MOMBASA WATER FUND

A BUSINESS CASE FOR NATURE-BASED SOLUTIONS TO PROTECT THE WATER SOURCE AREAS OF MWACHE DAM AND MZIMA SPRINGS

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Cover photo: A typical household in the middle of the Mwache Dam catchment. Photo: JK Turpie.

Inside cover: Mombasa's waterfront is a popular tourism destination. Photo: JK Turpie.

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GLOSSARY

Adaptive Management: A systematic approach to learning and managing protected areas and natural resources that allows managers to make decisions despite uncertainty. It is an iterative process with six stages: problem assessment, experimental design, implementation, monitoring results of experiment, evaluation of results, and management adjustment.

Business-As-Usual Scenario: This assumes that management of the Western Area Peninsula Water Supply System will continue as currently implemented with no significant new investments in forest protection or restoration and that unmanaged urban and agricultural expansion will continue.

Carbon Sequestration: The process of capturing and storing atmospheric carbon dioxide. Natural carbon sequestration processes can be supported through changes in land use and agricultural practices, including forest restoration and the conversion of annual cropping systems and livestock grazing land into agroforestry systems.

Conservation Scenario: This assumes significant investments in interventions aimed at halting and reversing the deforestation that has taken place in the WAPNP, as well as to preserve and restore forest areas in the riparian zones of the urbanized areas below the park. It also assumes substantial investments in a suite of enabling interventions that seek to enhance the impact of the interventions directly aimed at forest conservation and restoration.

Currency: All monetary values are expressed in United States dollars (USD). All estimates were calculated using the exchange rate of 1 US$ = 107.5 KSh.

Catchment: An area where water is collected by the natural landscape. Precipitation that falls in a catchment runs downhill into creeks, rivers, lakes, or oceans, or into built infrastructure, such as reservoirs. In this document, the terms “catchment” and “watershed” are used interchangeably.

Cost Benefit Analysis: A conceptual framework and tool used to evaluate the viability and desirability of projects or policies based on their costs and benefits over time. It involves the adjustment of future values to their present value equivalent by discounting at a rate which reflects the potential rate of return on alternative investments or the rate of time preference.

Discount Rate: The interest rate used in discounted cash flow analysis to determine the present value of future cash flows.

Ecological Infrastructure: Nature’s equivalent of grey or engineered infrastructure. It forms and supports a network of interconnected structural elements such as catchments, rivers, riparian areas, and natural corridors supporting habitats and movement of animals and plants.

Ecosystem Services: the benefits people obtain from the Earth’s many life-support systems. The Millennium Ecosystem Assessment defines four categories of ecosystem services: provisioning, regulating, cultural, and supporting services.

Mombasa Water Supply System: All of the ecological and built infrastructure that together supply water to meet the needs of the population of the city of Mombasa as well as the surrounding coastal towns and inland towns as far as Voi.

Nature-based Solutions (NbS): actions taken to protect, sustainably manage, and restore ecosystems to effectively address societal challenges, such disaster risk reduction. Nature-based Solutions simultaneously improve ecosystem health and functioning to the benefit of human and non-human nature.

Net Present Value: A calculation used to estimate the net benefit over the lifetime of a particular project. Net present value allows decision-makers to compare various alternatives on a similar time scale by converting all options to current dollar figures. A project is deemed acceptable if the net present value is positive over the expected lifetime of the project.

Payments for Ecosystem Services (PES): Under PES, beneficiaries of ecosystem services compensate ecosystem managers (landowners or resource stewards) to change their practices in order to secure those ecosystem services. This may involve desisting from damaging activities or adopting more expensive practices that are less damaging to the environment.

Recharge Area: The area where rainwater seeping into the ground is able to reach and replenish an underground aquifer since no confining layer is present. In this study, it includes the Chyulu Hills Water Tower and the wider drainage area beyond the hills themselves.

Return on Investment (ROI): A simple ratio of the gain from an investment relative to the amount invested. ROI is calculated by dividing net profit (current value of investment less the cost of investment) by the cost of investment.

Riparian Area: Land occurring along watercourses and water bodies. For the purpose of this study, it can be defined as the area within 30 m of the river channel.

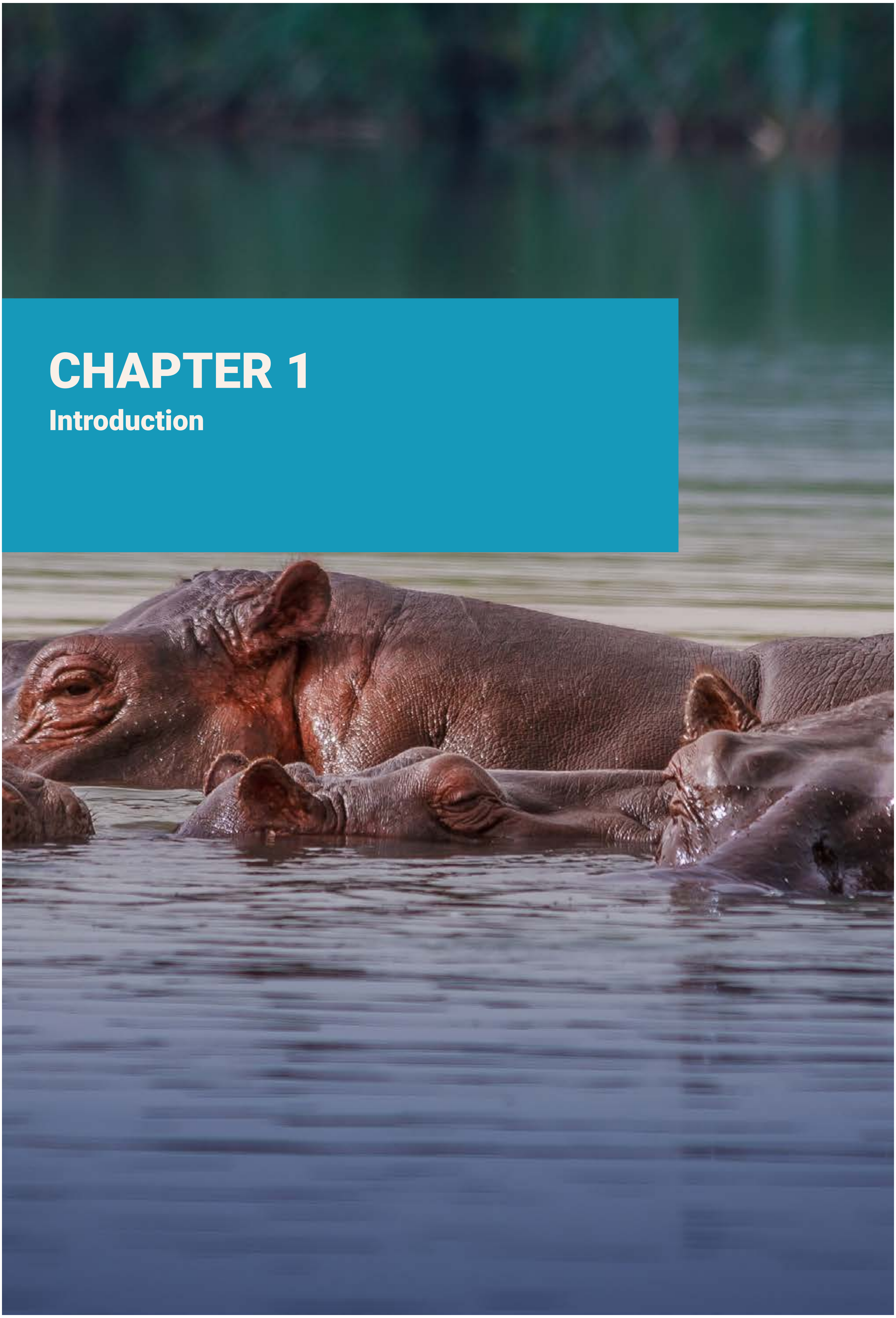
Water Fund: A funding and governance mechanism that enables water users to provide financial and technical support collectively in catchment restoration alongside upstream communities.

Water Security: The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality of water for sustaining livelihoods, human well-being, and socio-economic development for ensuring protection against waterborne pollution and water-related disasters and for the preservation of ecosystems in a climate of peace and political stability.

LIST OF ABBREVIATIONS AND ACRONYMS

AFD	Agence Française de Développement (French Development Agency)
BAU	Business as Usual
CDA	Coast Development Authority
CWWDA	Coast Water Works Development Agency
KWSCRP-2	Kenya Water Security and Climate Resilience Project – Phase 2
InVEST	Integrated Valuation of Ecosystem Services and Trade-offs
MOWASSCO	Mombasa Water Supply and Sanitation Company
MWF	Mombasa Water Fund
NBS	Nature-based Solutions
NGO	Nongovernmental Organization
PES	Payment for Ecosystem Services
REDD+	Reduced Emissions from Degradation and Deforestation
ROI	Return on Investment
SEC	Soil Erosion Control
SDR	Sediment Delivery Ratio
tC	Tonnes of Carbon
TNC	The Nature Conservancy
TSS	Total Suspended Solids
WASREB	Water Services Regulatory Board
WEAP	Water Evaluation and Planning
WRA	Water Resources Authority
WSP	Water Service Provider

CHAPTER 1
Introduction



Nature-Based Solutions for Water Security

Cities and regions around the world face increasing threats to their water security due to growing water demands in the context of climate change and degradation of their water source areas. Mombasa, Kenya's second largest city and an important hub for tourism and economic de-velopment, experiences par-ticularly severe water supply challenges. The city currently covers less than a third of its total water demand through the formal water supply network, with residents and businesses having to procure their own water at consider-able cost. In response to this challenge, various infrastructure projects are planned to augment the Mombasa water supply system, which also brings water to towns in Kwale, Kilifi, and Taita Taveta counties. However, the potential of these investments to provide a sustained and reliable supply of water is threatened by envi-ronmental conditions in their catchment and recharge areas.

Nature-based solutions (NBS are essential to strategies for achieving water security. They are also critical for addressing the dual challenge of biodiversity loss and climate change. Such measures are often more cost-ef-fective than tra-ditional responses, such as the augmentation and upgrading of water supply infrastructure, and have the added advantage of a range of co-bene-fits associated with having healthier ecosystems. NbS contribute to biodiversity conservation, can help reduce disaster risk, improve health and livelihoods, and can help countries meet their interna-tional climate change mitigation goals. While investment in built infrastructure is a primary element of achieving water security, even the best built infrastructure will be unable to supply sufficient water if the integrity of the ecological infrastructure, which helps secure water of sufficient quantity and quality, is not ensured.

Mombasa, Kenya's second largest city and an important hub for tourism and economic development, experiences particularly severe water supply challenges

The Business Case

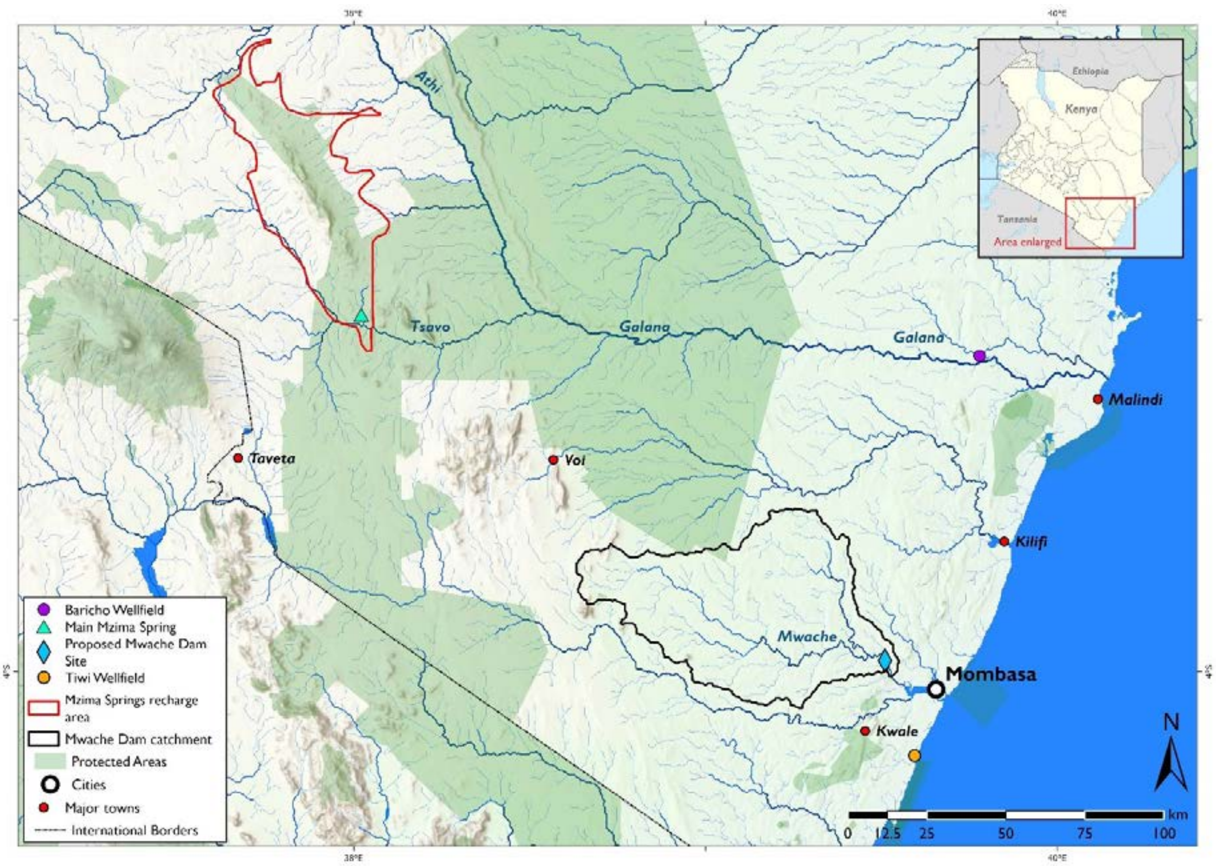
This is a Business Case for the creation of a water fund to serve the Mombasa Water Supply System by constructive-ly engaging the communities that act as stewards of the surface and groundwater resource catchments. The oppor-tunity for creating such a fund was identified by The Nature Conser-vancy (TNC), and research on the fund's feasibility (see Rural Focus Ltd., 2020) and design was supported by both TNC and AFD. The Business Case builds on a detailed study led by Anchor Environmental Consultants on the potential design and efficacy of land and water conserva-tion measures in two key water source areas for Mombasa and Kenya's coast region: the Mwache Dam catchment and Mzima Springs recharge area (Figure 1, Turpie et al., 2021). This Business Case aims to assess the financial, economic, and social at-tractiveness of establishing the Mombasa Water Fund (MWF) as a way of funding, coordi-nating, and implementing land conservation measures that will improve the sustainability of future water supplies to Mombasa and the towns linked to the same public water supply system.

The Business Case for the Mombasa Water Fund aims to provide an economic and scientific basis for private and public sector stakeholders to collaborate in creating a structure that will provide an integrated funding, governance, and implementation mechanism to design strategic measures to restore, rehabilitate, and protect the ecological and built infrastructure that supplies water to over 2 million people in south-eastern coastal Kenya.

The results support the case for creating a water fund that will:

- support the implementation of soil conservation measures in cultivated and pastoral lands;
- invest in rehabilitation and protection of badly eroded areas, particularly riparian areas;
- incentivize communities to protect and restore rangeland and forest vegetation cover in the catchment and recharge areas; and
- support the establishment of new conservancies and other community or landowner associations to conserve important natural areas.

Figure 1: The Mwache Dam catchment and Mzima Springs recharge area are key components for the Mombasa water supply system, which comprises the springs and wellfields shown. Note that the boundary of the recharge area is approximate.



3

The Role of the Mombasa Water Fund

The Mombasa Water Fund aims to provide a multi-stake-holder response to addressing environmental degra-da-tion in the Mwache Dam catchment and Mzima Springs recharge area. By doing so, the fund seeks to help ensure the long-term sustainability of the major water supply in-frastructure investments currently occurring in these water source areas. In addition to improving the quantity and quality of future water supply to urban consumers, the MWF has the potential to improve the livelihoods of communities living in critical water source areas, conserve biodiversity, and contribute to mitigating climate change through carbon sequestration.

Managing ecosystem condition, particularly in the upper catchment areas, can provide a cost-effective means of helping to ensure year-round water availability and improve water quantity for domestic use and for environ-mental flows. A better adoption of nature and green infra-structure components into conventional infrastructure systems can cost-effectively enhance service delivery while simulta-neously ensuring resilience and flexibility (Browder et al., 2019).

The **vision** for the Mombasa Water Fund is improved water security through a restored and well-con-served Mwache catchment and Mzima Springs recharge area.

The water fund's **mission** is to restore the Mwache Dam catchment and protect the forests of Chyulu Hills within the Mzima Springs recharge area so that they can supply the quantity and quality of water needed for all users of the Mombasa water supply system in Mombasa, Kwale, Kilifi, and Taita Taveta counties, while at the same time improving the live-lihoods of the people in these water source areas.

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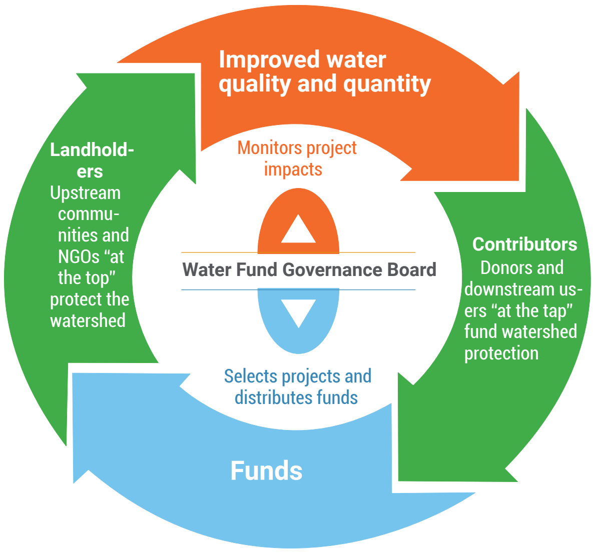
Water funds provide a means by which finance and assistance from downstream hydrologic service bene-fi-ciaries (e.g., water service providers and consumers) and donors (motivated by developmental or biodiversity conservation benefits) can be channelled to the actors that implement management changes or accommodate conservation actions in important water catchment areas. Water funds thus provide a financing and governance mechanism for linking downstream water consumers with upstream land users, typically taking the form of a public-private partnership. A key premise of the water fund approach is that often it is cheaper to prevent water problems at the source than to address them later. Funding is used to support economic opportunities that enhance livelihoods for local communities, including agricultural interventions that improve productivity. These catchment conservation measures also build resilience, enhancing communities' ability to adapt to climate change.

The MWF builds on the experience of over 40 other water funds that have been established in 13 countries by TNC. This includes the Upper Tana-Nairobi Water Fund (UTNWF), launched in 2015. The UTNWF has already contributed to the improved conservation and management of 40,000 ha of public forest and 78,400 ha of farmland, and it has increased yields for smallholder farmers by $3 million per year. It is also estimated to have increased water yields and improved water quality for Nairobi, with benefits to power generation and water treatment facilities worth over $850,000 per year.

Figure 2. Illustration of how a water fund works.



The UTNWF has already contributed to the improved conservation and management of 40,000 ha of public forest and 78,400 ha of farmland, and it has increased yields for smallholder farmers by

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What's in a Name?

The provisional name used in this Business Case—Mombasa Water Fund—is based on the fact that most of those who would benefit from the fund's improved water security reside in the city of Mombasa. However, the fund will actually serve many more. All those who share the water sources of the Mombasa water supply system—including in Kwale, Kilifi, and Taita Taveta counties, and as far inland as Voi—would benefit. The source areas of the water supply system also extend into Makueni and Kajiado counties. The water supply system itself does not have an official name, as in the case of the Western Cape Water Supply System that serves Cape Town and surrounding towns. The difficulty of naming the system and its water fund is that it spans multiple counties, and does not fit neatly into a recognized region, such as the coastal region e.g., Kenya Coast Water Fund). The provisional name is used in this study as it would be highly recognizable by potential funders, as opposed to if it were a combination of local county names, for example. The final name will be decided by the primary stakeholders.

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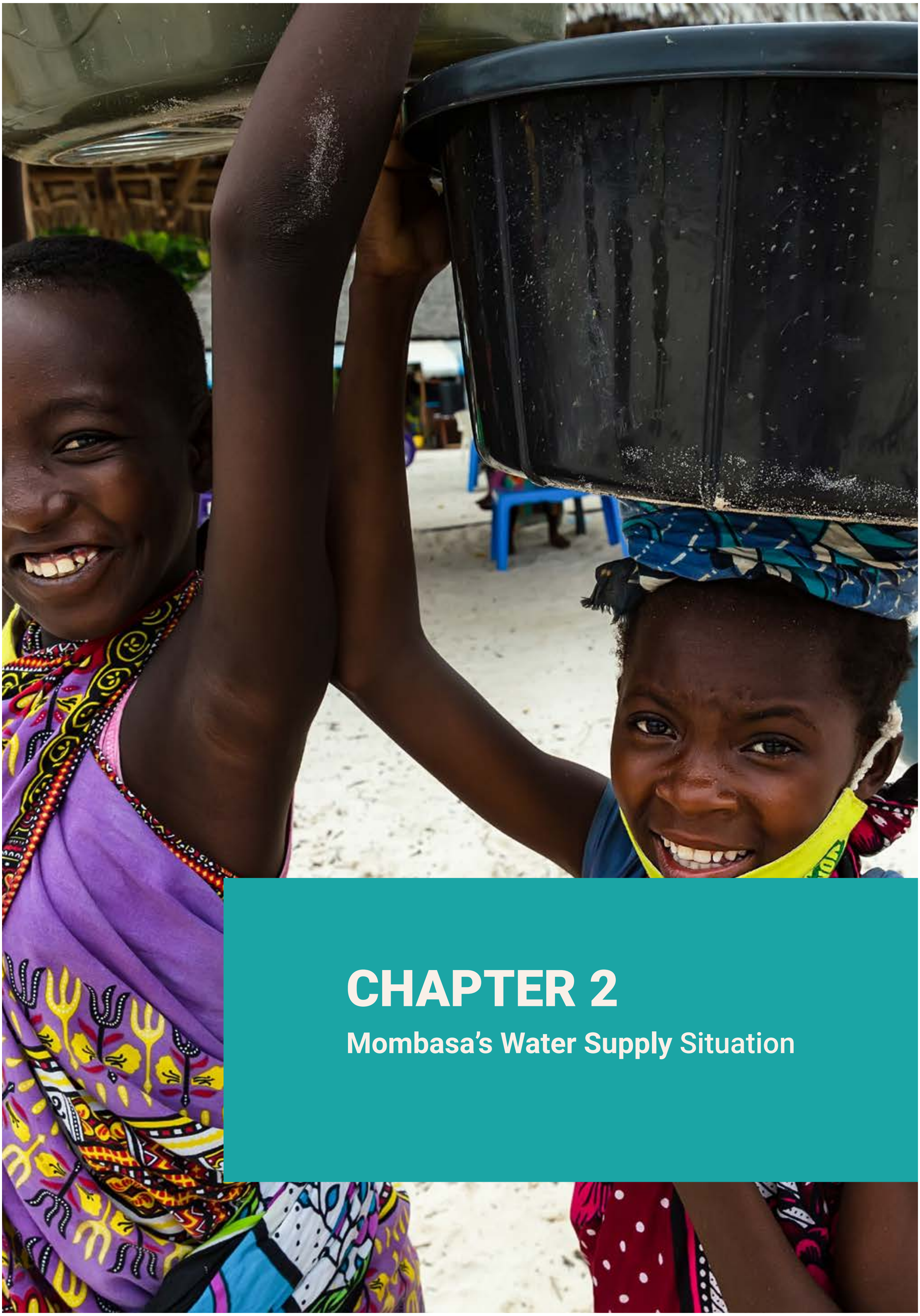

CHAPTER 2
Mombasa’s Water Supply Situation

The Coast Bulk Water Supply System

Mombasa is home to 1.2 million people (KNBS, 2019a), making it Kenya's second largest city after Nairobi. Situated along the Western Indian Ocean coastline, it is Kenya's foremost tourist city and the country's main port for the import and export of goods. Up to now, Mombasa has relied entirely on groundwater wellfields and springs for its water supply, most of which are located long distances (up to 220 km) away in Kwale, Kilifi, and Taita Taveta counties. The city is thus part of an extensive bulk water supply network that serves Mombasa and several other urban centres in the region (Figure 3), providing water to around 2 million people. The Baricho Wellfield and Mzima Springs are currently the major sources of water in this water supply system, with a relatively small amount contributed by Marere Springs and Tiwi Wellfield.

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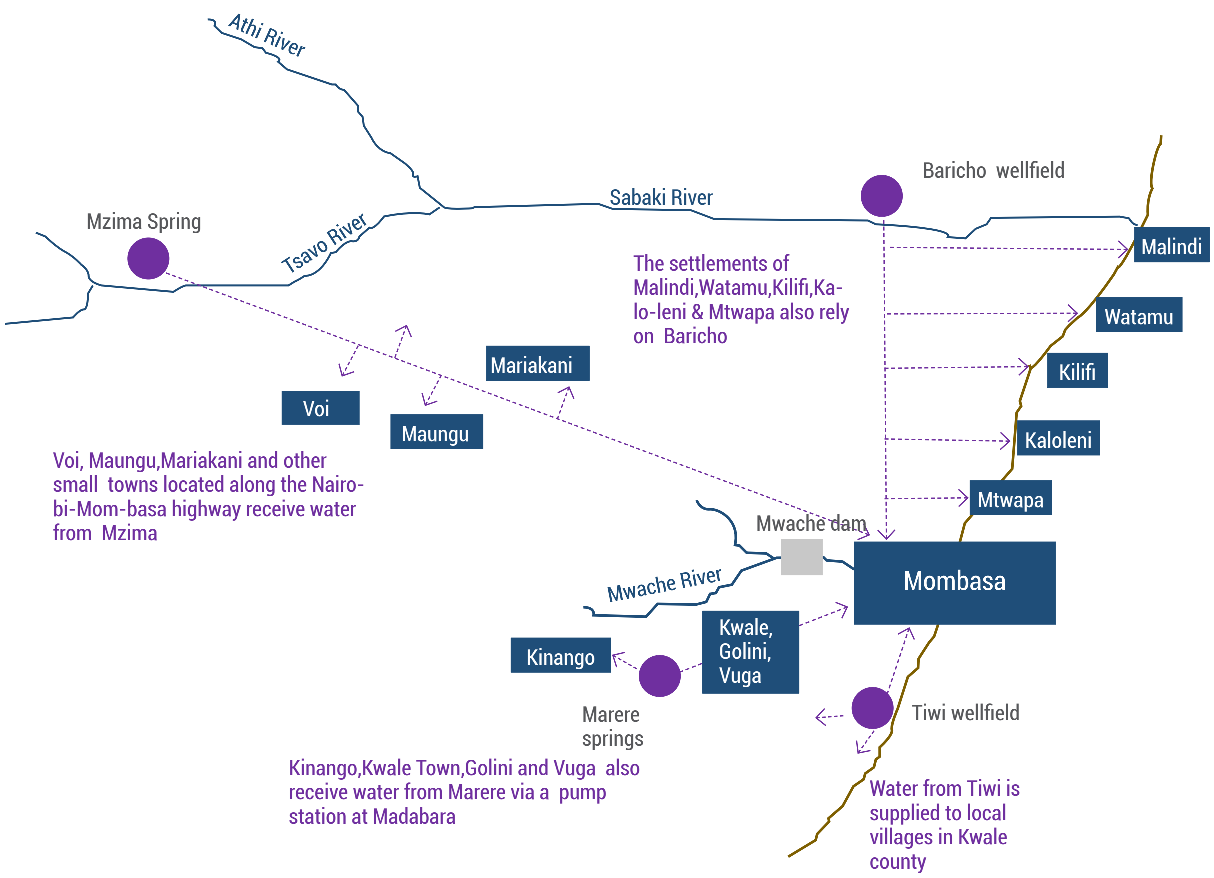

Figure 3: Schematic showing water sources for Mombasa and other towns and villages that receive water from these same sources. Note that the Mwache Dam is still to be constructed and will supply water primarily to Mombasa.Usambaras.

The bulk water supply system is currently managed by the Coast Water Works Development Agency (CWWDA), a national government agency responsible for managing and maintaining the waterworks and pipelines. Bulk water from the various water sources is sold by the CWWDA to county water service providers (WSPs). In the case of Mombasa, the WSP is the Mombasa Water Supply and Sanitation Company (MOWASSCO). County WSPs then sell water to their consumers. County WSPs are also responsible for maintaining water transmission and sewage infra-struc-ture under their jurisdiction. Under Kenya's devolution framework, management of this bulk water system will eventually be handed over to a joint authority, which has yet to be formally constituted. Ideally, this authority should have a mandate to invest in protection and management of its source water areas.

Mombasa's Water Supply Deficit

Despite its importance as an economic and tourism hub, Mombasa experiences severe water shortages. Although recent precise figures for Mombasa's total water demand are difficult to find, overall demand is estimated to be around 200,000 m^3/day (Kithiia & Majambo, 2020; Anthony Njaramba, MOWASSCO, pers. comm.). This demand from Mombasa alone is greater than the design capacity of the entire bulk water supply system, which is just 148,000 m^3/day. Due to allocations to upstream users, only 46,500m3/day is allocated to Mombasa. Furthermore, because of leakages, breakdowns, upstream over-abstraction, and other system challenges, Mombasa receives only around 35,000 m^3/day, and that's on a good day. This is just 17.5% of the 200,000 m^3/day demand estimate for the city. The gap between water demand and existing supplies will only worsen as the population continues to grow. By 2035, Mombasa's demand is projected to increase to about 320,000 m^3/day, while the demand on the whole bulk water system will increase to 530,000 m^3/day. Expansion of the city's water supply is thus critical.

Mombasa's total overall water demand is estimated to be around

200,000 m^3/day

The shortfall in the city's formal water supply has forced residents and business to rely on private boreholes, wells, and water vendors. Drilling boreholes is costly and does not always result in potable water, while water from bowsers is several times more expensive than water provided by MOWASSCO, severely burdening the city's poorer residents.

Moreover, the proliferation of unregulated boreholes has resulted in widespread salinization problems thanks to the city's coastal location. Notably, 94% of borehole water samples taken from across Mombasa's North Coast were found to exceed WHO salinity limits, rendering it unsuitable for drinking without costly treatment (Idowu, Nyadawa, & K'Orowe, 2017). Exacerbating matters, Mombasa effec-tively lacks a sewage system, forcing residents to rely on soakaways. This in turn contaminates borehole water, presenting a serious health risk. Boreholes therefore do not provide a satisfactory solution to the city's water supply woes, particularly since water table drawdown and salini-zation will worsen with continued abstraction. Given this, our stakeholder engagement revealed a strong appetite for a more reliable public water supply, which could be tapped into to provide support to the MWF. Given the uncertainty around the long-term viability of boreholes, even major corporate users with existing boreholes indicated they would consider supporting the MWF as a way of securing alternative water supplies for their business activities.

Planning for Growing Demand and Scarcity

Major new infrastructure has been planned to address these challenges. This includes new offtake infrastructure and pipelines to increase the supply from Mzima Springs, and the Mwache Dam and treatment works to augment the supply of water to Mombasa and Kwale County. With a planned commissioning date in 2022, the Mwache Dam is set to become Mombasa's largest water supplier, projected to supply 186,000 m^3/day. Expected to take six to eight years to complete, the dam will exceed the current supply capacity of the entire bulk water system, enabling the whole system to meet projected water demands in 2035. Meanwhile, the expansion of the Mzima Springs infra-structure is projected to increase abstraction from 35,000 m^3/day to 95,000 m^3/day, of which 50,050 m^3/day will be allocated to Mombasa. However, the sustainability of both these water sources is threatened by land use practices.

Key Water Source Areas and Threats to Future Water Supply

Increased protection of the vegetation and soils of the Mwache Dam catchment and the Mzima Springs recharge area will be essential to maintaining the output of the bulk water supply system.

Located mostly in Kwale County, the Mwache Dam catchment covers 3,560 km^2, with the dam site situated about 20 km west of the city of Mombasa (Figure 1). The catchment is generally semiarid with rainfall increasing towards the coast. Overall, the catchment is characterized by high poverty levels and limited livelihood opportunities. Farming is the main livelihood, with most households in the central and eastern parts of the catchment practicing a mixture of crop cultivation and livestock rearing. In the more sparsely populated western parts of the catchment, livestock farming and wildlife conservation on group ranches are the dominant activities. Charcoal production and sand mining have become common in recent years, particularly closer to the urban centres and main roads.

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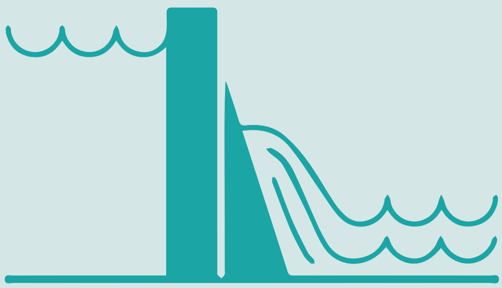


Figure 4. A charcoal trader in the Mwache Dam catchment. Photo: JK Turpie

Land use practices, sand mining, and fuelwood harvesting in the catchment area present a serious threat to the lifespan and potential water yield of the dam. These activities increase soil erosion and sedimentation, which in turn elevate rates of sediment accumulation in the dam, reducing its capacity. These activities also diminish water quality, which then significantly increases water treatment costs. The costs of sediment clearing and water treatment will ultimately fall on consumers, as these activities will increase the cost of water supplied from the dam.

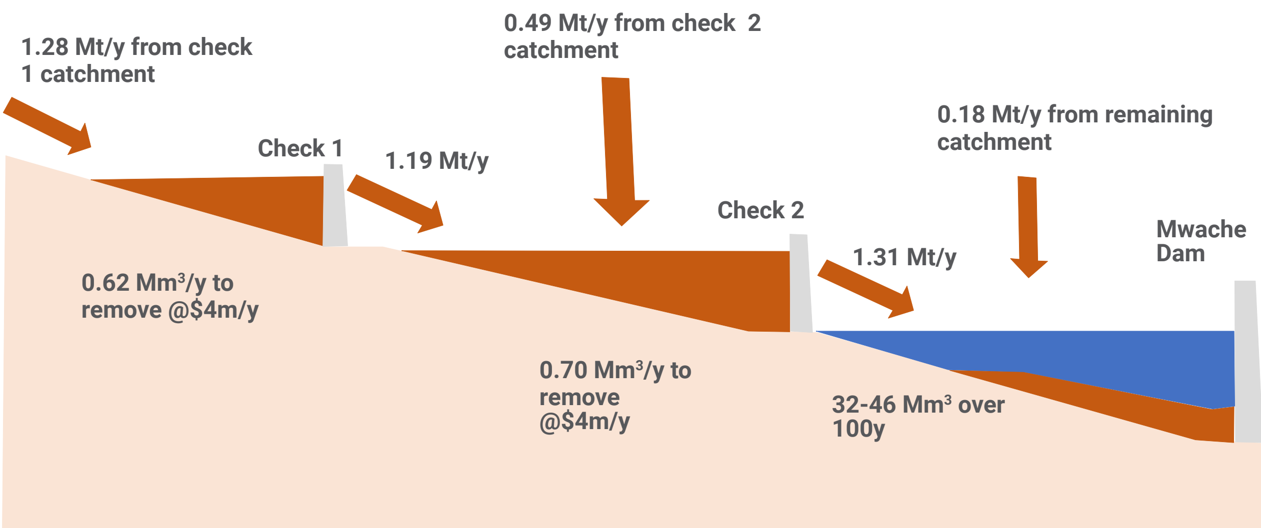
Figure 5. Erosion associated with riparian agriculture and livestock watering near Mariakani in the Mwache Dam catchment. Photo: JK Turpie.

To mitigate the threat of sedimentation, two large check dams have been planned to trap sediments upstream of the Mwache Dam (Figure 6). These should significantly reduce the amount of sediment entering the main dam, though there will be some overflow as well as inputs from the remainder of the catchment. At current rates of erosion and sedimentation, the dam's lifespan could be reduced to as little as 20 years (Nippon Koei, 2018). Extending the lifespan will be possible only if sediment is cleared each year from both check dams. Otherwise, the check dams will themselves rapidly fill up with sediment and no longer serve to protect the main dam. Clearing sediment from these check dams will require significant amounts of labour and equipment. According to the sediment management plan (Nippon Koei, 2018), costs could be as high as $8 million per year.

This figure has been confirmed through consultation with a CDA engineer. While funding for the check dam construc-tion and some catchment rehabilitation activities has been secured through the Kenya Water Security and Climate Resilience Project – Phase 2 (KWSCRP-2), it is unclear who will be responsible for clearing the check dams or how this will be funded. Given the high costs involved in clearing the check dams, efforts to reduce sediment export from the catchment could result in significant avoided sediment removal costs. Furthermore, increased protection of the vegetation and soils of the catchment area will be essential to avoiding elevated water treatment costs.

To mitigate the threat of sedimentation, two large check dams have been planned to trap sediments upstream of the Mwache Dam.

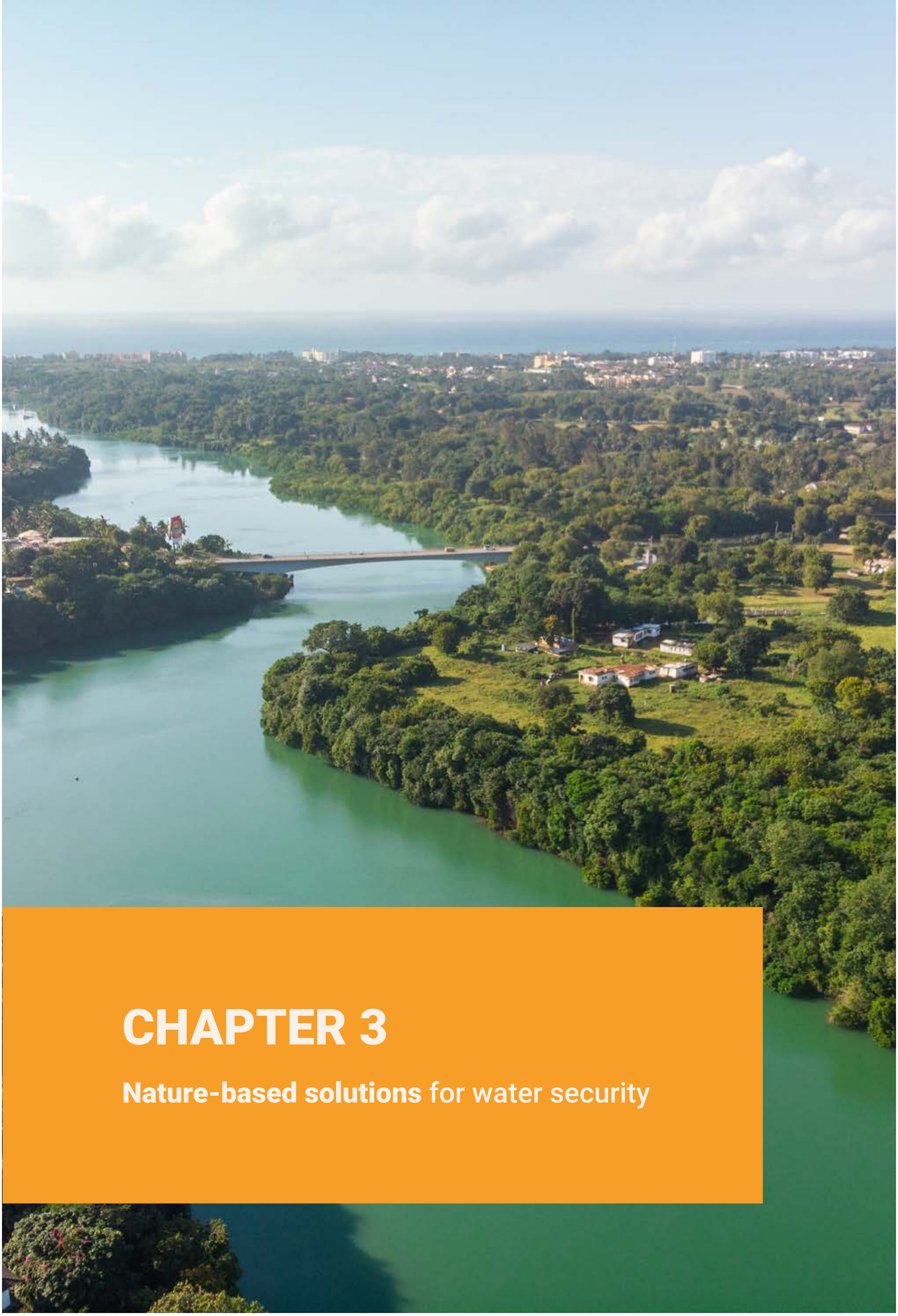
Figure 6. Schematic of the movement of sediment into and between check dams and the Mwache Dam, and the estimated rate and cost of excavation from the check dams, based on Brune's Method. Source: Diagram adapted from Nippon Koei (2018).



The Mzima Springs are fed by water from the Chyulu Hills volcanic aquifer. The aquifer's recharge area is around 2,000 km2, most of which is in Makueni County. The cloud forests of Chyulu Hills play a vital role in capturing rainfall and condensation (from mist) that infiltrates into the un-derground aquifer. The Chyulu Hills National Park covers the eastern portion of the hills and adjoins the Tsavo West National Park to the southwest. Pasto-ralism is the dominant livelihood on the western side of the Chyulu Hills, making way for crop production in some parts. On the eastern side, small-scale subsistence agriculture dominates. This area also includes the main Nairobi-Mom-basa highway and its associated towns and businesses.

Water supply from the Mzima Springs is threatened by deforestation. Continued loss in forest cover is expected to lead to a significant decline in rainwater infiltration rates and a reduction in the amount of water that is discharged from the aquifer at the springs. Therefore, measures to halt and reverse the loss of forest cover are essential to protect the significant infrastructure investments being undertaken and to safeguard future water security for the region.

Figure 7. The volcanic mountain range and cloud forests of the Chyulu Hills. Photo: artofsafari.travel/.



CHAPTER 3

Nature-based solutions for water security

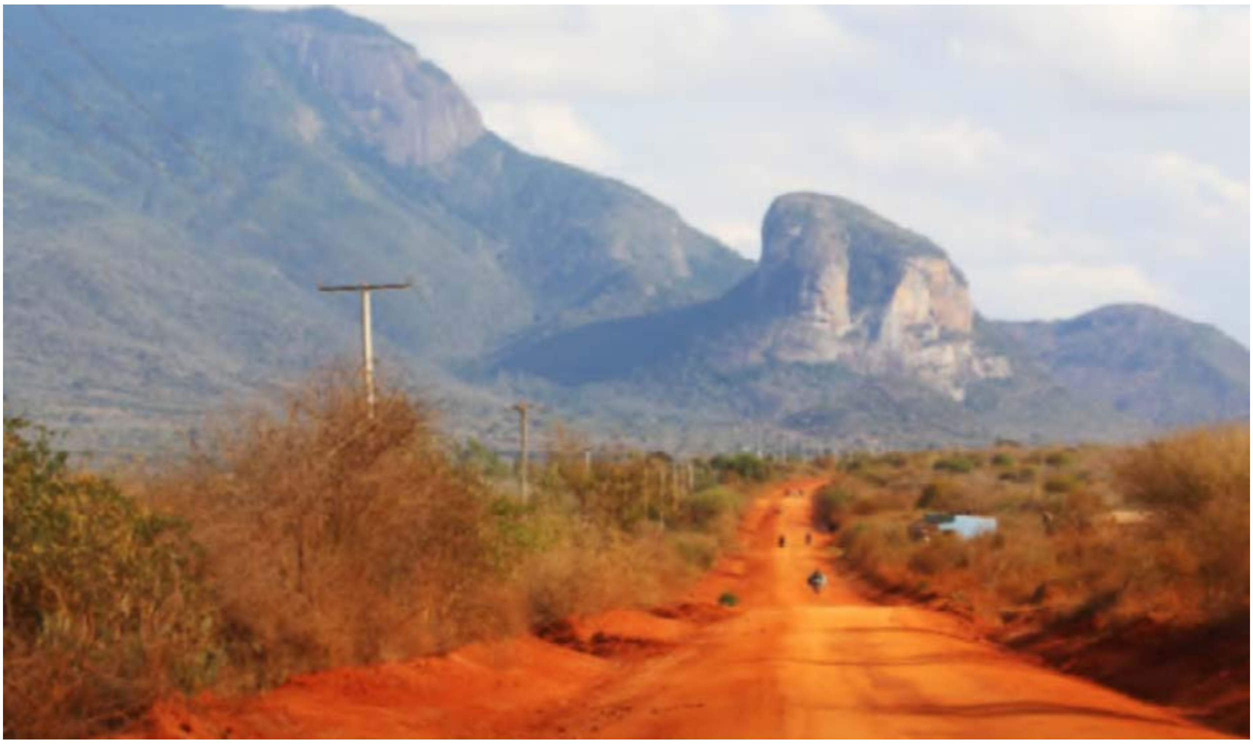
Mwache Dam Catchment Area

In the Mwache Dam catchment, the focus of nature-based solutions would be on reducing soil erosion, given this is the primary threat to sustainability. This will help mitigate the threat of sedimentation to water quality and the future water storage capacity of the dam. The premise behind this approach is that addressing soil erosion at source will be cheaper than removing sediment once it reaches the check dams or main reservoir. This will also reduce water treatment costs by reducing loads of suspended solids and other pollutants. The proposed solutions also have the potential to improve livelihoods through increased agricultural productivity and expanded opportunities for the generation of income through nature-based tourism. Some of the proposed interventions will also contribute to carbon sequestration and biodiversity conservation.

Based on the likely effectiveness of a range of potential measures, the biophysical characteristics of the catchment, land use activities, and the likely acceptability of different options under the socioeconomic and institutional context, the following combination of environmental management measures is proposed:

1. Active rehabilitation, which includes planting appropriate trees and grass in badly degraded riparian and roadside areas and restoring tree cover in deforested areas.
2. Soil erosion control (SEC) interventions on farmland, including cover crops, reduced and no-tillage approaches, agroforestry, and terracing, with different combinations of in-terventions proposed depending on slope.
3. Sustainable natural resource management, which includes sustainable rangeland management, sustainable use of fuelwood, and the managed recovery of degraded areas.
4. Conservation of important natural areas, which includes protection of all riparian zones and the establishment of community wildlife conservation areas (i.e., potential expansion of conservancy areas) in larger blocks of remaining natural vegetation that are not currently protected.

Figure 8. View of Mount Kasigau, in Rukanga, in the far western corner of the Mwache catchment. Photo: JK Turpie View of Mount Kasigau, in Rukanga, in the far western corner of the Mwache catchment. Photo: JK Turpie

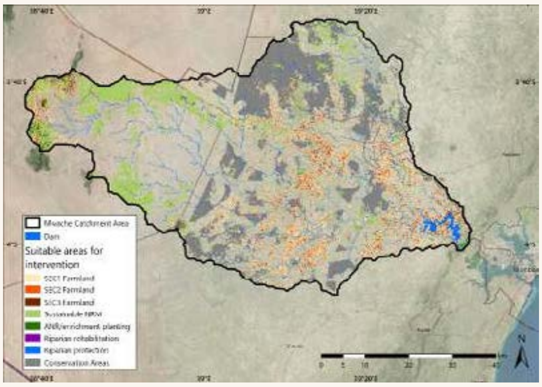


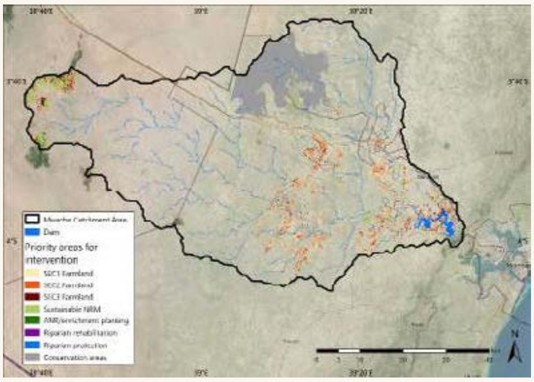
The proposed portfolio of interventions in the Mwache Dam catchment (see Box 1 for how this was determined) will cover just over 43,000 ha, with a total cost (expressed in present value terms) of $31.3 million (Table 1). The sus-tainable natural resource management and conservation intervention includes costs for the planning and implementation of a PES-type scheme in the western group ranch areas of the Mwache Dam catchment.1 While this would take the lion's share of the budget due to the size of the area over which it would be implemented, it has the lowest per hectare cost compared with the other interventions (Figure 9).

BOX 1

Suitable areas for the selected environmental management measures were mapped in Geographic Information System software using a combination of datasets, including for areas where deforestation and land degradation have occurred. However, the return on investment (ROI) of these interventions varies across the catchment due to variations in both costs and benefits. We therefore identified priority areas for the interventions based on the ROI (sedimentation avoided per dollar spent). Prioritising intervention areas in terms of ROI provides the most cost-effective plan for any given budget. Given that the budget constraint was unknown, we included all areas up to the point of inflection where the ROI starts to diminish more rapidly. Beyond this point, the ROI for additional intervention areas becomes increasingly less likely to compete with the ROI for grey infrastructure interventions.

Estimating the spatial variation in ROI involved modelling the percentage change in sediment export from the landscape after the implementation of the proposed interventions across all potentially suitable areas using the Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) Sediment Delivery Ratio (SDR) model. Resulting changes in sediment export to the dams in physical terms was based on previous studies, which used the Soil and Water Assessment Tool. The prioritization of sites for intervention was carried out using the Restoration Opportunities Optimization Tool.



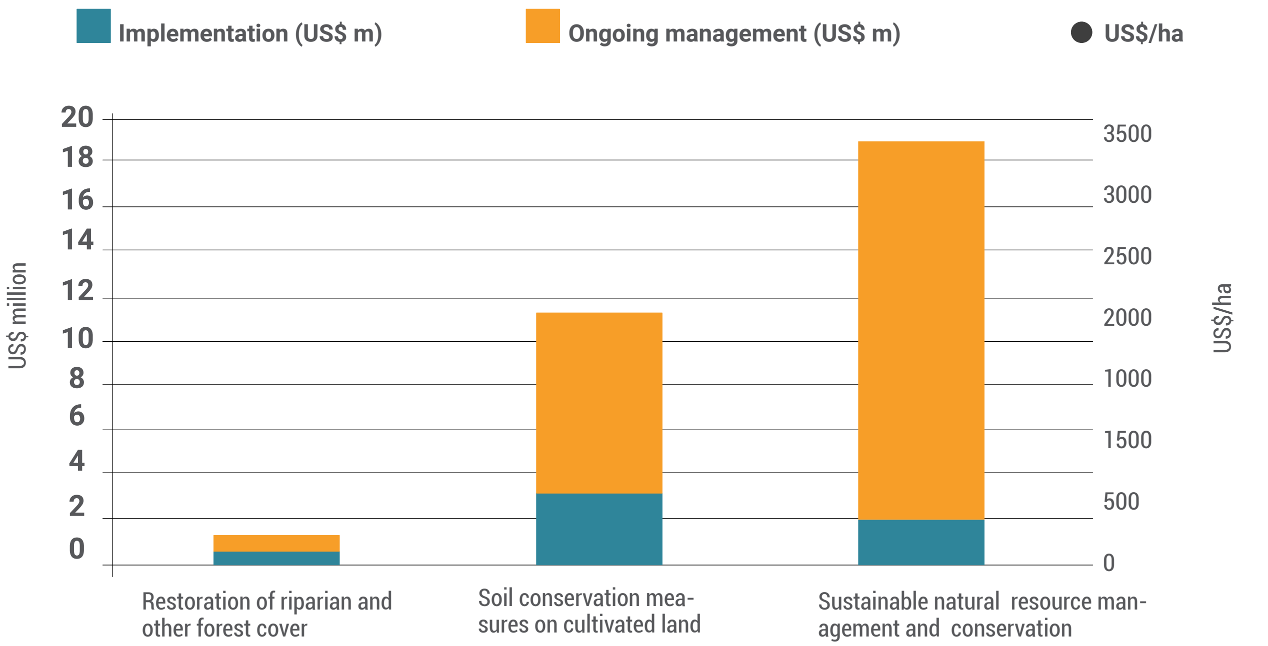


1. Costs are based on ongoing annual costs (opportunity costs) of around $68/ha/y. Included in this figure is the management cost (effective policing and protection) of $9/ha/y.

Table 1: The areal extent and cost (expressed in present value terms; 2021 US$ millions, 6.52% discount rate, 30 years) of proposed interventions in the Mwache Dam catchment

Intervention	Area (Ha)	Cost (US$ million)
Restoration of riparian and other forest cover	585	1.3
Soil conservation measures on cultivated land	12,444	11.2
Sustainable natural resource management and conservation	30,231	18.8
Total		**31.3**

Figure 9: Total and per hectare costs (in present value terms, 2021 US$ millions, 6.52% discount rate, 30 years) of proposed interventions in the Mwache Dam catchment.



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Mzima Springs Recharge Area

In the Mzima Springs recharge area, the focus of na-ture-based solutions would be on reducing deforestation and rangeland degradation in the Chyulu Hills, thereby aiming to restore and secure the groundwater recharge capacity of the area and avoid future declines in the amount of water that can be extracted from the Mzima Springs.

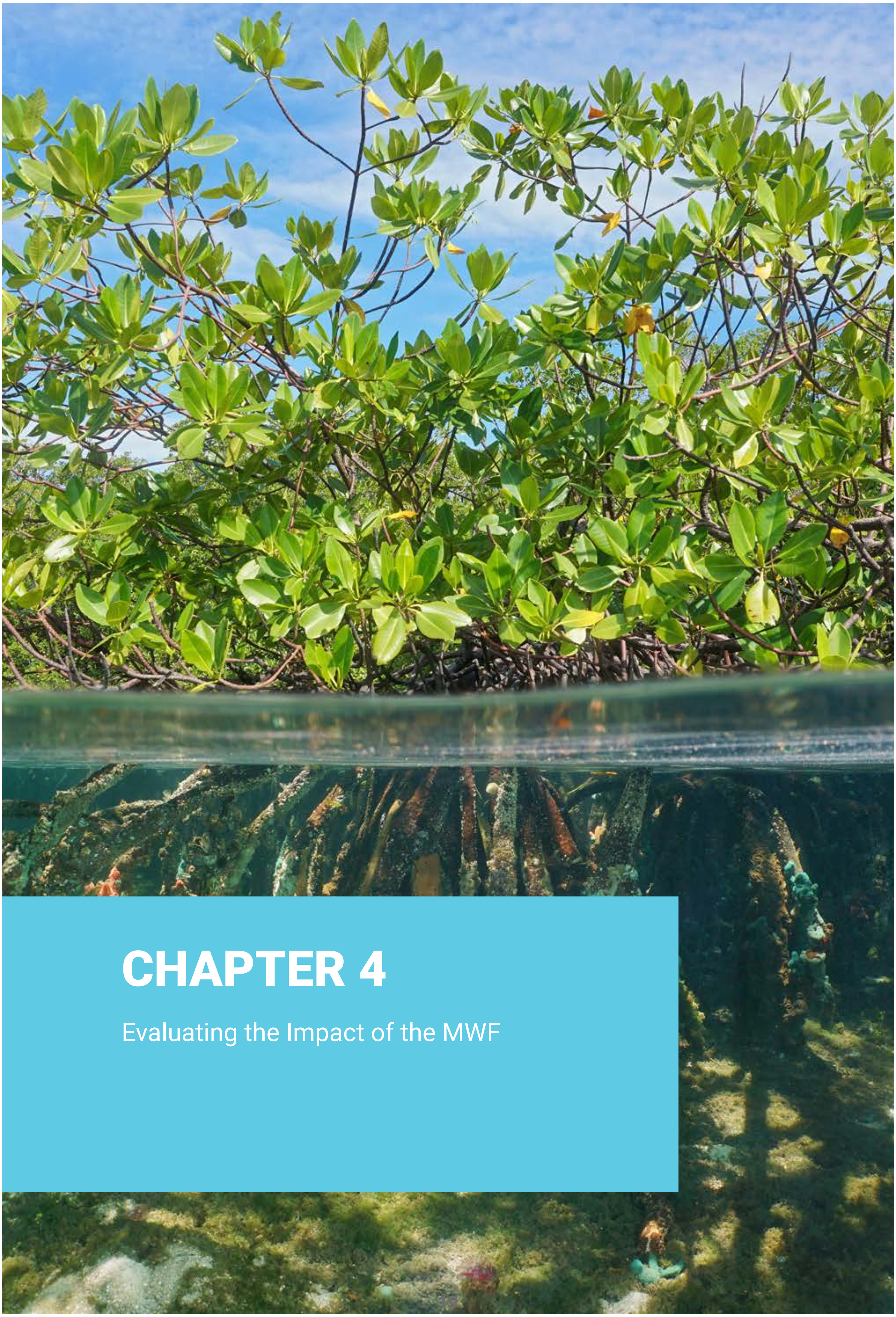
While efforts have already been made to address forest and rangeland degradation problems in the recharge area through the establishment in 2013 of a REDD+ Project by the Chyulu Hills Conservation Trust,[2] further investment is needed to ensure water security. Although the project has already generated $12 million from the sale of carbon credits and is expected to generate another $30 million in its next phase (Chris White, pers. comm.), financial analysis suggests that further income streams are needed to achieve the level of conservation required (GNIplus, 2021). The addition of payments for hydrological services to the revenue stream (which also includes ecotourism, phi-lan-thropy, and government support) would help achieve this, as well as smooth funding flows.

The MWF could contribute to the successful protection of the geohydrological functioning of the recharge area through transfers to the Chyulu Hills Conservation Trust. The project area covers about 4,100 km^2, of which the Chyulu Hills Water Tower[3] makes up a quarter. This would help the trust provide a steadier flow of payments and support to communities in return for conservation action. Based on GNIplus (2021), additional funding of $6.3 million per year is needed to meet the REDD+ objectives of halting and partially reversing deforestation in the Chyulu Hills, amounting to $72 million (in present value terms) over a 30-year period.

The **focus** of nature-based solutions would be on reducing deforestation and rangeland degradation in the Chyulu Hills, thereby aiming to restore and secure the groundwater recharge capacity of the area and avoid future declines in the amount of water

2 Nine stakeholder partners make up the Chyulu Hills Conservation Trust. Six of the partners have title to all the land in the REDD+ project area. This is made up of Chyulu Hills National Park and a section of Tsavo West National Park, gazetted to Kenya Wildlife Service; the Kibwezi Forest Reserve, titled to Kenya Forest Service; and four communally owned Maasai group ranches (Kuku, Kuku A, Imbirikani, and Rombo). The other three trustee partners are local NGOs: the Sheldrick Wildlife Trust, Maasai Wilderness Conservation Trust, and Big Life Foundation.

3 Kenya's main water source areas are called water towers. The Chyulu Hills Water Tower encompasses the Chyulu National Park, Tsavo West National Park, Kibwezi Forest Reserve, and the Mbirikani and Kuku Group ranches. It traverses Makueni, Taita Taveta, and Kajiado counties, and covers 110,945 ha, of which about 7,895 ha is protected (Kenya Water Towers Agency, 2020).



CHAPTER 4

Evaluating the Impact of the MWF

Water Security Benefits

The proposed nature-based solutions in the Mwache Dam catchment and Mzima Springs recharge area could col-lectively lead to avoided water supply costs amounting to over $6 million per year.

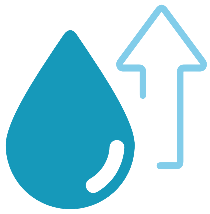
Interventions in the Mwache Dam catchment are expected to reduce the costs of managing sedimentation of the check dams, maintain higher dam yields and reduce water treatment costs, as follows:

- Modelling carried out using the InVEST S DR tool suggests that the proposed Mwache Dam catchment interventions could reduce sediment export by at least 16% relative to business as usual (BAU). A major benefit of this would be the reduction in the costs of clearing sediment from check dams. Based on the estimated sedimen-ta-tion rates and annual costs of clearing sediment from the check dams in the design report, the proposed soil conservation measures could save approximately $1.23 million per year in bulk water supply system management costs.

- In addition, the Water Evaluation and Planning (WEAP) hydrological modelling tool was used to estimate how the conservation measures would impact the yield of the Mwache Dam, taking into account changes in flows in the catchment and the residual sedimentation of the Mwache Dam, which is not entirely protected by check dams. This suggested that yield would increase by 1.1% relative to the BAU scenario. In other words, yield will decline more slowly over time, saving on having to make up this difference from the next best al-ter-native, which is likely desalination. Thus, the in-ter-ventions could result in additional water supply cost reductions of $750,000 per year by 2030.

- The WEAP model was also used to estimate how the interventions would affect the quality of water entering the dam, notably the loads of phospho-rous and total suspended solids (TSS). A reduction in TSS sediments and associated nutrient inputs decreases the need for flocculation, filtration, and backwashing in the water treatment process. Based on an assumed daily water treatment capacity of 140,000 m3 for the proposed treatment plant,[4] the reduction in TSS and phos-phorous resulting from the proposed catchment management interven-tions is expected to avoid annual water treatment costs of $850,000.[5]

Interventions in the Mzima Springs recharge area are expected to avoid the reduction in yield from the springs, saving on grey infrastructure costs needed to make up the shortfall. Estimating the benefit of reducing deforestation and degradation was based on hydrological modelling using the WaterWorld spatial model and an accompanying risk assessment carried out for a recent feasibility study for im-plementing payments for hydrological services in the Chyulu Hills area (GNIplus 2021). That feasibility study considered how a change in land use and management in the Mzima Spring recharge area might affect water supply at the spring. The study found that several risk factors have a high likelihood of occurrence and could have severe and unmitigable impacts on water supply if deforestation of the cloud forests continues at current rates. However, these effects could not be accurately quantified using available data. Therefore, based on expert opinion, it was conserva-tively assumed that under a BAU scenario, yields would be reduced by at least 25% relative to an intervention scenario. The value of this 25% increase in water supply compared with the BAU scenario, which would be brought about by augmenting existing efforts to incentiv-ize conservation action in the Mzima Springs recharge area, was estimated to be at least $3.26 million per year.[6] This assumes that the Chyulu Hills REDD+ project operational model is also strengthened.



The value of this 25% increase in water supply compared with the BAU scenar-io, which would be brought about by augmenting existing efforts to incen-tivize conservation action in the Mzima Springs recharge area, was estimated to be at least

$3.26 million

per year

4 This is the reported capacity of the proposed water treatment works attached to Mwache Dam (https://www.afd.fr/en/carte-des-projets/mwache-water-treat-ment-plant-mombasa), which translates into a mean monthly treatment volume of 4,256 megalitres.

5 These are approximate estimates since water quality is not closely monitored, their impact on raw water quality depends on dam conditions, and the dam and water treatment plants are yet to be built. Avoided costs were therefore estimat-ed using a value transfer approach based on a model developed by Turpie et al. (2017) using monthly data.

6 Using the unit cost of desalination ($1/m3) to value avoided reductions in water supply from Mzima Springs.

Additional Benefits of Restoration and Conservation

There are several additional benefits that could arise from the MWF's interventions, through changes in ecosystem condition, and the supply of ecosystem services other than those that are directly associated with formal water supply. These co-benefits include tangible livelihood benefits obtained by rural households from increased crop production, income and employment benefits from tourism and recreational activities, and avoided climate change costs to local and global society through retention of intact natural ecosystems.

Change in Agricultural Productivity

Most of the Mwache Dam catchment is dry with low agricultural potential, and the area is prone to periodic food shortages. Maize is the staple food crop grown by most farmers. Maize yields are significantly lower here than in other (wetter) parts of Kenya (MoALF, 2016).

Total crop production from the catchment is estimated to be about 21,700 tonnes per year, with an estimated value of $11.5 million per year.[7] If it is conservatively assumed that implementation of on-farm soil conservation interventions, which would reduce soil losses and improve water retention, would increase yields in the project sites by 25%,[8] this would result in an increase in an annual crop production value of $1.1 million relative to a BAU scenario.

Nature-Based Tourism

Nature-based tourism is the backbone of the tourism industry in Kenya and is a key contributor to socioeconomic development. In the Chyulu Hills, ecotourism is an important income generator, and the Mzima Springs site is also a major tourist attraction in the region. There is limited ecotourism in the upper Mwache Dam catchment, where wildlife conservancies have been established in the corridor area between Tsavo West and Tsavo East National Parks. This has seen the development of several small tourist lodges and community tourism projects. The rest of the catchment, outside of these wildlife conservancies, is less suited to ecotourism.

We estimated that in 2019, nature-based tourism in Mwache Dam catchment and the Mzima Springs recharge area contributed $8.8 million and $11.7 million, respectively, to tourism expenditure, together making up 1.2% of the total attraction-based tourism spend in the country. The per hectare spend was highest in the protected areas, with values as high as $105/ha in Tsavo West and averaging just $17/ha outside the protected areas.

Restoration, improved protection, and the establishment of community wildlife conservation areas should result in the expansion of wildlife habitat and an increase in the number of wildlife, with these areas having an opportunity to increase in value over time to more align with values seen in the surrounding conservancies and protected areas. In the Mwache Dam catchment, tourism spending[9] was expected to increase by about $2.84 million annually by the end of the 30-year analysis period compared with the BAU scenario. The gains were estimated to be slightly higher in the Mzima Springs recharge area, at $3.07 million per year by 2050 when compared with the BAU scenario.

7 Maize yield of 0.561 tonnes/ha for Kwale County (MoALF, 2016) at a mean price of KSh 49.20/kg (KNBS, 2019b).

8 This is a conservative estimate relative to the higher estimate by Liniger et al., (2011) of 100-150%.

9 Estimated in terms of direct value added to GDP, this is in-country spend only. A combination of national and subnational tourism data and the density of geotagged photographs uploaded to the internet were used to estimate tourism spending in and around the study area.

Carbon Storage and Sequestration

Natural systems play a critical role in the global carbon cycle. Based on global datasets derived from satellite data (FAO and ITPS, 2018; Spawn & Gibbs, 2020), it was estimated that approximately 17.1 million tonnes of carbon (tC) are stored within the vegetation and soils of the Mwache Dam catchment. Under the current trajectory, about 382,600 tC could be lost over the 30-year analysis period. The analysed nature-based solutions would not only avoid this BAU degradation of carbon stocks but would also increase current carbon sequestration and storage through agroforestry, farmer-managed natural regeneration, and active restoration, resulting in net gains of 467,000 tC compared with the BAU scenario. This would result in annual avoided climate-related damage costs of about $22 million at a global scale and some $300,000 to Kenya . Furthermore, the establishment of a community wildlife conservation area in the central northern part of the catchment would link the adjacent Tsavo East National Park and the existing Shirango Conservancy to other Tsavo Region conser-vancies and the Wildlife Works Kasigau Corridor REDD+ Project ranches in the west.[10] This conservation area covers about 20,000 ha and could, through the Kasigau Corridor REDD+ Project, generate annual earnings of $200,000 through the sale of carbon credits.[11]

According to information extracted from the Chyulu Hills PES feasibility study (GNIplus, 2021), approximately 5.3 million tC are stored within the forest and grassland areas of the Chyulu Hills. We estimated that 8.1 million tC could be gained relative to a BAU scenario through sustainable forest management, worth $416 million at a global scale and $600,000 to Kenya in avoided climate-related damage costs. In addition to the avoided costs related to damage from climate change, the residual gains in carbon relative to the BAU scenario, as a result of halting deforestation and ensuring afforestation of some 58,000 ha through the water PES scheme, could be worth about $2.3 million per year at current market prices for carbon.[12]

The Viability of the MWF

The costs and benefits of the proposed MWF restoration and conservation interventions described above were analysed over 30 years at a social discount rate of 6.52% (see Addicott, Fenichel & Kotchen, 2020) to determine their potential overall net benefit and ROI (net welfare gains per US$ invested). The robustness of these figures was also tested using a sensitivity analysis.

Contributions to the Chyulu Hills PES scheme through the MWF to ensure protection of the cloud forests could generate benefits totalling $92 million over the 30-year time frame (Table 2). This represents an ROI of about $1.30 in benefits for every dollar spent. However, the benefits could be far greater than this, as the Chyulu Hills also support significant bio-diversity and wilderness areas, both of which are highly valued by Kenyan citizens and the global society and which contribute to Kenya's biodiversity conservation commitments. There is a great number of people, including many who may never visit the area, who would have a positive willingness to pay for conservation of this landscape. These non-use values could greatly exceed the tourism value of this area.

10 In 2011, the Wildlife Works Kasigau Corridor REDD+ Project was successfully validated and verified under the Verified Carbon Standard and the Climate, Community and Biodiversity Standard. Today, there are 16 conservancies participating in the project, with over 200,000 ha of forest and bushland protected, securing the wildlife migration corridor between the Tsavo East and Tsavo West national parks.

11 Based on 1.6 million tonnes of mitigated carbon annually with gross earnings from carbon credit sales of KSh 360 million (~$3.2 million) in 2018 and 2019 (TTWCA; 2020).

12 Based on sales of carbon credits made through the Chyulu Hills REDD+ Project to date (GNIplus, 2021).

Investments in the Mwache Dam catchment are expected to have even better returns. Here, a $31 million investment in restoration interventions is expected to return at least $65 million in economic benefits over the 30-year time frame (Table 2). In other words, every $1 invested by the water fund is expected to generate at least $2.10 of included benefits to stakeholders. Again, in addition to the water security and tangible co-benefits included in the calculations, this would also come with some biodiversity benefits, in that improved conservation in the upper area of the catchment would increase wildlife habitat and the connectivity of conservation areas in the region.

Figure 10. The establishment of conservancies in the western area of the Mwache catchment has led to greater connectivity between the Tsavo West and Tsavo East national parks, creating corridors for the movement of wildlife. Photo: LJ Wilson.

Taken together, the overall investment costs would amount to $104 million, with returns of $157 million, resulting in a net present value of $53 million and an ROI of 1.5 (Table 2). Figure 11 shows how the benefits, costs, and net annual benefits are anticipated to be realized over time for the Mwache Dam catchment and Mzima Springs recharge area.

Table 2. Present value of the costs of interventions and value of ecosystem service benefits for Mwache Dam catchment and Mzima Springs recharge area (2021 US$ millions, 6.52% discount rate, 30 years).

	Present value (US$ millions)		
Intervention	**Mwache Dam catchment**	**Mzima Springs recharge area**	**Combined**
Costs			
Restoration of riparian and other forest cover	1.3		1.3
Soil conservation measures on cultivated land	11.2		11.2
Sustainable natural resource management and conservation	18.8		18.8
Community forest management: Chyulu Hills Water PES	-	72.5	72.5
Total present value of costs	**31.3**	**72.5**	**103.8**
Benefits: Mwache Dam catchment			
Impacts on water yield	6.9	-	6.9
Savings on check dam dredging	11.9	-	11.9
Avoided water treatment costs	8.2	-	8.2
Production gains from agriculture interventions	12.9	-	12.9
Carbon gains*	2.3	-	2.3
Increase in tourism and recreation opportunities	23.2	-	23.2
Benefits: Mzima Springs recharge area			
Impacts on water yield	-	31.3	31.3
Carbon gains*	-	32.5	32.5
Increase in tourism and recreation opportunities	-	27.8	27.8
Total present value of benefits	**65.4**	**91.6**	**157.0**
Net Present Value	**34.1**	**19.1**	**53.2**
ROI	**2.1**	**1.3**	**1.5**

* These results include the market value of carbon (if sold through the Chyulu Hills REDD+ Project or the Wildlife Works Kasigau Corridor REDD+ Project), as well as the avoided costs to Kenya for damage associated with climate change.

Under varying assumptions of costs and benefits and timing and discount rates, the results of the analysis remain favourable, but only in some cases. Changing the assumption around agricultural yields to be more conservative reduced the ROI to 1.4, and removing community conservation areas increased the ROI slightly to 1.5. The ROI for the Mwache Dam catchment remains positive at 1.3 even when tourism benefits are excluded from the analysis. However, while the net benefits remain positive under varying assumptions, the overall viability of the MWF is sensitive to changes in the timing of benefits as well as in terms of the costs of interventions. Increasing costs and decreasing the benefits by 15% dropped the ROI to 1.1, and delaying restoration benefits by a further three years dropped it to 1.2, with a net present value of $9.6 million and $19.1 million, respectively.

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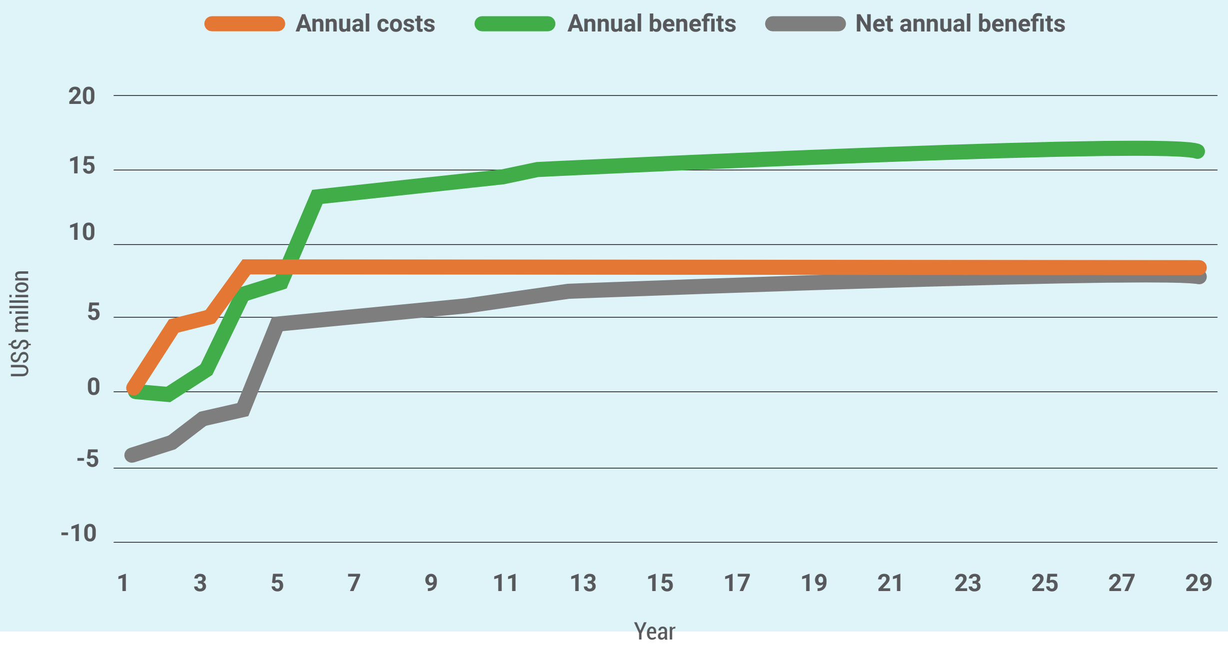
Figure 11. Total annual benefits and costs over time for the extended analysis of the Mwache Dam catchment and Mzima Springs recharge area (2021 US$ millions, 30 years)..



Expanding forest protection, actively restoring degraded forest areas and rangelands, and fostering community support for sustainable agriculture in the eastern community areas and improved grazing and rangeland management in the pastoralist areas in the Chyulu Hills could bring wider benefits beyond securing water supply and quality. These include growing nature-based tourism, improving climate change resilience, creating jobs, expanding opportunities for women and, most im-portantly, avoiding the irreversible loss of the unique and valuable bio-diversity of this area. While the overall viability of the MWF could be sensitive to changes in the timing of benefits as well as in terms of the costs of interven-tions, the sensitivity analysis shows that even under these conditions, economic viability can still be maintained.

The following key results demonstrate the importance of catchment restoration and conservation and the feasibility of establishing the MWF. Compared with a BAU scenario, investing in catchment ecological infrastructure would yield the following returns:

1. The amount of sediments entering the rivers of the Mwache Dam catchment would be reduced by around 16% (109,000 tonnes), with an annual cost savings in terms of dredging sediment check dams of $1.23 million per year.
2. A 1% loss in average annual water yield from the Mwache Dam catchment could be prevented, translating into avoided costs of $380,000 per year for the first five years, $420,000 per year for the next five years, and $750,000 per year after that.
3. Losses of at least 25% in water yield from the Mzima Springs could be prevented, trans-lat-ing into avoided costs of at least $3.26 million per year.
4. The amount of phosphorous and TSS entering the rivers of the Mwache Dam catchment could be reduced by 70% and 50%, respectively, with annual avoided water treatment costs of around $860,000 .

5 Agricultural interventions implemented on cultivated land could increase agricultural productivity through improved crop yields, generating increases in annual returns of $1.07 million to farming households.

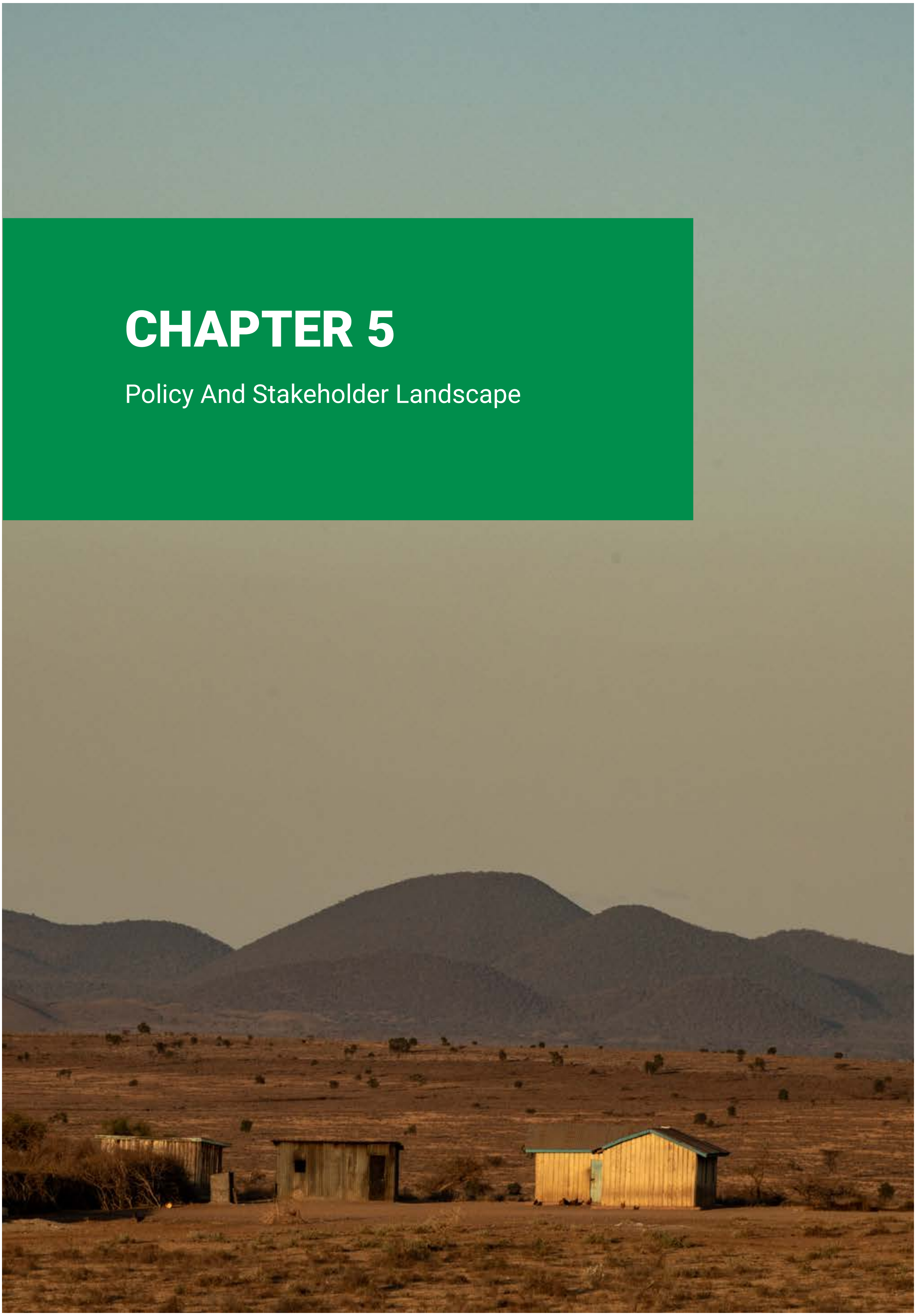
6 Carbon stored in the study area would be 9.1 million tonnes higher over the 30-year study horizon, avoiding estimated annual climate change damages of $640,000 to Kenya and $438 million at a global level, with a current carbon market value of $2.5 million per year.

7 Increased tourism related spending across the study area could amount to $5.9 million annually by 2050.

8 Nature-based solutions will improve the pollination of crops in nearby fields by insect pollinators that are supported by natural habitats; cultural values derived from improved community forest management in Kwale County; nutritious (and income-earning) fruit from fruit trees planted in agroforestry systems; human and livestock health benefits associated with the cooling services provided by agroforestry systems; and the potential health benefits as a result of reduced coliform loadings into waterways through rehabilitation of riparian buffers.

CHAPTER 5

Policy And Stakeholder Landscape



Compatibility of the MWF with Existing Policy and Legal Instruments

While water funds are not explicitly anchored in any existing policy or legislative instruments in Kenya, the concept is nevertheless compatible with existing legal frameworks. The envisaged MWF could help realize goals and visions for conservation and water resource management enshrined in several official policies, acts, strategies, and plans. For example, the MWF aligns with several objectives identified in the National Water Policy, including protecting and securing sustainable water supplies and suitable financing systems for water resource management, including an emphasis on the role of public-private partnerships. Meanwhile, objectives of the National Environment Policy include the promotion of part-nerships in the protection and sustainable management of the environmental management, and the use of innovative conservation approaches, such as conservation incentives like PES. The Land Reclamation Policy seeks to increase public investment in addressing land degradation, while also calling for the creation of enabling environments for increased private investment in land rehabilitation, primarily through public-private partnerships. The water fund can capitalise on these and other existing frameworks to engage and partner with governments, the private sector, and communities in watershed conservation and management. It could provide an innovative financing mechanism and a coordinating framework to assist with meeting important strategic goals for the country and helping various government institutions fulfil their constitutional mandates. Further detailed analysis of the legal and policy framework related to the water PES is included in the Chyulu Hills PES Baseline Report (GNIplus, 2021).

Key Stakeholders in a Mombasa Water Fund

This study identified various stakeholders of relevance to the MWF. The fund will have to grapple with a complex institutional landscape surrounding water resources in the counties that contribute to or benefit from the water sources that serve Mombasa. Several stakeholders will be key to the success of the MWF, most of which are briefly described below. A number of these stakeholders are already represented on the fund's interim steering committee.

Government Stakeholders

Nationally, the Water Resources Authority (WRA) and Water Services Regulatory Board (WASREB) will be important for winning high-level support for the fund. The WRA has already been active in the Mwache Dam catchment, un-der-taking riparian conservation measures in conjunction with the (CDA). Meanwhile, WASREB is the only body with the authority to approve tariff changes, which could be an important source of revenue for the MWF if part of the cost of conservation activities is integrated into water tariffs. This Business Case recommends a change of tariff to include a KSh2/kl of water for conservation. At the highest level, the Ministry of Water, Sanitation, and Irrigation can play a role by providing and attracting funding, especially since it is the overall implementing agency for the Mwache Dam project and therefore has a high vested interest in extending the dam's lifespan. The Kenya Wildlife Service (KWS) is also an important stakeholder, particularly for the Mzima Springs recharge area, a large portion of which falls within national parks.

Regionally, the CDA is another key stakeholder. As an im-ple-menting partner in the Mwache Dam project, the CDA has a large interest in addressing the threat of sedimenta-tion to the dam's lifespan and has already done extensive work on catchment rehabilitation. Given its experience with the catchment, it can thus provide valuable technical expertise to the fund. The CWWDA, responsible for the bulk water system, is another essential stakeholder. The joint multi-county authority meant to take over bulk water provision from the CWWDA in the future will be integral to the fund once it is constituted.

At the local level, the Mombasa County Government and MOWASSCO have the greatest interest in sustaining water supply from the Mwache Dam, given that Mombasa is set to receive most of its water. However, because the entire dam catchment lies outside its area of jurisdiction, the main role of the Mombasa County Government will be to provide support to the MWF to conduct these activities in the neighbouring counties.

The county governments of Mombasa, Kwale and Taita Taveta all have an incentive to support conservation activities in the Mzima Springs recharge area, since all three counties are set to benefit from the augmentation of this water source. Kwale also has some incentive to support interventions in the Mwache Dam catchment, as it will receive water from the dam, albeit a much smaller allocation than Mombasa. Taita Taveta, however, has no direct incentive to support interventions in the Mwache Dam catchment, as it is not set to receive water from the dam.

Nevertheless, several of the proposed interventions for the Mwache Dam catchment are in line with county government mandates for environmental protection and management . The Kwale and Taita Taveta county gov-ern-ments might therefore consider co-financing interven-tions under the MWF to improve the livelihoods of their citizens and fulfil their constitutional mandates. They could also provide technical and advisory support to the MWF, such as through secondment of staff.

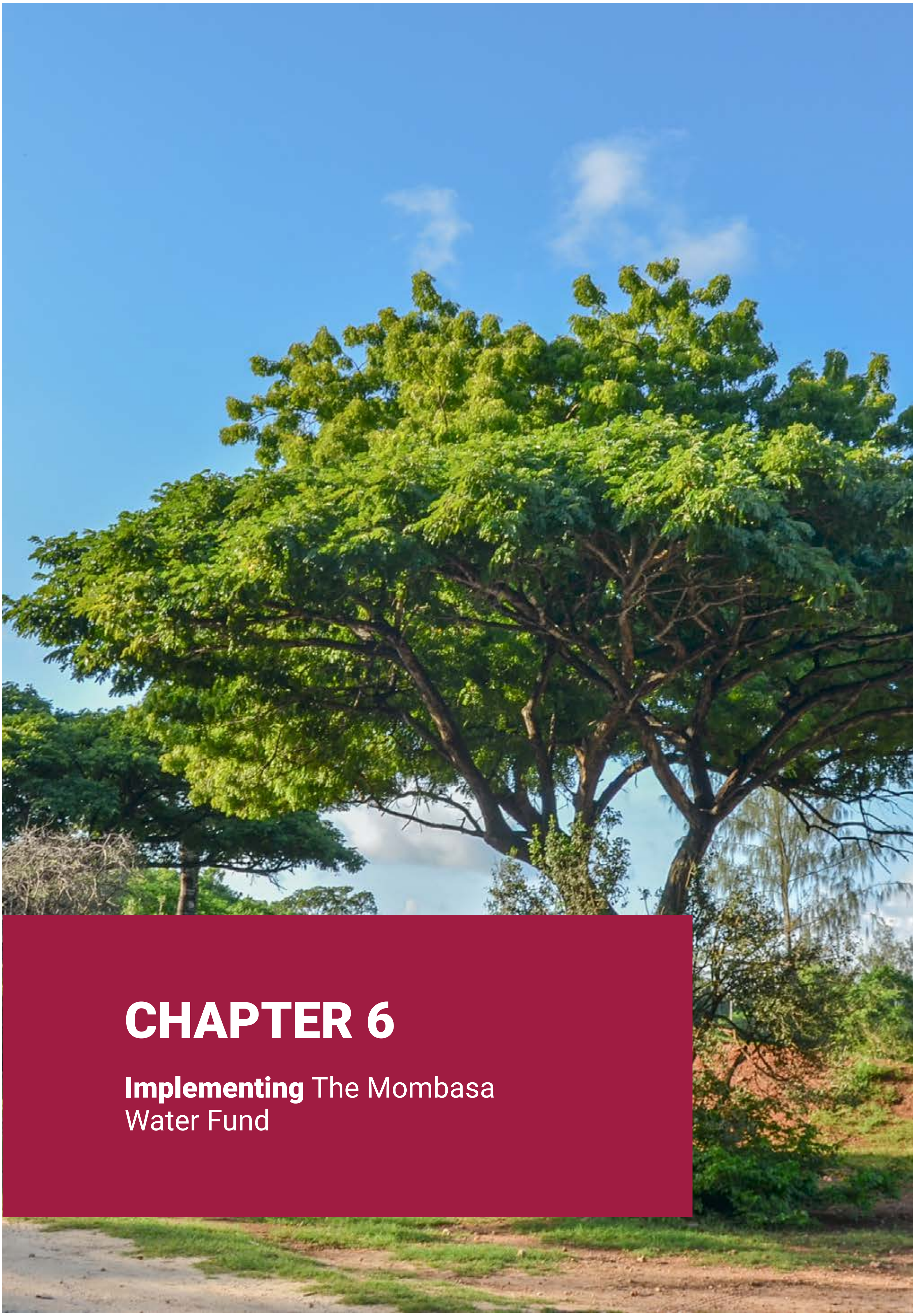
Various other government agencies and research insti-tu-tions could also provide valuable advisory support to the fund, even if they will not directly benefit from it. To name a few, these include the Kenya Forest Service (KFS), Kenya Wildlife Service, Kenya Agricultural and Livestock Research Organization, and Kenya Forestry Research Institute.

Private Sector, Donor, and NGO Stakeholders

It is envisaged that major private sector water users might support the MWF as a way of securing future water supplies to sustain their business activities. These include major manufacturing companies such as Coastal Bottlers Limited/Coca-Cola and Bamburi Cement, as well as large tourist establishments. While Mombasa's unreliable supply of water has forced large businesses to primarily rely on securing their own supplies of water through boreholes or by purchasing from water bowsers, these are not optimal long-term solutions. Water provided by bowsers is very expensive, while the proliferation of boreholes and the lack of a functional sewage system in Mombasa mean that water table drawdown, salinization, and contamination are serious threats to the use of borehole water. Although es-ta-blished boreholes may continue to provide a cheaper and more reliable source of water to major private consumers in the short-term, the risks of salinization and contamination threaten the long-term sustainability of this water supply source (Idowu et al., 2017), particularly for companies like Coastal Bottlers that depend on potable water. Thus, for-ward-thinking private companies may support the MWF as a way of mitigating business risk by diversifying and securing alternative sources of water to sustain their business activities over the longer term.

The World Bank, funders of the new water supply infra-struc-ture, will have a vested interest in the MWF's contri-bution to the protection of its investments. Donors and financing institutions, motivated by developmental or biodiversi-ty conservation benefits, are also key potential sources of financial support to the MWF. Several donors already have a track record of funding similar initiatives in Kenya, as evidenced by their support for the Upper Ta-na-Nairo-bi Water Fund. Importantly, donors and financing institu-tions will likely be more willing to contribute to the fund if they feel there is also adequate buy-in and support from government stakeholders. Finally, NGOs could also have an important role to play in the fund, particularly as partners for implementing the proposed sustainable land management activities on the ground.

Figure 12. View from the western edge of the Mwache Dam catchment towards the Taita Region conservancies. Photo: LJ Wilson.



CHAPTER 6

Implementing The Mombasa Water Fund

Implementation Models

Implementation of the restoration and conserva-tion activities can be undertaken using different types of incentive- and assistance-based approaches. The Business Case proposes a range of complementary and mutually supportive types of assistance to be funded to bring about the land and resource management inter-ven-tions required in different parts of the two priority water source areas. These include the following:

- Direct assistance to farmers in Mwache catchment to implement and maintain soil conservation measures, by the Kwale County government and with the assistance of an NGO.
- Establishing and financing environmental restoration teams that include trained core personnel and locally employed labour to undertake vegetation restoration and rehabilitation measures, particularly in the Mwache Dam catchment.
- Setting up PES or PES-like schemes in the Mzima Springs recharge area (Chyulu Hills water PES scheme) and the Mwache Dam catchment (within the western pastoral/ conservancy landscape) to incentivize the resto-ration and maintenance of woody resources and rangeland ecosystem health.
- Encouraging and assisting with the establishment of new conservancies and other community or landowner associations that might be incentivized by and able to benefit from PES-type funding or other opportunities in both water source areas.

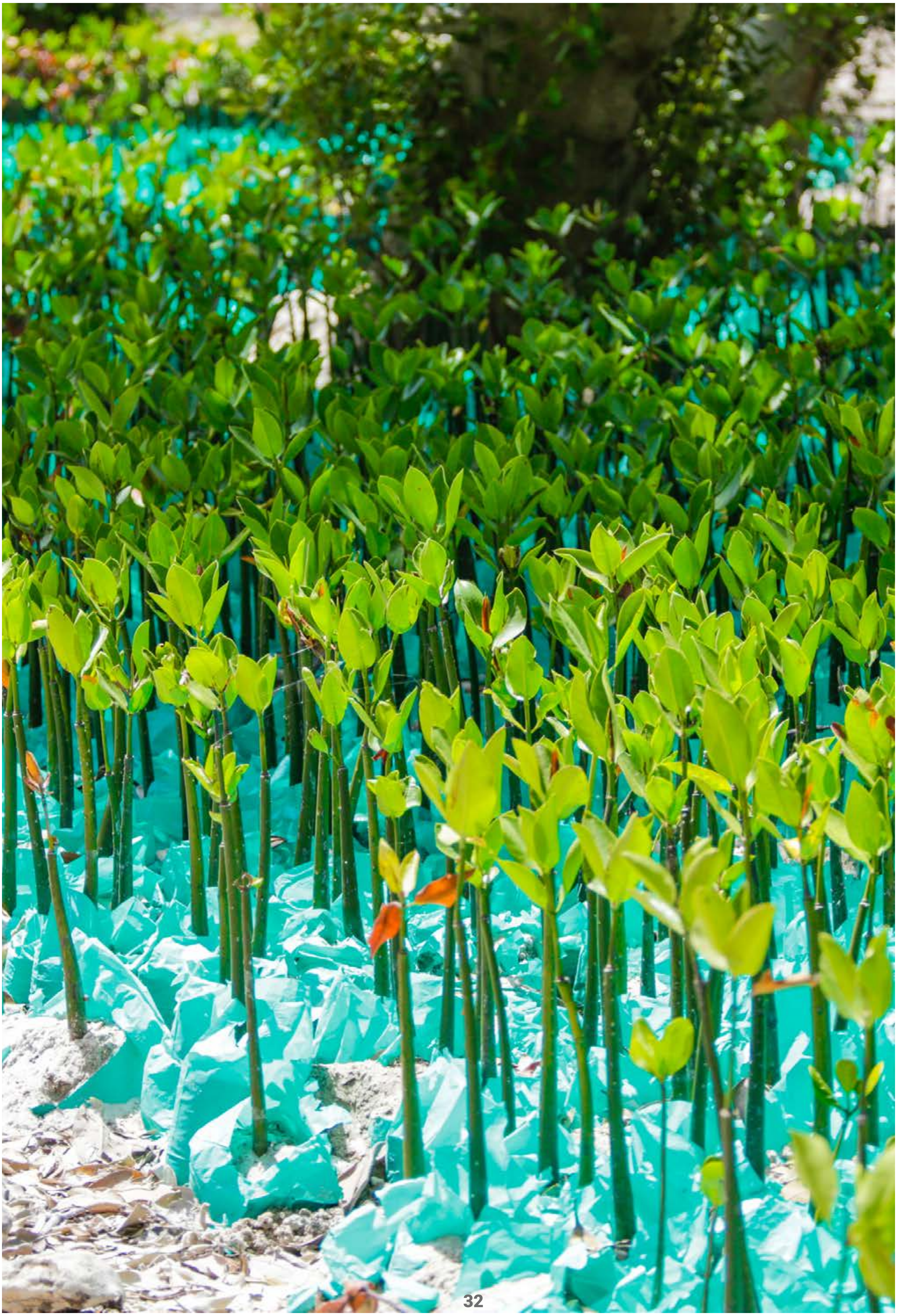
How these projects are designed and implemented will be key to their success.

Farmer Assistance

The farmer assistance model seeks to emulate the success of large-scale soil conservation programs that combine government extension staff, donor agencies, and NGOs in other parts of Kenya. For example, successes in Machakos County under the National Soil and Water Conservation Programme show the potential for large-scale adoption of terracing and other soil conservation measures after providing adequate training, extension support, and tools to local farmers. Following multiple soil conservation programs in Machakos, over half of all arable land and 83% of land in hilly areas had been adequately conserved by 1985 (Mortimore & Tiffen, 1994). About half of this growth was attributed to unassisted farmers who spontaneously adopted conservation measures following their general success in the region. In the Mwache Dam catchment area, Kwale County's agriculture department is better situated to take the leading role in helping farmers set up their terraces and other associated measures by providing extension services and direct support in terms of assisting farmers with earthworks and other labour-intensive work. Grants could also be provided to NGOs with relevant expertise and interests, to either directly assist farmers themselves or partner with the county government. Numerous NGOs in Kenya currently provide assistance and training to farmers around similar interventions to those proposed under the MWF. Additionally, the CDA has worked extensively with farmers to reduce soil erosion as part of the KWSCRP-2 and could thus provide valuable advisory support to the MWF from its experiences to date.

Restoration Programme

It is recommended that the direct rehabilitation of badly degraded areas be undertaken by trained restoration teams. It would be infeasible to expect widespread adoption of these practices among communities.



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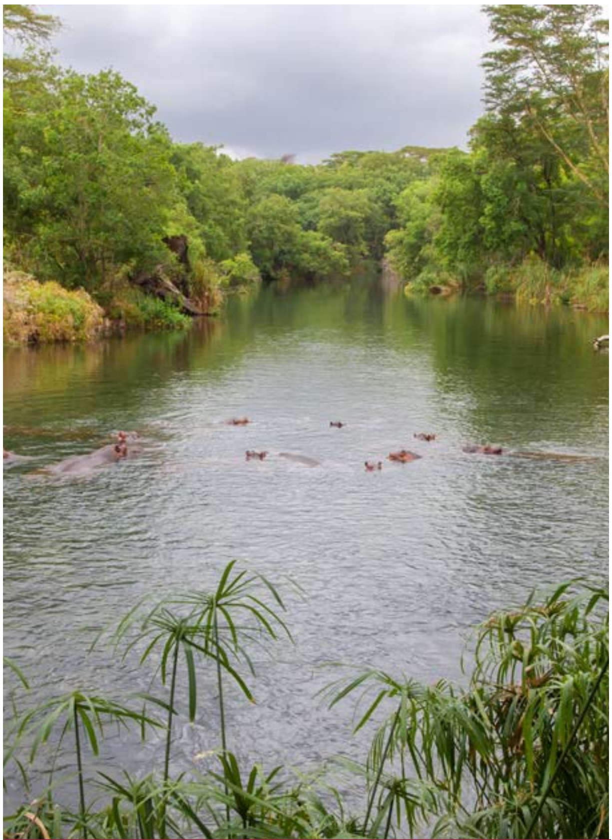
However, the program should be designed to use local laborers so that the activities create employment. This program should maintain a long-term business re-la-tionship with local laborers to ensure that the planted vegetation survives and thrives. Training support could be provided by staff from government agencies with relevant expertise. These could include the environmental depart-ments of county governments and staff from the CDA and WRA with experience conducting rehabilitation activities in the Mwache Dam catchment. Additional technical support could be provided by NGOs such as Vetiver Network Inter-national or companies with expertise in land restoration.

Payments for Ecosystem Services and the Establishment of New Conservancies

In the Mzima Springs recharge area and Mwache Dam catchment area, PES or PES-like schemes could be used to incentivize the restoration and maintenance of woody resources and rangeland ecosystem health (as part of the sustainable natural resource management interven-tion which involves incentives to reduce overgrazing and control overharvesting of fuelwood in degraded areas). In such a PES scheme, the buyer would by the MWF, acting on behalf of the water beneficiaries. PES schemes are one of the few options available to leverage an improvement in catchment management. The use of PES may in fact provide a stimulus (the financing required) for the devel-opment of conservation areas through the establishment of new conservancies and other community or landowner associations. In the northern part of the Mwache Dam catchment a large block of natural vegetation that lies between the Tsavo East National Park and the Shirango conservancy has been identified as a potential site for the establishment of a community wildlife conservation area.

Within forest, woodland, or bushland areas, the primary aim of a PES scheme or wildlife conservancy would be to reduce the rate of woody vegetation loss due to unsustain-able harvesting or clearing for agriculture and encourage vegetation recovery. A PES scheme or conservancy would also discourage overgrazing and encourage the maintenance of grass cover. Within the Mzima Springs recharge area, woody vegetation cover and biomass can be easily and objectively measured using satellite data. Indeed, there is already a robust forest and vegetation monitoring program in place, as required under the Voluntary Carbon Standard VM009 method, under which the REDD+ project is accredited. Within the Mwache Catchment, monitoring and measuring ecosystem condition will need to include on-the-ground field surveys, which are already undertaken on the Wildlife Works Kasigau Corridor REDD+ Project ranches. The PES scheme could also focus on riparian areas, the goal of which would be to create and maintain riparian setback areas that are free of cultivation and resource use and where natural vegetation can re-estab-lish itself. Such a scheme would also protect these areas from activities that lead to erosion, including unmanaged watering of livestock and sand mining. The outcome would be easily and objectively measured using satellite data.



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In the Mzima Springs recharge area and Mwache Dam catchment area, PES or PES-like schemes could be used to incentivize the restoration and maintenance of woody resources and rangeland ecosystem health

Given that PES schemes have been implemented in Kenya with mixed success, it is important that institutional prereq-uisites and key design elements be properly addressed. In-stitutional prerequisites are that the communities involved be clearly defined, have trusted leadership, and have a well-defined, designated conservation area under their control. Essential to the design of such schemes are that the measurement of conservation outcomes be determined and executed by an independent party, that the scheme is well understood by the communities, that the payments are conditional on conservation outcomes, and that the payments are high enough to incentivise the practices that lead to these outcomes. Without a strong community structure or secure land tenure in this landscape, it is rec-ommended that communities not be too large and that they are invited through a roadshow to organise themselves and bid to opt into the PES scheme. This will avoid having to work directly with individual farmers in the group. Given that local leaders have been benefitting from active defor-estation, the scheme design will need to ensure that they will gain more from ensuring protection. Communities that share common grazing areas may also be encouraged to cooperate with one another. Participat-ing communi-ties could be given exclusive rights to harvest sand, for example, on the condition that it came from one designated site managed according to strict environmental protocols.

For the Chyulu Hills landscape, the MWF can build on existing institutional, governance, financial management, and operational capacities through the existing REDD+ project. However, it is recommended that a strong element of conditionality is introduced.

Financing the MWF

The MWF will be able to receive, generate, manage, and spend funds through endowment and revolving facilities,[13] as well as guide aligned public investment for financing the above interventions. Funding would be provided by domestic and international donors, water charges and, ultimately, from interest on the endowment fund. Public and private investment may also take the form of non-mon-etary actions that are aligned with the MWF, such as legal assistance or staff assignments to undertake MWF activities in the designated water source areas.

It is estimated that the average total annual budget that the MWF will need to carry out its mission effectively and effi-ciently will be approximately $8.8 million. Interventions in the Mwache catchment would require an initial expenditure of $6.4 million followed by annual payments of $2.2 million, while those in the Mzima Springs recharge area would require a smaller upfront investment of $2.1 million but much higher ongoing payments of $6.3 million per year. The origination and establishment costs, which include costs for the MWF's financial, legal, and institutional struc-turing, are estimated to be in about $300,000. The annual costs can be expected to be around $275,000 per year.[14]

Given the size of the overall investment required, it is likely that the MWF would need to raise an initial sum of about $20 million, which could generate a net average annual income of about $1 million (based on the 5% spending policy[15]). After demonstrating the success of initial endeavours, it could obtain further commitments over time. Future funds could also be pledged conditionally depending on the fund's success.

Ultimately, the main purpose of the MWF is to protect in-vestments in water security. As such, the primary bene-fi-ciary is the state, specifically those organisations re-spon-sible for raw water supply infrastructure. Therefore, there is strong motivation for a contribution from the sale of raw water, some or all of which could be passed on to county government water service providers. A modest KSh2/ kl catchment conservation levy could generate annual revenues of $1.3 million for MWF activities in the Mwache Dam catchment and $700,000 per year for the Mzima Springs recharge area. This would also greatly encourage co-funding by other national and international stakehold-ers. For example, as a funder of the Mwache Dam, the World Bank may be interested in protecting its investment. Indeed, initial expenditure for effective inter-vention in the Mwache Dam catchment ($6.4 million) represents just about 3% of the $200 million dam devel-opment cost.

Furthermore, it is also envisaged that some funders—for example, those motivated by carbon, biodiversity, or other gains—might need ringfenced funding for specific projects, such as the Chyulu Hills water PES scheme. Im-plementa-tion of the Chyulu Hills PES could be relatively

13 For example, the revolving fund could provide a vehicle to prepare the groundwork while raising capital for the endowment fund, such as by funding the immediate initiation of priority interventions while the endowment is being capitalized.

14 The MWF's annual costs are expected to include salaries, vehicles, office rent and equipment, marketing and communications, training, audit, and miscellaneous costs.

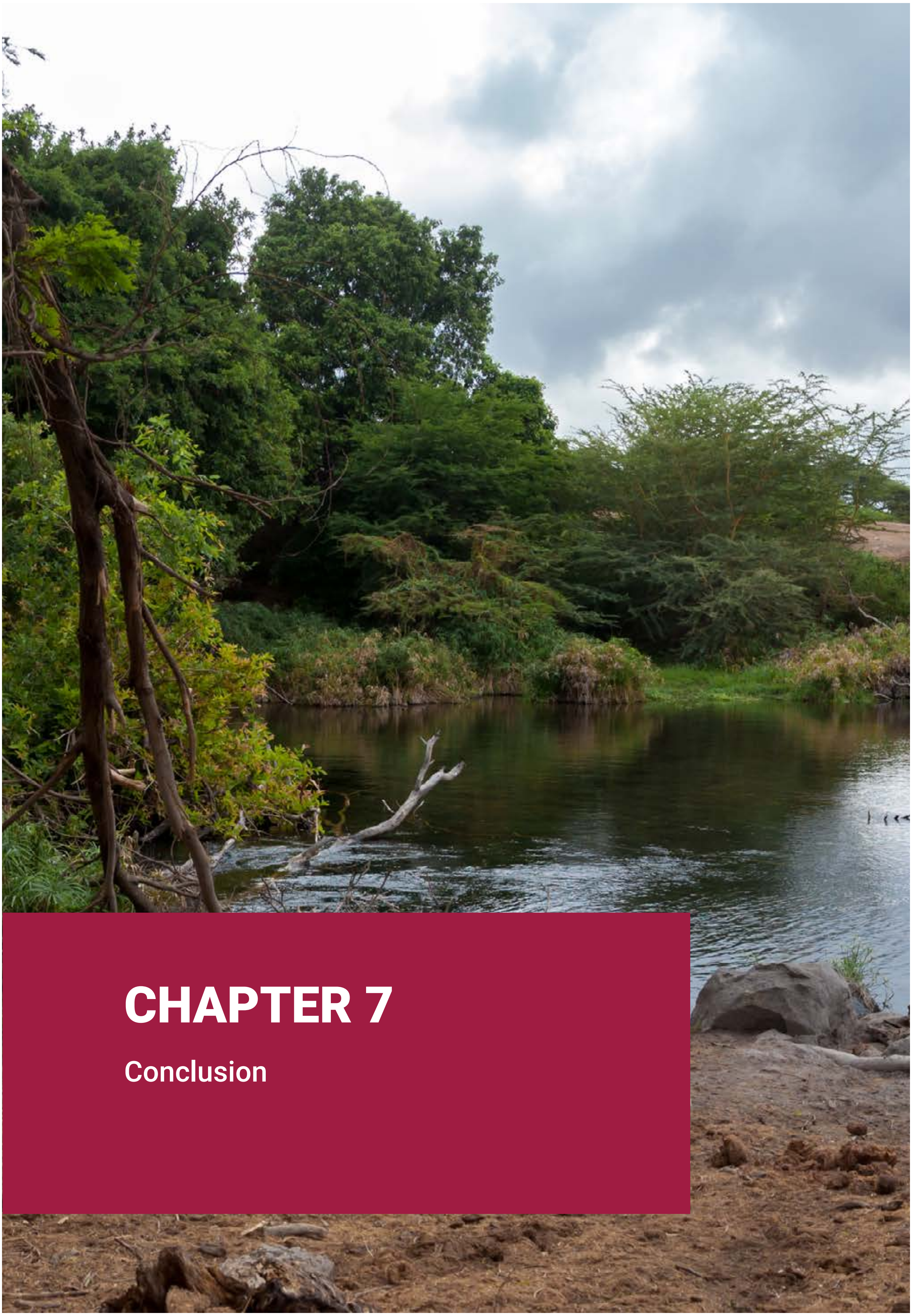
15 Broadly adopted by most U.S. NGOs and charitable foundations as a sensible baseline for spending, a 5% spending policy means an organisation must achieve a return of 5% plus the rate of inflation to support the organisation in perpetuity.

straightfor-ward given the already operational Chyulu REDD+ Project, through which it would operate. However, revenues from the recommended KSh2/kl water charge ($700,000 per year) for water supplied from the springs would cover only a small portion of the annual payment. Significant amounts would need to be raised to increase the endowment or received through grants and donations to cover the costs of the PES scheme fully. This is not an impossible feat given the rich biodiversity of the landscape and the signif-icant existence and bequest values attached to it.

Monitoring and Evaluation

Monitoring and evaluation will be important to ensure the MWF is achieving its desired outcomes and to provide accountability to funding partners. There is a pressing need to increase the collection of flow and water quantity monitoring in the Mwache Dam catchment in particular. To address this, the WRA is in the process of developing new water monitoring stations. Ideally, sufficient river monitoring stations should be established before signi-fi-cant land management interventions take place under the MWF, to improve understanding of the baseline situation in the absence of the fund. Given limited resources, water monitoring stations should be established primarily in subcatchments within the lower half of the Mwache Dam catchment, since this is where degradation is generally most severe and where most of the planned water fund in-terventions will take place. Key parameters to be collected by these stations are turbidity, TSS, and flow. Turbidity and TSS will be important for evaluating the impacts of the MWF interventions at reducing soil erosion and sedimentation, while flow data will be needed to evaluate impacts on water yield. A digital platform for Chyulu Hills is in production, which will be useful for monitoring and evaluation of the PES scheme in the Mzima Springs recharge area.

It will also be important for the MWF to keep track of the areas and reach of the various proposed interventions. This can involve simple criteria, such as the area of farmland under various SEC measures and the number of farmers undertaking these, the area and number of households participating in PES schemes, and so forth. As noted above, field and satellite-based monitoring will also be essential components of the PES schemes themselves to ensure compliance with the terms of payment. However, we also recommend periodic follow-up monitoring of other interventions, such as SEC measures on farmland, to evaluate the extent to which such interventions are being maintained following their initial establishment. This will be important to ensure interventions do not become once-off events with no lasting impacts.



CHAPTER 7

Conclusion

Land use practices in the Mwache Dam catchment area seriously threaten the lifespan and potential water yield of the currently under construction Mwache Dam, and water supply from the Mzima Springs is threatened by deforestation in its recharge area in and around the Chyulu Hills. A long-term commitment to investment in critical ecological infrastructure is needed to restore and protect the catchment areas of these important water source areas. Worldwide, there is an increasing realization of the important role of catchment health in achieving water security. Healthy catchments regulate the timing, quantity, and quality of stream flows, saving on grey infrastructure costs. Indeed, the degradation of ecological infrastruc-ture leads to the need for more traditional grey infrastruc-ture or to fix or maintain existing grey infrastructure more frequently. This is particularly pertinent in the Mwache catchment given the construction of the Mwache Dam, the lifespan of which will be significantly curtailed if changes are not made soon to how the catchment is managed.

The results demonstrate an economic basis for the establishment of a water fund. A $31 million investment in restoration interventions in the Mwache Dam catchment is expected to return at least $65 million in economic benefits over the 30-year time frame. In other words, every $1 invested by the water fund is expected to generate at least $2.10 of benefits to stakeholders. This provides a compelling case for developers, such as the World Bank, to consider a long-term commitment to investing in ecological infrastructure to ensure the longevity of their grey infrastructure assets. Indeed, initial expenditure for effective intervention in the Mwache Dam catchment represents just 3% of the dam development cost. Therefore, the development of a water fund is timely. Construction of the dam is expected to take six to eight years, providing enough time to restore already degraded areas and potentially halt any further degradation. Investment in the recommended activities now would mean that the restoration and conservation projects could be fully tested and implemented by the time the dam is operational.

In the Mzima Springs recharge area, a $73 million investment in a Chyulu Hills water PES scheme is expected to return about $92 million in economic benefits over the 30-year time frame, with an ROI of 1.3. The protection and restoration of the cloud forests and rangelands of the Mzima Springs recharge area is critical for ensuring the long-term supply of water to the Mombasa water supply system. Potential donors may be further motivated by maintaining the important biodiversity of the area, the value of which (apart from tourism) is not fully included in this analysis.

Taken together, an investment of $104 million in water fund interventions in the Mwache Dam catchment and the Mzima Springs recharge area is likely to return $157 million in economic benefits, resulting in a net present value of $53 million and a positive ROI of 1.5. Given the scarcity of data in some cases and the difficulty in modelling the hydrology of the Mzima Springs, the calculation of benefits was conservative. Sensitivity analysis shows that costs could be increased and benefits further reduced while still maintaining economic viability. While the Chyulu Hills water PES project will likely require further development to secure investment, restoration and conservation inter-ven-tions in both areas should ideally be funded through the MWF to ensure improved water security for all users of the Mombasa water supply system. In addition to securing the water supply, catchment restoration and conservation can bring wider benefits in terms of climate change resilience, job creation and community empowerment, and the res-to-ration and protection of critical biodiversity.

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