.
	Water supply sustainability – poor siting, design, or construction	Poor siting or construction of ponds could lead to reduced inflows or increased leakage losses which would affect the ability of the pond to deliver water supply through the 'design drought'.	By piloting the program, and implementing with experience partners, best practice will be developed and experienced gained by staff designing/locating ponds and overseeing construction.
	Contamination of waterbody with fertilizers and pesticides – medium.	Pesticides, fertilizers and other agricultural chemicals are significant source of water pollution, and can make their way to farm ponds, with damaging impact on the quality of water and biodiversity.	Adequate mitigation techniques should be reflected in related regulatory and technical documents. Siting of ponds should consider exposure to contamination risk.
	Risk to human life – medium.	Like other waterbodies, farm ponds carry a risk of accidental drowning, especially for children and vulnerable adults.	Adequate mitigation techniques should be reflected in related regulatory and technical documents and include, for example, clear demarcation of the area, warning signs, etc.

Additional information

List any additional relevant project information



A three-dimensional sketch of a dam wall.

Source: Erik Nissen-Petersen for DANIDA. 2006. Water from Small Dams: A Handbook for Technicians, Farmers and Others on Site Investigations, Design, Cost Estimates, Construction and Maintenance of Small Earth Dams.

Infrastructure improvements for the water sector – Implementing GIS, district metered areas and innovative leak detection programs

Introduction	
Project title	Infrastructure improvements for the water sector – Implementing GIS, district metered areas and innovative leak detection programs
Purpose of the project	The objective of this project is to improve water tracking, identification and reporting of leakages to reduce water loss and non-revenue water (NRW) ¹³ .
Strategic Action – Link to the Sector Roadmap	SO3.4.1: Innovation in water tracking and the identification and reporting of leakages
Description	<p>One of the critical challenges facing the water sector in Kenya is a high rate of NRW, which is estimated at 42%¹⁴, that results from ageing infrastructure, leakage, limited operation and maintenance, and limited metering and knowledge of water distribution systems.</p> <p>The purpose of this project is to reduce water leakage across Water Service Providers (WSPs). The baseline situation is relatively weak¹⁵; although there is a recently established NRW unit in the Ministry, there is a lack of clarity on responsibilities and organisational structure. At the WSP level, there is varying capacity for leak detection and reduction. In the worst cases, large parts of distribution systems are unknown and un-mapped. There is a lack of metering to determine water balances (and estimate leakage), limited knowledge of the techniques for leak identification and repair, and a lack of equipment (listening sticks, clamp on meters, etc).</p> <p>The project will provide long running technical assistance and support to WSPs to improve their capacity to reduce water loss and NRW. Investment in materials and equipment should be made by WSPs through their own funding/finance sources (for example Kenya's pooled water fund). The project will include direct support and training in, where necessary:</p> <ul style="list-style-type: none"> - Establishing GIS based maps of distribution networks - Locating and installing valves, as necessary, to create isolated district metered areas (DMAs) - Training in water balance calculations for DMAs, and other techniques such as night-time step-testing, to identify high leak zones - Use of clamp on (ultrasonic) flow meters for flow monitoring - Leakage identification with listening sticks and other appropriate (low tech) techniques - Developing pressure management plans <p>The technical assistance will include a Water Operator Partnership (WOP). WOPs link a mentor utility (often international) with a mentee utility. The mentor utility provides real practitioner expertise, advice and training. These arrangements have proven extremely effective, particularly in NRW management, where utility staff have this expertise – there are grants available for WOPs through bilateral donors. The technical assistance will also facilitate knowledge sharing between WSPs in Kenya as capacity develops nationally.</p> <p>The project will also include a pilot project in innovation in a WSP selected for its good capacity in leakage management, where a number of DMAs will be equipped with acoustic loggers to target and identify leakage in real time. This technology requires good GIS and IT capabilities, so the pilot WSP will be selected carefully. Once complete, lessons can be learned and this can be scaled up appropriately.</p>

¹³ Non-revenue water (NRW) is produced, clean water that is lost in the water distribution system, never reaching the final consumer.

¹⁴ JICA project brief note. 2019. Project for Strengthening Capacity in Non-Revenue Water Management. Available at: https://www.jica.go.jp/project/english/kenya/012/materials/c8h0vm0000f5y5nm-att/briefnote_201901.pdf

¹⁵ JICA project brief note. 2019. Project for Strengthening Capacity in Non-Revenue Water Management. Available at: https://www.jica.go.jp/project/english/kenya/012/materials/c8h0vm0000f5y5nm-att/briefnote_201901.pdf

Rationale	Reducing water leakage is essential to address the challenge of water availability across Kenya and reduce the current high levels of non-revenue water. Improving water efficiency will deliver value for money in the water industry, putting WSPs in better financial positions for future investment in capital and operation programs. This project is strongly aligned with the government's national target of achieving 20% NRW ratio by 2030 . Efficiency in water delivery (reduction of losses) also reduces the carbon footprint of every unit of water delivered to customers due to the energy used in treatment and distribution.		
Project type	<input checked="" type="checkbox"/> Infrastructure investment <input type="checkbox"/> Capacity Building <input type="checkbox"/> Document/Plan/Strategy		
Key stakeholders and beneficiaries			
Project owner	<ul style="list-style-type: none">- Ministry of Water, Sanitation and Irrigation - Water Infrastructure Development Department, and- Water Service Providers.		
Potential project partners/key stakeholders	<p>National government:</p> <ul style="list-style-type: none">- Water Works Development Agency- Water Service Regulatory Board- Water Sector Trust Fund- Kenya Water Institute- Water Services Providers Association- Climate Change Directorate <p>Local government:</p> <ul style="list-style-type: none">- County-level governments <p>Private sector:</p> <ul style="list-style-type: none">- Kenya Innovative Finance Facility for Water <p>State-owned entities:</p> <ul style="list-style-type: none">- County-level water service providers <p>Civil society:</p> <ul style="list-style-type: none">- Kenya Pooled Water Fund <p>Development partners/Donors:</p> <ul style="list-style-type: none">- World Bank- African Development Bank- French Development Agency (ADF)- German Development Agency GIZ- German Development Bank (KfW)- Danish International Development Agency (DANIDA)- Swedish Development Agency (SIDA)- Food and Agriculture Organization of the United Nations (FAO)- European Union- Bill and Melinda Gates Foundation- UNICEF		
Direct beneficiaries	Group	Estimated number Total: Male – Female	Vulnerability characteristics?
	Kenya's Water Service Providers	88 in total, 86 public, 2 private	Water Service Providers are suffering from high losses in revenue as a result of NRW. Management of leakage is generally poor and techniques and equipment (hardware and software) are lacking. There has been limited uptake of global best practice and innovation in leakage management. Illicit water consumption arising from water theft, illegal connections and unauthorised is also a critical aspect of NRW.
	Citizens of Kenya	47 million, mostly rural population (69%)	The World Bank estimates than only around 50% of Kenya's population has access to clean water . Reduction in water loss and NRW will help to improve general access to water in Kenya and the financial position of WSPs and increase water availability and efficiency to enable climate resilient expansion.

Impact measures and estimates	Reducing NRW will help the WSPs ensure their financial viability and improve levels of service provided to customers. Financial loss of up to estimated 10.6 billion shillings can be prevented. The target is for reduction of NRW to a manageable 20%. Efficiency in water delivery and reduction of losses will reduce the carbon footprint of every unit of water delivered to customers due to the energy used in treatment and distribution.																							
Key benefits	<ul style="list-style-type: none">• Increase water availability and efficiency• Improve financial position of WSPs enabling future investment• Climate-proofing the water sector by reducing wasted water resources• Improving access to water for all																							
Location and scope of activities																								
Geographic scale and location	The project would be implemented in collaboration with all (86) public water service providers in Kenya.																							
Status of preparation	<input checked="" type="checkbox"/> Project idea note <input type="checkbox"/> Concept note / pre-feasibility study <input type="checkbox"/> Full project proposal including feasibility study <input type="checkbox"/> Under implementation																							
Project preparation steps	<table><tr><th>Activity</th><th>Implementation timeline</th><th>Activity owner</th></tr><tr><td>Step 1 –Prepare scope of technical assistance</td><td>3 months</td><td>NRW unit, Ministry of Water, Sanitation and Irrigation</td></tr><tr><td>Step 2 – Tendering and contracting</td><td>3 months</td><td>NRW unit, Ministry of Water, Sanitation and Irrigation</td></tr><tr><td>Step 3 – TA team evaluate equipment needs of WSPs</td><td>4 months</td><td>NRW unit, Ministry of Water, Sanitation and Irrigation</td></tr><tr><td>Step 4 – WSP procurement (pilot study commenced by TA team)</td><td>2 months</td><td>NRW unit, Ministry of Water, Sanitation and Irrigation</td></tr><tr><td>Step 5 – TA team support implementation and provide training in leakage reduction (pilot study completed by TA team)</td><td>17 months</td><td>NRW unit, Ministry of Water, Sanitation and Irrigation</td></tr><tr><td>Step 6 – Lessons learned and reporting</td><td>1 month</td><td>NRW unit, Ministry of Water, Sanitation and Irrigation</td></tr></table>			Activity	Implementation timeline	Activity owner	Step 1 –Prepare scope of technical assistance	3 months	NRW unit, Ministry of Water, Sanitation and Irrigation	Step 2 – Tendering and contracting	3 months	NRW unit, Ministry of Water, Sanitation and Irrigation	Step 3 – TA team evaluate equipment needs of WSPs	4 months	NRW unit, Ministry of Water, Sanitation and Irrigation	Step 4 – WSP procurement (pilot study commenced by TA team)	2 months	NRW unit, Ministry of Water, Sanitation and Irrigation	Step 5 – TA team support implementation and provide training in leakage reduction (pilot study completed by TA team)	17 months	NRW unit, Ministry of Water, Sanitation and Irrigation	Step 6 – Lessons learned and reporting	1 month	NRW unit, Ministry of Water, Sanitation and Irrigation
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Potential for replication	Successful aspects of the pilot study will be scalable.																							
Alignment with national and international strategies and frameworks	<ul style="list-style-type: none">• Water Act, 2016• Water Master Plan 2030• Strategic Action 4: Promote water efficiency (monitor, reduce, re-use, recycle and modelling) with an expected result to reduce water wastage and non-revenue water from the current 43% to 20% by the Year 2023 through several targeted projects (The Kenya Vision 2030) and its targeted increase of coverage of water supply to 100% for both urban and rural areas• National Climate Change Action Plan 2018-2022, in particular:• Strategic Action 2: Increase livelihoods system climate-proofing, water harvesting, and water storage infrastructure and improve flood control with an expected result to increase the annual number of climate-proofed water harvesting, flood control, and water storage infrastructure from 700 to 2,000 by the year 2023 through several targeted projects																							

	<ul style="list-style-type: none"> • The Kenyan Vision 2030 that aims to decrease NRW rate to 20% for efficient water use • National Climate Change Act, which provides framework for Kenya's response to climate change • National Climate Change Response Strategy 2010 that outlines adaptation measures to climate-proof the water sector • National Policy on Climate Finance • UN Vision 2030 Agenda and its Sustainable Development Goals, many of which directly relate to sustainable provision of water
Does the current legislative and policy framework allow for the implementation?	The existing frameworks allows for the implementation of this project.
Sustainable Development Goals whose achievement will be supported by this project	<input type="checkbox"/> Goal 1: No poverty <input type="checkbox"/> Goal 2: Zero hunger <input type="checkbox"/> Goal 3: Good health and well-being <input type="checkbox"/> Goal 4: Quality education <input type="checkbox"/> Goal 5: Gender equality <input checked="" type="checkbox"/> Goal 6: Clean water and sanitation <input type="checkbox"/> Goal 7: Affordable and clean energy <input type="checkbox"/> Goal 8: Decent work and economic growth <input type="checkbox"/> Goal 9: Industry, innovation, and infrastructure <input checked="" type="checkbox"/> Goal 10: Reduced inequality <input checked="" type="checkbox"/> Goal 11: Sustainable cities and communities <input checked="" type="checkbox"/> Goal 12: Responsible consumption and production <input checked="" type="checkbox"/> Goal 13: Climate action <input type="checkbox"/> Goal 14: Life below water <input type="checkbox"/> Goal 15: Life on land <input type="checkbox"/> Goal 16: Peace, justice, and strong institutions <input type="checkbox"/> Goal 17: Partnerships for the goals
Financial information	
Indicative project cost	Total initial investment: CapEx: \$2.5M (between 88 WSPs) OpEx: unknown Technical assistance: \$2M (not including cost of pipe replacement/repair, domestic meter installation/replacement/repair, or pressure reduction valves)
Are any costs covered by the project owner?	\$2.5M covered by WSPs for leakage detection equipment.
Remaining financing need	\$2M for technical assistance in leakage detection and pilot to deploy acoustic loggers.
Financing approach	TA to be included in water sector loan projects. WSP costs can be packaged up with WSP capital works programs. Could be financed through Kenya pooled water fund (15 year loan). NRW projects can be funded through energy savings contracts or performance-based contracts.
Revenue opportunities	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Revenue per unit cost is increased, because the main cost in distribution is energy, energy savings contracts are feasible for NRW reduction – funding investments through future savings under a BOT (Build Operate Transfer) type arrangement. ¹⁶
Is this a standalone investment?	If the pilot project is successful there is potential for replication and scaling up across utilities which have proven capacity in NRW management.
Potential project barriers/risks	

¹⁶ Watergy: Energy and Water Efficiency in Municipal Water Supply and Wastewater Treatment. 2007. Available at: <https://www.gwp.org/globalassets/global/toolbox/references/watergy.-water-efficiency-in-municipal-water-supply-and-wastewater-treatment-the-alliance-to-save-energy-2007.pdf>

Risk and barrier types and mitigation measures	Theme	Potential risk	Mitigation measure
	Social	N/A	N/A
	Environmental	N/A	N/A
	Economic	N/A	N/A
	Water supply sustainability	Poor selection of equipment and/or training results in limited uptake and poor NRW results.	Procurement of highly experience TA team who have implemented similar programs in a similar utility context to Kenya.
Additional information			
List any additional relevant project information	List of WSPs in Kenya per region: https://wasreb.go.ke/downloads/WSP%20Register%202019.pdf		

Appendix B Water Sector Roadmap Excel Tool and User Guide

The Water Sector Roadmap Excel Tool can be found in the attachments to this report, as shown in the figures below. The User Guide and Videos for the Roadmap Tool can be found on the **'Introduction Tab'** of the tool.

We advise using the Adobe Acrobat Reader DC program to easily read this report and access the attached Roadmap Tool. *If unsure of where to find the attachment, please follow the figures below.*

