MOZAMBIQUE

UPSCALING NATURE-BASED FLOOD PROTECTION IN MOZAMBIQUE'S CITIES

Lessons Learnt from Beira

January 2020

NBS Nature Based Solutions
PROFOR INNOVATION AND ACTION FOR FORESTS
Building Disaster Resilience in Sub-Saharan Africa
GFDRR Global Facility for Disaster Reduction and Recovery
CES
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ABREVIATIONS

3CP	Cities and Climate Change Project
ADEG	Associação de desenvolvimento do Goto (Association for the Development of Goto)
ADEL	Associação de Desenvolvimento Economico Local (Association for Local Economic Development)
AIAS	Administração de Infra-estruturas de Água e Saneamento (National Administration of Water and Sanitation Infrastructure)
ASSANI	Associação de Activistas e Animadores (Association of Activists and Animators)
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry of Economic Cooperation and Development)
BoQ	Bill of Quantities
CBA	Cost Benefit Analysis
CES	CES Consulting Engineers Salzgitter GmbH
CMB	Conselho Municipal da Beira (Beira Municipal Council)
COLFOCI	Cólera Fora da Cidade (Association 'Cholera out of the City')
DEM	Digital Elevation Model
DTM	Digital Terrain Model
EdM	Electricity Company of Mozambique
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
FRPU	National Fund for the Reduction of Urban Poverty
FS	Feasibility Study
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GUI	Green Urban Infrastructure
IDF	Intensity-Duration-Frequency
IL	INROS LACKNER SE
IUCN	International Union for Conservation of Nature
KfW	KfW Development Bank
LiDAR	Light detection and ranging
NbS	Nature-based Solutions
NGO	Non-governmental organization
O&M	Operation and Maintenance
PPCR	Pilot Program for Climate Resilience
PPP	Public Private Partnership
PROFOR	Program for Forests
SASB	Serviços Autónomos de Saneamento da Beira
SCF	Strategic Climate Fund
WB	World Bank

1 INTRODUCTION

1.1 NATURE-BASED VS. CONVENTIONAL FLOOD PROTECTION

The majority of flood protection investments, in Mozambique and worldwide, are still made in the rehabilitation and construction of grey infrastructure, such as drainage canals, retention basins, protection walls and their appurtenant infrastructures. While there are several reasons to consider for and against grey infrastructure, incl. degree of urbanization, existing infrastructure, local capacities (construction and operation), etc., nature-based solutions are becoming a preferred option by international financing institutions, national agencies as well as local stakeholders. Especially when looking at small-scale interventions, nature-based solutions can be a more cost-effective option and may also be implemented and operated/ maintained by local agents, including communities and NGOs (e.g. afforestation measures).

Nature-based solutions (NbS) are defined by IUCN as “actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits”.

Figure 1-1 Nature-based solutions and their benefits.
Source: ***https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions***

According to IUCN, NbS is an umbrella concept comprising different approaches, incl. ecosystem restoration approaches, issue-specific ecosystem-related approaches, infrastructure-related approaches, ecosystem-based management approaches and ecosystem protection approaches.

Green infrastructure is considered a NbS, falling into the sub-category of infrastructure-related approaches. The European Commission defines it “a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces and other physical features in terrestrial and marine areas”.

In many cases, NbS and green infrastructure in particular can lead to advantageous results over traditional grey infrastructure such as drainage canals or pumping stations as the developed projects often have multi-faceted benefits and can improve a range of issues as opposed to usually single-purpose grey infrastructure projects. Especially in developing countries, green infrastructure has a multitude of advantages as it can also e.g. deliver

economic benefits, clean water or improve the overall sanitary situation while operation and maintenance are possible with very limited means (caring for the ecosystem vs. costly maintenance of technical structures).

Nevertheless, it needs to be pointed out that nature-based and hybrid flood and erosion protection measures may also be very complex in their planning, especially when looking at their impacts. Ecosystems and their service provision are a condition for the interventions' success, meaning that many aspects of their functioning need to be considered. Often, a network of ecosystems can be found, which are linked to each other, so that influencing one will also affect the others. Accordingly, the publication 'Implementing nature-based flood protection' (World Bank, 2017) concludes that there is no 'one-size fits all' solution. Based on a specific hazard and risk assessment, a variety of natural as well as social aspects need to be assessed for a well-designed project.

1.2 SCOPE OF THE CONSULTANCY AND THE REPORT

The objective of the Consultancy is to provide technical and analytical support to contribute in the upscaling of nature-based solutions for urban flood risk management, particularly in the coastal cities of Mozambique. The activity will also leverage the lessons learnt in Mozambique to support the future application of similar solutions in the wider Africa region.

Mozambique is one of the countries most exposed to coastal and river flooding in Africa. The World Bank has been active in providing emergency recovery after flooding in Mozambique and is increasingly supporting the Government in preventive disaster risk management operations on the city and regional levels (e.g. the environment resilience program). While traditional infrastructure-based interventions still make up the majority of global financing to improve disaster risk management, the application of nature-based solutions is gaining momentum.

One of the first nature-based urban flood management projects supported by the World Bank is in the coastal city of Beira in Mozambique. To maximize results from such projects, it is important to clarify the benefits for urban flood risk management and how such approaches can be best adjusted and scaled up to other cities in Mozambique and other countries in Africa. More generally, nature-based urban flood risk management projects struggle to provide a structured and comprehensive assessment of grey and green infrastructure solutions and produce and communicate evidence on the cost effectiveness of such solutions compared to other priorities.

The Program for Forests (PROFOR) aims to enhance and upscale the green infrastructure pilot for urban flood risk management to other cities in Mozambique by building on lessons learnt in Beira and using guidelines produced under PROFOR's ongoing "Harnessing Forests for Nature-Based Solutions to Disaster Risk Management" funded under the DRM and Forestry Global Knowledge Management program.

The two pilot cities that were selected for this assignment are Quelimane in Zambezi Province and Nacala in Nampula Province. Uncontrolled cutting down of mangrove trees and ignorance of the importance of the symbiosis between mangroves and man led to degradation of the environment in Quelimane and disrupt the natural flood protection in the city. Nacala is facing alarming erosion rates which are harming the infrastructure, livelihoods and economy of the city.

Specific objectives of the consultancy services are:

> (1) to identify the lessons learnt of the green infrastructure pilot project in Beira, as well as legal, regulatory and institutional constraints and opportunities to integrate nature-based risk management solutions in the cities of Mozambique; and
>
> (2) to identify different options for nature-based and hybrid solutions to manage urban flood risks in two pilot cities and assess their effectiveness, costs and benefits.

The present report presents the lessons learnt from the green infrastructure pilot project in Beira to be considered for future similar projects in Mozambique and the region. It evaluates technical solutions developed and project results, as well as the overall planning and implementation process, integrating perspectives by different stakeholders.

1.3 THE RIO CHIVEVE AND GREEN INFRASTRUCTURE PROJECT CASES

A pilot project of flood protection through green-grey infrastructure in Mozambique is the Rio Chiveve and Green Infrastructure project in the city of Beira. The first phase of the project, financed by the German Federal Ministry for Economic Cooperation and Development (BMZ) through KfW, was completed end of 2016. The second phase is financed by the World Bank within the Cities and Climate Change Project (3CP) together with KfW, its construction phase having recently commenced. The experience from the two project phases shall be used to gather best practices and lessons learnt for future similar nature-based flood and erosion protection projects in Mozambique and within this consultancy for the cities of Quelimane and Nacala.

1.3.1 Background

The project 'Green Infrastructure' in Beira, together with its forerunner, "Chiveve River Rehabilitation Project", are in their approach and scale so far unique in the Mozambican context of infrastructure investments for flood protection. Both projects can be considered hybrid solutions. Investments in blue and green infrastructure focus on the rehabilitation of the natural riverbed, its adjacent mangrove wetland area and an upgrading of the general surrounding green space as an urban park. The river rehabilitation included the construction of a 'conventional' controllable tidal outlet to protect the inner city from spring tides, storm surges and excessive rainfall whereas the natural river flow is generally maintained. During excessive rainfalls, the rehabilitated river acts as retention basin and water will be released via the tidal outlet during low tide. Also, the park design is using grey urban infrastructure (buildings, pathways, etc.) to enable its social accessibility and economic sustainability.

Beira is Mozambique's second largest coastal city with over half a million inhabitants and one of the largest ports in the country. Substantial parts of the city center are located only a few meters above sea level, mainly occupied by informal settlements. These neighbourhoods are characterized by a high population density, inadequate residential areas and infrastructure, a lack of water supply, waste -and storm water drainage systems and a high poverty rate, which also make them particularly vulnerable to extreme weather events.

Due to its exposed coastal location, its vulnerable infrastructure and population, Beira is considered to be the city most threatened by climate change in Mozambique and one of the cities most at risk along the East-African coast. In addition to the rising sea level and, high-intensity rainfall both amplified by the more frequent occurrence of cyclones causes flooding on a regular basis. When this happens, inhabitants not only suffer material losses, but are also exposed to increased health risks due to stagnant water. In future, this situation will only be exacerbated even further due to weather extremes, rising ground water and sea levels, inadequate drainage and ongoing coastal erosion. The inhabitants of informal settlements, one of the most vulnerable, are particularly at risk.

The City Council and the Mayor, Daviz Mbepo Simango, made climate change adaptation one of the priorities of the urban development, considering that climate impacts are already affecting Beira. The main focus of the City's climate adaptation strategy lies on flood and coastal protection. One priority adaptation measure of the City comprised the rehabilitation of the tidal river Chiveve with its surrounding mangrove and wetland areas.

The Government of Mozambique (GoM) receives funding from different international donors to enhance the climate resilience of Beira City. While the initial rehabilitation of Rio Chiveve received financing by KfW with special climate funds from the German Government, the Green Infrastructure Project had a joint investment by KfW and the World Bank. The latter provides funding through the "Cities and Climate Change Project" (3CP) with a specific grant from the Strategic Climate Fund's "Pilot Program for Climate Resilience" (SCF-PPCR). Furthermore, the 3CP implements rehabilitation works of the main storm water drainage system in Beira, comprising largely conventional drainage infrastructure with a nature-based retention basin. In addition to the rehabilitation of drainage canals and the Rio Chiveve/Green Infrastructure project, the city of Beira also gets support from the Dutch development cooperation, which so far included the development of a master plan for the city and green drainage infrastructure concepts for different neighbourhoods of the city, amongst other activities.

The Chiveve Rehabilitation and Green Infrastructure measures are implemented through the National Administration of Water and Sanitation Infrastructure (AIAS). The investments have the objective to restore the valuable

riverine and wetland ecosystem, re-establishing its stormwater drainage and retention function while upgrading the river's surrounding green space as an urban park area. While the financing and planning took place in two separate stages, this report will consider it as one project with two phases which are described in more detail below.

The initial project kick-off took place in December 2012 with the award of the consulting contract to the CES / Inros Lackner joint venture. The inception, feasibility and detailed design phase were carried out in 2013 and 2014 with construction starting in 2015. In parallel to the construction works for Phase 1 (Chiveve Rehabilitation), the feasibility study and design works for Phase 2 (green infrastructure) were carried out and ended mid of 2017 with finalisation of the tender documents. Construction works for this second phase started in July 2018 and are scheduled to last approximately 2 years. Figure 1-2 provides a timely overview of the planning and implementation of both project phases. It shows certain interruptions during the feasibility study of the second phase, mainly due to the joining of KfW and World Bank funding and resulting project extension.

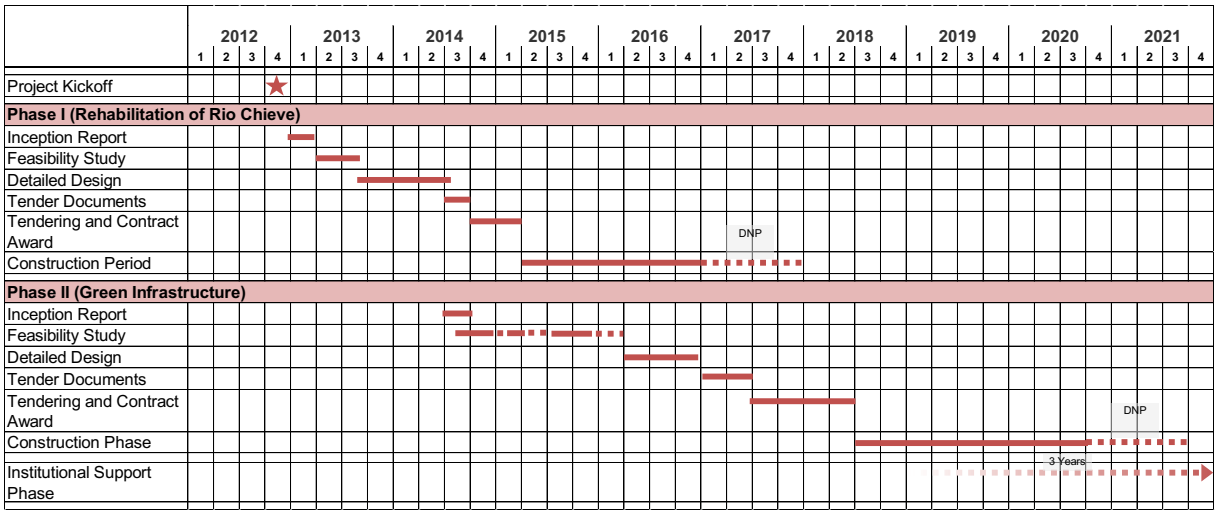


Figure 1-2 Project timeline of Phase 1 and 2

1.3.2 Chiveve River Rehabilitation - Project Phase 1

Figure 1-3 Rio Chiveve in 1963 with a natural river mouth (left), situation in the 1970s (right) *(Source: CMB)*

The Chiveve River once was the heart of the natural drainage system of Beira's city centre. Since the closure of its river mouth in the 1960s, the riverbed and floodplains have been threatened by ongoing urbanization, causing an increase of flood and storm risks and a loss of its rich landscape and biodiversity.

Figure 1-4 View of extensively wooded Chiveve area (left) and Rio Chiveve (right), 2014

The investment for the rehabilitation of the Chiveve River started almost as a conventional drainage project, however under climate change adaptation goals, with funding from the "Energy and Climate Fund" by the German Federal Ministry of Economic Cooperation and Development. An early intention of the project was the interlinkage of conventional primary storm water drainage channels with the Chiveve River. Only as a result of the feasibility phase, the necessity for a hybrid solution with a stronger focus on the restoration of the ecosystem emerged, a result also of an awareness process by all stakeholders involved about the benefits of natural solutions and related ecosystem-based services.

The designed and constructed investment measure comprised the opening of the river course towards the estuary with the construction of a controllable tidal outlet structure (protection from spring tides and storm surges and targeted control regulation of the water levels in the retention basin). The riverbed was enlarged and cleared from waste and accumulated sediments to restore its function as a natural drainage system. Additional water retention areas/volumes were introduced to further prevent flooding. In addition, the economically important fishing port, situated at the mouth of the Chiveve was dredged from accumulated sediments in order to improve the function of the river and the port and create additional benefits for the mobility of fishing vessels. Considering that excavations and the enlargement of the river beds resulted in the removal of over one thousand trees, comprehensive mangrove reforestation activities took place during the course of the project aiming to restoring

the ecosystem and at the same time increasing biodiversity. Construction started in March 2015 and was finished in December 2016.

Complementary measures were implemented in cooperation with GIZ, comprising the construction of tertiary drainage channels in Goto settlement and the establishment of a community-based waste collection system to further reduce flood risks in this neighbourhood.

Figure 1-5 Render of the tidal outlet in a storm scenario (left), aerial view of retention pond and tidal outlet structure (right) *(Source: CES/Inros Lackner)*

1.3.3 Green Urban Infrastructure (GUI) – Project Phase 2

The 3CP follows the development objective to "strengthen institutional capacity for local revenue enhancement and land use management in targeted municipalities, and enhance climate resilience in the coastal cities of Beira and Maputo". The "Pilot Program for Climate Resilience (PPCR)" under the Strategic Climate Fund (SCF) is a multi-donor fund which is administered by the World Bank. It supports most vulnerable countries in building their adaptation and resilience to the impacts of climate change. For Beira, the SCF-PPCR originally included the rehabilitation of the Chiveve River and was then in coordination with KfW adapted to extend the environmental social and economic impacts of the first phase and to guarantee its sustainability. The investment measures thus aim to improve and protect the green infrastructure surrounding the Chiveve River. Following the detailed design, construction works upgrade the green space, incl. mangroves, grass and wetlands within a public urban park through landscaping and sustainable urban planning measures. The planned green and grey infrastructure shall stop urbanization processes around the Chiveve River, protecting the sensitive environment, while also offering access to the population for leisure and small businesses.

The provision of a healthy urban park environment is additionally considered an important contribution to climate change adaptation due to its diverse ecosystem services, from lowering temperatures to filtering air and (rain)water, together with health benefits through leisure activities. Furthermore, it is envisaged that the park infrastructure will motivate the beneficiaries, users and operator of the park and Rio Chiveve area to maintain the area and keep it clean so that the functionality of the natural drainage system is ensured also in the future.

A major challenge of this project is clearly its sustainability, knowing that public parks require substantial maintenance and therefore money which the City Council of Beira cannot provide from its own budget. Therefore, income-generating facilities related to the park space were included during the feasibility stage. Furthermore, AIAS will contract a consultant who shall support the Municipality in building up a competent semi-autonomous Park Management Unit, responsible for all operation and maintenance tasks, including the financial management of the Chiveve Park.

Figure 1-6 Vision of Rio Chiveve Park

In addition to these core investments into blue and green infrastructure measures, partnerships were built up during the different project phases with other institutions and NGOs to increase the impacts and sustainability of the investments. Cooperation took place for example with the German International Cooperation GIZ to improve waste collection services and storm water drainage in Goto, the main informal settlement upstream of the Chiveve River. As pollution is a major issue for the functioning of the river and the inhabitants of Goto are heavily affected by flooding, with a high vulnerability, these community-based measures can be understood as an important complementary part of the infrastructure investments.

Overall, both investments present a unique experience of how to combine green infrastructure with urban development to increase the resilience of a city, although they are still in a development stage. In most of the highly urbanized areas of cites around the world, green and blue infrastructure is rare. With the valorisation of park spaces and natural drains in the context of climate change adaptation, major cities now even remove grey infrastructure to reintroduce green spaces. Many good practices and examples for the preservation and restoration of green infrastructure in urban spaces exist all over Africa (e.g. Nairobi's Uhuru Park, the National Park of Mali in Bamako), mostly aiming at creating a healthier environment and leisure spaces. However, when looking at flood and erosion protection infrastructure the use of nature-based solutions is still a new concept. So far, projects are implemented individually, the reforestation of mangroves probably being a more common and often community-based initiative along the coast.

The Chiveve and Green Infrastructure measures in Beira therefore serve as an important source of experience and information to feed back to the national political level and create a more consistent framework for the use of NbS for disaster risk management and climate change adaptation action.

2 METHODOLOGY

For gathering information on the local impact and perception of the project, the consultant conducted interviews with different stakeholders of the project as listed below.

Table 2-1 Interviews conducted for Task 1

Type of Stake-holder	Interview Partner	Role
Individuals	Individual beneficiaries in Beira Residents and businesses in neighbouring areas, (see Annex 1)	Direct beneficiaries
Government	AIAS (Maputo Office) Maputo Office / Paulo Oscar da Silva, Carlos Noa Laisse	Project Client
	Beira Municipality Mayor Simango, Moises Chenene (SASB), Nilza Binda (FRPU)	Project Owner and Operator
Civil Society	ADEL Responsible for reforestation Eugénio Sigauque	NGO responsible for mangrove reforestation
International Financing Institutions	KfW Project Managers Cristof Griebenow and Pascale Magin, Technical Advisor Sebastian Norrmann	Financing Institution Phase 1 and 2
	World Bank Paula Pini, Task Team Leader Cities and Climate Change Project	Financing Institution Phase 2
Private Sector (Consultants)	CHICO Construction Construction Managers	Contractor
	TPF Mocambique Supervision Team GUI	Construction supervision consultant for Phase 2
	CES / Inros Lackner Design Team, Supervision Team	Engineering consultants for Feasibility Study (Phase 1 and 2), Detailed Design (Phase 1 and 2) and execution of Construction Supervision Phase 1.

To obtain information on lessons learnt from the direct beneficiaries, semi-structured interviews were conducted in various locations with a variety of interview partners as shown in Annex I. With this target group, the interviews aimed towards collecting information on the perception of the project within the target group, based on the following key questions:

1. How has your personal and economic situation changed through the works at the Chiveve River? What were positive impacts? What were negative impacts?
2. What impacts on your personal and economic life do you expect through the new park planned around the Chiveve (beginning of the works in the coming weeks)?
3. Have you had any positive or negative impacts during the preparation of the park project?

For the other main stakeholders, semi-structured interviews were conducted focusing on four main aspects, with emphasis on relevant aspects depending on the interview partner.

1. Project Concept

   Key Aspects: Development of project concept, perception of project concept, challenges during implementation of GUI phase, degree to which the project fulfilled the initial expectations, recommendations for future nature-based flood protection projects

2. Planning and Design Process

   Key Aspects: Participation during planning and design process, shortcomings during the process, considerations for future projects

3. Technical Quality

   Key Aspects: Best practices to derive from the project, shortcomings in technical design, challenges during implementation – especially in regard to nature-based vs. conventional projects, considerations for future projects

4. Sustainability

   Key Aspects: current/planned sustainability, risk factors for sustainability, suggestions for increasing sustainability for similar projects

In addition to the interviews, a field visit was conducted to assess the project site, principally to verify the results of the first construction phase and status of the ecosystem.

3 RESULTS – LESSONS LEARNT AND BEST PRACTICES

3.1 CONCEPTUAL PROJECT APPROACH, PROJECT GOALS AND SETUP

3.1.1 Project Scope

Initially, the first phase - the Chiveve Rehabilitation Project - had a very different scope shown in its original title "Rehabilitation, Extension and Operation of the Storm Water Drainage System of Beira / Mozambique". Based on the KfW's Terms of Reference for the Feasibility Study's Consultant and appraisal mission in early 2013, it was planned to discharge water from the existing storm drainage system through Rio Chiveve into the sea. During the first steps of the feasibility study it was found that this would be very difficult to achieve, as the water table elevation in the drainage system in vicinity of Rio Chiveve is significantly lower than the river levels and thus conveyance by gravity was not possible. Furthermore, the initially foreseen routing of a connection canal had been built up with residential buildings by the time the Feasibility Study was started. Additionally, concerns existed regarding the degree of pollution from the industrial area's drainage system. Therefore, the initial project idea turned out to be unfeasible and the implementation consultant developed the new concept in consultation with the main project stakeholders that has now also been implemented and is described in Section 1.

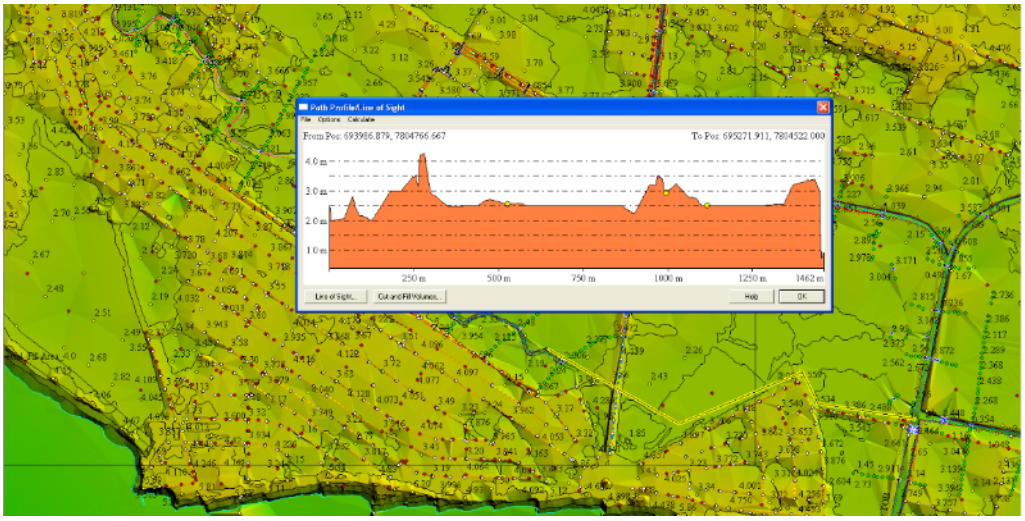


Figure 3-1 Elevation profile between storm drainage system (right end of profile) and Rio Chiveve (left end of profile). Elevation difference is around 1.0 m

The first project phase initially covered only drainage aspects. When the project scope was narrowed down to the rehabilitation of the Chiveve River with a tidal outlet, as a result of the Feasibility Study, the ecological component of this project started to gain more relevance. The importance of the mangrove and saltwater wetlands was finally acknowledged by all stakeholders at the time of the Detailed Design, when a specific Wetland Rehabilitation Plan was elaborated. The goals and target groups of the project were also redefined during the course of the feasibility study and detailed design. The original project objective was to make the city more resilient against inundations and the consequences of climate change. With a defined project area this aimed at the reduction of urban flood risks in the direct catchment of Rio Chiveve, for which the residents of the informal settlement of Goto were identified as the main target group. In order to increase the project's impact on this target group, the installation of tertiary drainage ditches and the establishment of a waste collection service in Goto were added to the project scope, implemented by GIZ experts. These activities were closely coordinated with the Rio Chiveve measure, as the rehabilitation of Rio Chiveve gave the opportunity to use it as the receiving water course.

In 2013 AIAS already commissioned a preliminary study for the PPCR's Green Infrastructure investment in Beira to outline technical solutions that should "optimize the role of natural drainage ways in the city of Beira in flood control, while also combining these solutions with the creation of attractive public spaces". This report identified the Chiveve River's surrounding green space as a potential project area, thus complementing the Chiveve Rehabilitation project.

KfW in 2014 approached the World Bank to include the Feasibility Study for the SCR-PPCR 'Green Infrastructure in Beira' in the consultancy contract of the first phase, in order to allow an integrated planning of both infrastructure measures. During the course of the Feasibility Study the two financing institutions agreed that besides the USD 15.75M SCR fund (loan of USD 6.5M + Grant of USD 9.25M), another USD 16.5M would be contributed by KfW with an extended project scope. An upstream wetland was included, as well as increased landscaping, social and economic infrastructure measures.

In this context, the planning stage of the second 'Green Infrastructure' project phase experienced various alterations in terms of its concept and project scope. Firstly, the scope of the PPCR was vaguely defined at the start of the Feasibility Study in 2014 , leaving a large range of investment scenarios for landscaping measures and social infrastructure, which were then guided by the preferences of the main stakeholders, i.e. AIAS, Beira Municipal Council (CMB), KfW and WB. Secondly, challenges regarding the financial sustainability resulted in an increased necessity to include economic infrastructure which would allow returns for the operation and management of the urban park landscape. At last, the question of environmental sustainability resulted in a difficult process of balancing grey and green infrastructure.

3.1.2 Project Outcomes

3.1.2.1 Direct impact of the project

The combination of re-opening Rio Chiveve and the GUI measures around, it has so far shown to be a successful concept. According to the interviewed stakeholders in the administration, it is welcomed by most residents of Beira and is a high priority project of the municipal administration. The results from the interviews with local residents (see Annex I) support this claim. Only local businesses were not overly supportive of the project during the first phases and showed little interest in supporting it actively, as they first only saw the disruption through construction works. The interviews conducted within the scope of the current consultancy showed that this has changed, and the project is now welcomed also by surrounding businesses – mostly due to the drastically improved security situation in the area. The flooding / drainage situation in the city vastly improved. According to residents and the municipality, there was no major flooding in the Chiveve area since the completion of the construction works. Also, residents of Goto confirmed that the drainage situation has drastically improved.

The cleanliness of the area improved remarkably. Before the project, the area of Rio Chiveve was used as a dump site for residential and faecal waste. The river excavation removed large parts of the waste pollution, but as this site had been used as a waste dump site for decades, the remnants could not be fully removed, as the soil in the area is thoroughly mixed with the waste. During the time of the field visit (07/2018), the area of Rio Chiveve was still mostly fenced off due to the then-imminent construction works for GUI. Waste that still was disposed in the area (e.g. thrown over the fences, brought into the area with the stream, disposed by trespassers) is currently being removed by volunteers receiving support from the CMB, from the associations ASSANI (*Associação de Activistas e Animadores*). COLFOCI (*Cólera Fora da Cidade*) is also controlling the Chiveve surroundings against open defecation.[1] Therefore, the area is mostly free of solid waste on the surface as well as human faeces. This new state of cleanliness is also well-received by both residents and municipal administration, as the interviews showed.

[1] ASSANI and COLFOCI are community-based non-governmental organizations that existed before the project. For their services at the Chiveve the CMB provides equipment and minor daily subsidies.

Figure 3-2 Volunteers cleaning up the Chiveve area

As an additional outcome of the project, almost all interviewed citizens in the project area mentioned a sharp decline of robberies, rape and thefts in the area. This facilitated the work for surrounding businesses. The situation for the cultural centre “Casa Cultura” has improved, as the risk of becoming victim of a crime when visiting the centre in the evening is much reduced.

Figure 3-3 Solid waste contamination before/after

Even though the area is not open to the public yet and the establishment of the park infrastructure has just started, residents, businesses and the municipality are already excited to have the public space in their city. High hopes are connected to the finalization of the project, such as an increasing business, better security, higher quality of living, reduced flood risk or that there will be more public space for leisure (family and sports), arts and culture.

3.1.2.2 Additional impacts of the project

According to the CMB, the changes in the groundwater regime induced by the project around Basin 1 had a positive impact on the surrounding buildings. First assessments by the CMB staff seem to conclude that groundwater-induced structural damages to the buildings are reducing.

The few negative comments regarding the project were collected from merchants and small-business owners around the Chiveve area. Merchants previously selling in an informal market next to the Chiveve had to be moved during the construction works. They lost lucrative spots for their market stands and hope to be able to receive stands in the formal market planned in the future Chiveve Park. Nearby car wash businesses are facing similar challenges. With the start of the GUI construction works, they will have to move their business from the Chiveve area elsewhere. For them the CMB promised to provide an alternative location to conduct their business.

Due to extensive media coverage in Mozambique and abroad, the project is widely known (see also section 3.5). Especially in Mozambique it raised awareness for possible nature-based solutions for the ubiquitous urban drainage and flooding problems. Parts of the administration in Mozambique also seem to recognize the lack of public space in many cities. A combination of high-quality public places with effective urban drainage and flood protection is seen as a very attractive solution.

3.1.3 Lessons Learnt

The stages of feasibility study, detailed design and construction led to the following findings regarding project scope and impacts:

- Coordination of donors is important and necessary and can lead to more sophisticated and beneficial projects. Individual initiative and commitment by the main parties responsible for the project financing and set-up play a major role for the establishment of such coordination and particularly co-financing formats. High project visibility increases the possibility for donors to allocate additional funds for a project already financed by another donor.
- Awareness raising for NbS may take time, especially if not communicated as a main goal of a project intervention in advance. Urban flood protection related to storm water drainage is mostly a field of conventional engineering. It is necessary to first create a common understanding of the importance of NbS by all project parties and then create awareness involving a broader range of stakeholders as well as residents.
- Projects, especially those focusing on NbS, need to have the flexibility to be adapted during the Feasibility Studies. In the case of the first phase of the project, the initial proposal quickly turned out to be not feasible to implement. The second phase required some time to finally define all project measures. Such uncertainty largely extends the planning stage.
- Should the project scope include social and possibly economic infrastructure, the extent and type of infrastructure should be defined at an early planning stage. If not clear at the start of the project, Feasibility Studies should include market and social studies as well as participatory workshops to identify adequate options.
- Urban park landscapes with leisure infrastructure require proper management and a budget to cover operation and maintenance (O&M). These aspects should be considered at an early project planning stage (see section 3.2.4 and 3.6.1).
- Infrastructure projects financed through climate funds or with a climate resilience objective should require the investigation of environmentally sustainable and where possible nature-based solutions. Where ecosystems are part of the project solution or within the project area, clear guidelines and targets should be set by the financing institutions on protection and/ or restoration measures. Consulting teams should then include experts in relevant fields e.g. of ecology, marine biology, botany and zoology.
- When working with climate change scenarios, all relevant factors need to be studied during the planning stage. Changes in the groundwater regime were initially not budgeted in the project. A basic groundwater assessment was then added to the feasibility study through an addendum.
- The restoration of urban green areas proves to have wider social impacts, which should be communicated more prominently to promote NbS with (local) stakeholders. The establishment of an organized infrastructure can improve not only the drainage and flooding situation in a project area, but also positively impact people's lives through an improved security situation, increased cleanliness, an improved business climate and an increase of the quality of living through the provision of public spaces for recreation, arts and culture.
- One of the keys for the public acceptance was the public participation and community outreach (see also 3.5). Extensive coverage in newspapers, social media, radio and TV, a dedicated info point and public

workshops publicized the project. The involvement and visibility of the Mayor, as well as official visits such as the Prime Minister further demonstrated its importance.

3.2 PLANNING AND DESIGN

3.2.1 Planning and Design Process

The planning and design of both project phases was conducted by an international consortium of consultants composed by INROS LACKNER (IL) and CES Consulting Engineers Salzgitter, contracted by AIAS and financed through KfW. In both phases, a Feasibility Study was elaborated to identify the preferred project solution(s) in terms of technical, financial, social and environmental feasibility. Subsequently, the Detailed Design was prepared, together with tender documents for the construction works (incl. contract conditions, technical specifications, drawings, BoQ, etc.).

The Feasibility Study for the rehabilitation of the Chiveve River included amongst others:

- Climate Change Assessment
- Hydrological Analysis
- DEM generation
- Run-off and Flood Modelling
- Coastal Assessment
- Ground Water Assessment
- Sedimentation Study
- Assessment of sludge characteristics and identification of sludge disposal site
- Cost Benefit Analysis (CBA) and
- Environmental and Social Impact Assessment (ESIA, Category B)

The Detailed Design for the Chiveve Rehabilitation investment then focused on the following:

- Investigation of boundary conditions, topographic, soil and other additional surveys
- Definition of design criteria
- Design drawings of the main project components, incl. the excavation of the riverbed, construction of the tidal outlet, construction of a road and roundabout, a dump site (sludge disposal) and dredging of the port
- A Wetland Rehabilitation Plan (for the reforestation of mangroves)
- Tender Documents for construction works with technical specifications (incl. technical as well as environmental and health and safety aspects)

The Feasibility Study and Detailed Design for the Green Infrastructure measures were included in the services of the Design and Supervision Consultant IL/CES through a contract amendment. The Feasibility Study comprised the following main aspects:

- Assessment of features and environmental conditions of the project area
- Landscape solutions and a Landscape Development Plan (incl. vegetation, footpaths and cycling routes, an amphitheatre, playgrounds and park elements)
- Urban planning and architecture solutions (incl. a restaurant, an exhibition centre, food kiosks, a formalized market, an office building, a multi-purpose ‘garden’ center and public toilets)
- The assessment of park management models and public-private-partnerships (PPPs)
- A Financial Analysis
- An ESIA (Category A)
- Preliminary designs for landscaping and architecture measures

The feasibility study had undergone some interruptions due to the increase of the project budget and scope of works, as well as due to discussions of its financial feasibility considering the high operation and maintenance (O&M) costs of the 20ha project area. The latter created the need for additional economic infrastructure, at the same time reducing maintenance-intensive infrastructure and equipment. Furthermore, good park management models and practices were an important point of discussion in regard to the local capacity to operate and maintain the green and grey infrastructure (see section 3.6.1).

For the elaboration of the Detailed Design, additional surveys were conducted and the various components of the project investment designed, resulting in a design report, design drawings, and tender documents.

The wetland located upstream of the Chiveve River was included in the project area at a later stage and its Feasibility Study and Detailed Design conducted partly separately and with some delay to the other components.

3.2.2 City Development

Already during the first weeks of the planning stage of Phase 1, it became apparent that substantial construction activity in a new formal settlement was taking place in the area where the conveyance canal from the main drainage canal to Rio Chiveve was foreseen. In addition to the unfavourable elevation situation, this made the initial project proposal (which would have required a canal of >30 m width) impossible without substantial resettlement efforts. The settlement was established outside of the development plan, considering that the area originally is part of the protection zone of the Chiveve floodplain.

In addition, the necessity for the resettlement of an informal settlement of approximately 20 households living on the Chiveve's adjacent wetland was identified during the Feasibility Study. The Municipality of Beira took responsibility for this measure and was accompanied by the Consultant to follow international social safeguard standards.

Phase 2 required compensation and resettlement measures within the lately defined additional project area of the upstream wetland. The boundaries of the wetland are set by a formal settlement on the one side, on the other side is the Goto settlement where individual huts and small housing had to be removed within the project area of the flood zone. A simplified Resettlement Action Plan was elaborated by the Consultant and implemented with the Municipality of Beira.

3.2.3 Available Data

During the design process of Phase 1, it was discovered that a previous project in the city of Beira had created a detailed DTM using a LIDAR survey. During the initial data collection, there was no indication of the existence of such a DTM. However, during the Feasibility Study this data could be obtained and was utilized for the study and design works.

The reference elevation datum for the different datasets (LIDAR data, other topographical survey data, tidal data, elevations in as-built drawings of other projects) was initially unclear and differs from project to project. Based on own topographical surveys, the IC was able to adjust data between the different sources, but the verification of the elevation reference for each data source remained problematic and the process was prone to errors. Similar problems were faced regarding the geographic projection of different datasets.

For the subsurface municipal storm water drainage and sewer system rehabilitated in 2007, the IC's team was able to obtain digital (shp) datasets showing the location of the pipe network and manholes. Probably due to extensive data processing, all elevation data had been stripped from the data though, so that it was of limited use for the project. The IC was able to re-map approximate elevations to the manholes but could not recover the lost elevation information for the dataset.

While precipitation data (daily interval) is collected at a station at Beira Airport, very little information on the intensity of rainfall events is known. There was some additional data from surrounding stations regarding rainfall intensity. For the study, the intension-duration-frequency curves (IDF-curves) had to be derived from a very limited amount of data.

3.2.4 Lessons Learnt

As a result of both planning phases the following lessons can be drawn on the general process, as well as data quality:

- During the feasibility and especially the design phase of NbS, adaption of project components may come up more frequently requiring non-conventional solutions. In addition, a certain degree of unpredictability has to be accepted for the engineering of green infrastructure. This requires flexibility and may also create resistance. The most controversial issues in the project were the protection of mangrove trees during works, the use of gabion mats in the river course for erosion protection, the type of excavation works and use of machinery in the river and wetland area.
- Contrary to conventional engineering measures, NbS may present a larger variety of options and less standard practices. In an urban context, subjective preferences such as aesthetics are also relevant for the selection and design of project measures. This requires a very close and regular communication between the main entities involved in order to provide a clear direction.
- The financial feasibility and sustainability of green infrastructure measures need to be assessed looking at O&M costs and local capacities to operate and maintain them. Lessons Learnt from the establishment of a semi-autonomous Park Management Entity in Beira should be evaluated to consider this management model for other similar projects.
- It would be useful if municipalities had “base data” sets for their own use as well as for consultants working on projects in their jurisdiction. This packet could include topographic data as well as information on cadastre, soil characteristics, water quality, groundwater levels, utilities, benchmarks and precipitation. This would ensure that all technicians and consultants work with the same set of data and therefore the same base assumptions, reducing costs and time of data collection and increasing quality and compatibility of outputs.
- The municipalities should improve their data management – important project outcomes such as GIS-based maps of utility systems should be fully backed up so that they can be restored to full functionality when the need arises.
- For the assessment of drainage and flooding, the rainfall intensity and IDF curves are a key factor to determine the size of the drainage system. Therefore, it would be useful to establish rainfall intensity gauges and/or IDF-curves in/for different parts of Mozambique.

3.3 EXECUTION / TECHNICAL QUALITY

As construction for Phase 2 (green urban infrastructure) started in 2018, this section only refers to the already completed construction works of Phase 1 (Chiveve River rehabilitation).

3.3.1 Construction Phase

In general, the construction works of the river rehabilitation and tidal outlet were executed without major technical problems. However, some areas of improvement were highlighted during the interviews.

One concern during the construction phase was related to a resettlement of market vendors which took place unexpectedly, due to the necessity of the Contractor to use this space. Feedback from the construction supervision team as well as the municipality and contractor were that the handling could have been improved through a better planning and clear orientation in advance. The design and tender documents had foreseen to not include this informally used market space in the construction area. At the time of mobilization of the Contractor, the different teams at site then found it impracticable to follow this instruction. This ad-hoc resettlement measure was prepared and monitored by a social expert, but due to its short timing it cannot be considered a good practice. Nevertheless, the market vendors could be integrated successfully into an existing market, with the perspective of having them return to the formalised market to be built under phase 2.

Another critical issue during construction were the challenging soil conditions in the area. The soft, water saturated riverine and wetland soils which are contaminated with relatively large quantities of solid waste do not present ideal conditions for earthworks or as a foundation layer. During the field visit, two spots with failed slopes were observed which illustrates the issue of unstable soils. Also in Basin 3, one of the gabion mat protections slipped, probably also due to unstable soil conditions.

Figure 3-4 Failure of river slope in Basin 1, slipped gabion mats in Basin 3

Gabions have been widely used in the river rehabilitation to protect certain slopes. During the field visit, most gabion structures were found to be intact. Apart from the previously mentioned slipped gabion mattresses, one section of gabions was subject to theft. Stones were taken from two gabion baskets in Basin 1 – most probably for use in residential construction. However, due to the location of this specific set of gabion baskets, the river embankment stability is not jeopardized.

Figure 3-5 Gabion baskets subject to theft of stones (Basin 1)

During the construction phase, the balancing of works practicability and environmental preservation turned out to be a major challenge. The Technical Specifications of Works and Environmental Management Plan (EMP) clearly instructed the limitation of access to the site with heavy machinery, requesting the use of manual excavation and light machinery and avoidance of compacting of soils. In reality, construction however was done quite conventionally with heavy excavators which required compacted access ways along the margin of the river. Only some works were done manually, comprising excavation in basin 3 as well as final shaping of the river's cross-section.

Figure 3-6 Excavation works in Basin 1. *(Source: INROS LACKNER)*

In the same way, the EMP instructed the preservation of at least one line of mangrove trees along the margin of the river in order to facilitate its reproduction and prevent soil erosion. Construction works were not able to follow this principle in Basin 2, where the main part of the river margin was cleared from all mangrove trees. This clearance was seen as necessary by the Contractor and supervisor in order to achieve the required dimensions of the cross sections as well as to allow access to excavators. The Resident Engineer and Environmental Control Officer still tried to protect individual trees from clearance on the top of the cross section. The line of mangrove trees was marked up to which the Contractor could do clearance of vegetation.

The storage and use of cleared mangrove wood then presented another obstacle. Due to the relative value of the wood for local construction and firewood, the cleared mangrove trunks had to be stored safely. As it is generally prohibited to cut mangroves (without a special permit) KfW was interested to use it for a social purpose. The educational training center Young Africa was then contracted by CMB to produce school benches and other furniture for social facilities from the mangrove wood.

Regarding the topographic survey works (also as-built surveys and setting out), similar problems as during the design phase occurred. Due to the different elevation references for documents / measurements of different sources, some confusion was caused. This could be resolved with the experience from the design phase.

3.3.2 Complementary measures in Goto

The design of Phase 1 identified that the informal settlement Goto as main beneficiary area suffers from inundation after heavy rains, which would not be resolved solely by the Chiveve rehabilitation works due to a lack of drainage structures within the settlement. Furthermore, waste disposal presented a major environmental problem, further leading to increased flood risks. To be able to address these issues within the project, KfW established a cooperation with GIZ and provided EUR 350.000 through a disposition fund for the direct implementation of relevant measures. GIZ provided the international staff for implementation.

The IC took over the task of planning and monitoring the implementation of tertiary drainage channels in Goto. The rehabilitation of the Chiveve, especially the clearing and widening in basin 3 offers the possibility to receive excess storm water and drain towards the tidal outlet. Based on existing topographic information and various in situ assessments, an open drain ditch layout within Goto was developed. The alignment follows in general the slope from east to the west. The drain ditches have been realised by the installation of prefabricated concrete U-profiles.

Within this component a public awareness program has been set up to clean the ditches from waste in order to guarantee a regular drainage.

Furthermore, a University cooperation was established between the Mozambican Catholic University (UCM) and the German University Hochschule RheinMain. Students of the UCM have been involved in the elaboration of a waste management concept for Goto. A Cooperation Agreement between both Universities was signed in March 2015, providing continuity to the academic exchange in the area of Engineering Science on the topics of resource efficiency and climate change.

Based on the waste management concept, the community-based organization ADEG (Associação de Desenvolvimento do Goto) was equipped and capacitated as a waste collection service for Goto. Municipal waste collection does not enter the informal settlement, so that solid waste used to be dumped in the Chiveve, in drainage ditches, public spaces or even used as a housing foundation. ADEG now operates daily, collecting waste along specific routes within Goto and receives funding from CMB. While solid waste disposal is still a critical issue, the situation along the Chiveve and the drainage ditches has improved significantly.

3.3.3 Operation Phase

The tidal outlet was designed with simplicity in mind to facilitate operation and maintenance as much as possible. Therefore, the gates are simple sliding gates which are operated with an electric overhead crane installed in the gatehouse. For operation in case of power outages or during maintenance of the main crane, a set of manually-operated winches is also installed to ensure that the gates can be operated at all times. The staff at the tidal outlet mentioned that a generator would be useful to install at the gatehouse so that the electric crane could be operated also during power outages. However, based on the operation concept developed during the design phase of the project (see Figure 3-7), the gates are only to be closed if certain water levels are reached. Under normal conditions the gates remain open in order to allow a natural tidal movement into and out from the Chiveve. Thus the usage of the electrical crane is minimised so that the expense of purchasing, operating and maintaining a generator is hardly justifiable – especially as easy-to-use hand winches are available on site.

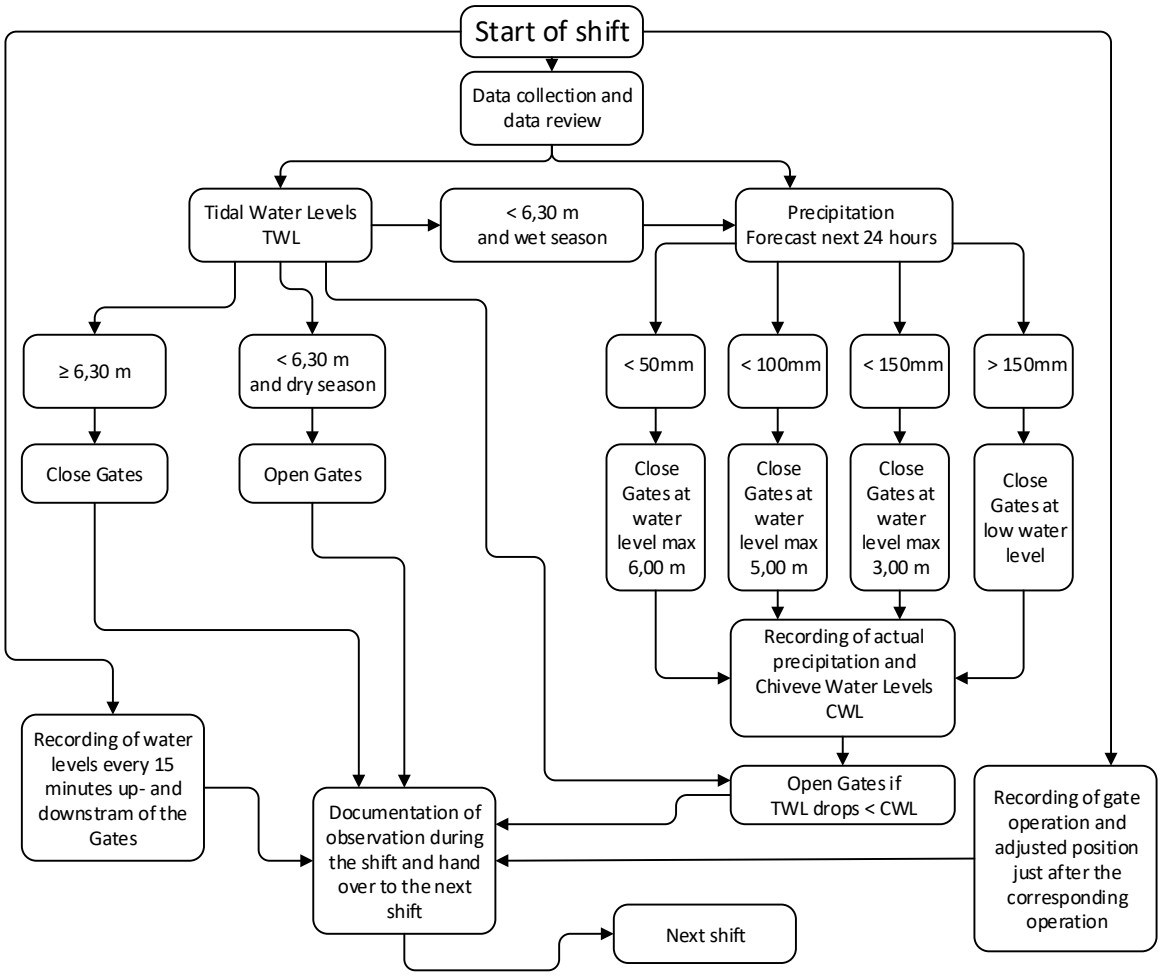


Figure 3-7 Operational Rules

A major concern during the design phase was the correct operation of the tidal outlet. Only when the outlet gates are operated properly, the system operates at its peak effectiveness. During the field visit it showed that the gatehouse is staffed with trained technicians which overall ensure a satisfactory operation. Currently, the gates are opened and closed more frequently and the water levels in the river section are not fluctuating as much as envisaged during the design phase. However, only a more in-depth analysis of the records could give a complete picture of the operating procedures.

Improvements on the timing of the opening/closing of the gates should be implemented in the future which will further increase the effectiveness and would be of particular benefit for the ecosystem (see chapter 3.4.4). Generally, the structure appeared well-maintained and the operation logbooks were complete. The logbooks are archived at SASB, however without any analyses of the accuracy of operation which would increase the operational effectiveness of the project.

The installation of rain gauges within the Chiveve catchment and water level recorders along the basins was recommend by the IC and should be implemented within the second project phase. Combined with the evaluation of the tidal outlet logbooks, it would be possible to better understand the characteristics of the rehabilitated Rio Chiveve and to improve operation and adapt to changing boundary conditions. The analysis and recommendations for gate operation could be done through the Park Management Entity to be established during the second project phase.

Figure 3-8 Staff discussing the gatehouse logs, example water level log sheet, operation of gate (from left to right)

The operation of phase 1 so far only considers the tidal outlet, with provisions that SASB should also take over responsibilities of maintaining the river course in terms of removal of increased sedimentation, erosion spots and blockages. The management of the green space, incl. monitoring of the ecosystem, is not part of the operation by SASB, for which it does not have the capacities. This needs to be covered within the operation of the second project phase that aims at the establishment of an urban park with a semi-autonomous management entity. Feedback on the operation of the gates should then also be provided based on results of regular ecological monitoring. Based on information from ADEL, the current operation of the gates does not allow sufficient flooding of the mangrove wetlands which may also have led to a limited success of introducing the red mangrove.

According to AIAS and the CMB, sedimentation in the retention pond in Basin 1 is lower than what is expected based on the design calculations. During the field visit this could not be verified, the retention pond could not be fully emptied.

3.3.4 Lessons Learnt

The experiences from the construction and operation phases provide a set of good practices and ideas for improvement for future similar projects:

- A project implementation unit with technical competence and sufficient funding is beneficial for the smooth implementation of a project.
- Green solutions require adaption of common construction techniques. Especially the use of heavy equipment might have to be limited in favour of manual labour. The use of special equipment (e.g. amphibious excavators for wetlands) should be clearly indicated in the tender documents and instructed for construction. Construction companies often do not have such equipment, which may increase overall costs. Small machinery and manual labour results in longer construction times and higher efforts, thus it is not a preferred approach by construction companies.
- Clear guidance has to be provided to the construction company and supervisors to prioritise the preservation of the habitat, with flexibility in regard to some of the provided construction targets. In the Chiveve case, minor adjustments of the upper river cross section and alignment could have resulted in a protection of a few hundred mangrove trees, especially along the margins on Basin 2. Such adjustments have to be done on site during mobilization, with a team of engineers and environmental experts present.

- For technical structures (such as a tidal outlet), simple solutions facilitate operation and maintenance for the project owner and help to minimize downtime e.g. due to lack of spare parts.
- The operational records of the tidal outlet seem to be complete and can be a valuable source for determining the operational efficiency of the project if they are archived, regularly analysed and used for operation improvement.
- Possibly required resettlement should be investigated during the feasibility phase and be well-prepared so that the construction works are not delayed due to it. The Contractor should then receive clear orientation and follow-up, especially regarding infrastructure to be protected from construction works.
- The use of standard gabions might be problematic. Many coastal cities in Mozambique have only very limited sources of rocks suitable for building houses. Therefore, the stones in gabions are sometimes seen as readily available building material and subject of theft, damaging the gabion structures and possible jeopardizing the functionality of the constructed infrastructure. Alternative green or grey solutions should be considered, if the gabion structures are deemed to be at risk.
- The operation of grey infrastructure within a hybrid solution should also be oriented towards benefiting the ecological system and clear operation and monitoring targets should be provided.
- Operation and maintenance of green infrastructures should be done by a competent entity. Especially in an urban context, the management of public green spaces and particularly parks requires funding and expertise, to be provided or by a private concessionaire (with strict environmental requirements) or by a public service provider with financial autonomy. The operation must ensure good environmental management practices, with regular ecosystem monitoring. Furthermore an urban park management must provide public services, ensuring public access and utilization, cleanliness and security.

3.4 ECOLOGY

Regarding the ecology, the project had two main objectives:

- The rehabilitation of the Rio Chiveve and reopening towards the estuary in order to both improve the drainage of the system and to improve the ecological functioning and health of the riverine ecosystem,
- The upgrading of urban green space for recreational purposes in the central city neighbourhoods of Chaimite and Ponta-Gêa.

3.4.1 Flood and Tidal Regime

By opening the river, widening its cross sections and connecting it to the estuary through the tidal outlet, the connectivity between the two ecosystems has been improved. Previously, only a small culvert provided drainage for the river area, whereas now the tidal outlet provides a suitable out –and inflow section to the estuary (see figure below). The fluctuation of the water levels in the river area is also much improved. While the direct influence of the tidal water levels is not restored to ensure the drainage function of the river and prevent flooding in the city, the operation of the tidal outlet ensures fluctuating water levels in Rio Chiveve and holding water in the retention area during storm events with high tides. Nevertheless, the current operational practice limits the tidal influence by closing the gates at a high tide above 5m and keeping water in the riverbed during low tide.

Figure 3-9 Old outlet culvert in 2012 (left) and new tidal outlet structure in 2018 (right)

3.4.2 Sediment

Excavation activities removed large quantities of sediment from the system and the final shape of the river was fairly uniform. It was expected that natural sedimentation and erosion processes will once again change the shape of the bed, banks and floodplain over time acknowledging the morphology as a natural characteristic of a river.

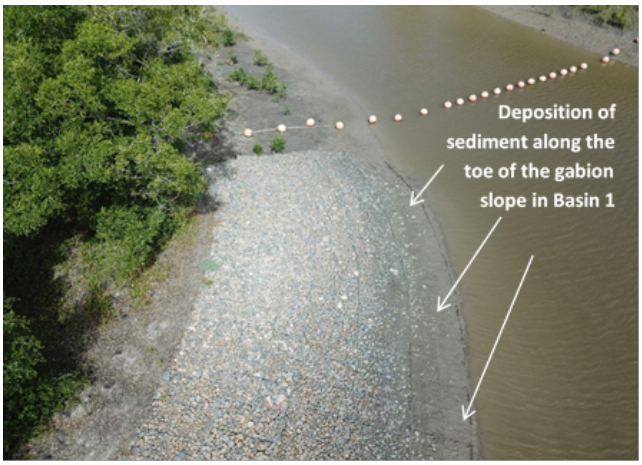


Figure 3-10 Deposition of sediment along the river *July 2018*

Due to the planned infrastructure along the river and the technical function of it, this has to be closely monitored and undesired changes have to be rectified to ensure the proper drainage capacity. For a healthy ecosystem, some sedimentation is however desired and can already be observed along the river.

3.4.3 Biota and biological processes

Any change to the flow and sediment regime in the river will lead to changes in the biota and biological processes that they drive. Ecological rehabilitation was aiming to achieve a new balance under the altered conditions. During the field visit it was observed that flora and fauna was already establishing in the gabion baskets and the natural sediment deposition areas and also in the areas around the river.

Figure 3-11 Mangroves establishing in the gabion baskets (left), grass growing over gabion baskets (right). *July 2018*

Several shrubs have established in the three basins, one of which is an edible plant species, typical for mangrove habitats. This shows that conditions in the basins are conducive to recruitment of a variety of species. From a biodiversity perspective, this is a good result. In the future, monitoring of plant species and density should take place to ensure that shrub species do not outcompete the mangroves.

3.4.4 Mangroves

The Mangrove Wetland Rehabilitation Plan, elaborated by IL/CES during the detailed design of phase 1 had foreseen to re-establish a near-natural mangrove population in the area around the river and re-introduce the red mangrove (*Rhizophora mucronata*) and black mangrove (*Bruguiera gymnorrhiza*). During the implementation phase, the local non-governmental organization (NGO) ADEL (*Associação de Desenvolvimento Economico Local*) - one of the main local NGOs working with mangrove reforestation in and around Beira - was subcontracted by the Contractor to realize the reforestation activities. Seedlings were grown in a dedicated nursery to be planted in the area. In 2018 it showed that these measures have not been very successful. The pioneer species white mangrove (*Avicennia marina*) has been established very successfully in the area, both where they have been planted and where they have established naturally. The other two species have not been planted successfully. Ecologically, this is acceptable, as the white mangrove can be expected to be the first species to inhabit substrates that have been disturbed. This species is also very tolerant of pollution, so may be the most likely candidate for recruitment in Basins 1 and 2. Over time, with the improved connectivity with the estuary and improved flow through the ecosystem, other species may arrive in due course.

As shown in the figure below, the area covered with Mangroves decreased with completion of the project. While in 2004 approx. 5.40 ha were covered with Mangroves in the studied area, the cover increased to 6 ha by 2012. After completion of the first phase of the project, the cover reduced to 2.8 ha. It has also to be considered that the stream of Rio Chiveve was virtually inexistent when the construction works started. The newly formed stream covers approx. 2.2 ha in areas which were mostly populated with mangroves before. This also includes approx. 0.4 ha which are covered by the retention basin at the tidal outlet. Also, part of the site was kept open for the now ongoing construction works for the park infrastructure and will partially be re-populated with vegetation during these works. The area close to the cultural centre “Casa de Cultura” (see detailed view in the figure below)

will feature an amphitheatre, artist workshop stalls and soft landscape. Those measures are to be implemented under Phase 2 of the project. Therefore, a mangrove reforestation has not taken place here.

Overall, mangrove reforestation measures required that each removed tree should be replaced by at least two others. With 1,100 mangrove trees removed during construction, ADEL was required to plant 2,2000 and guarantee their survival for the first two vegetation periods. A monitoring in August 2017 showed that from 3830 plants established in Basin 1 about 2750 survived and in Basin 2, 4760 plants were established with a survival of 4500, covering an area of approximately 2 hectare. Another reforestation site was Nhangau (North of Beira), where ADEL planted over five thousand mangrove trees.

Nevertheless the reforestation efforts, the Mangrove area has been reduced by the project and will also not reach the spatial extent of the pre-project times, as part of the area is taken up by the new river course as well as the future park infrastructure in the area.

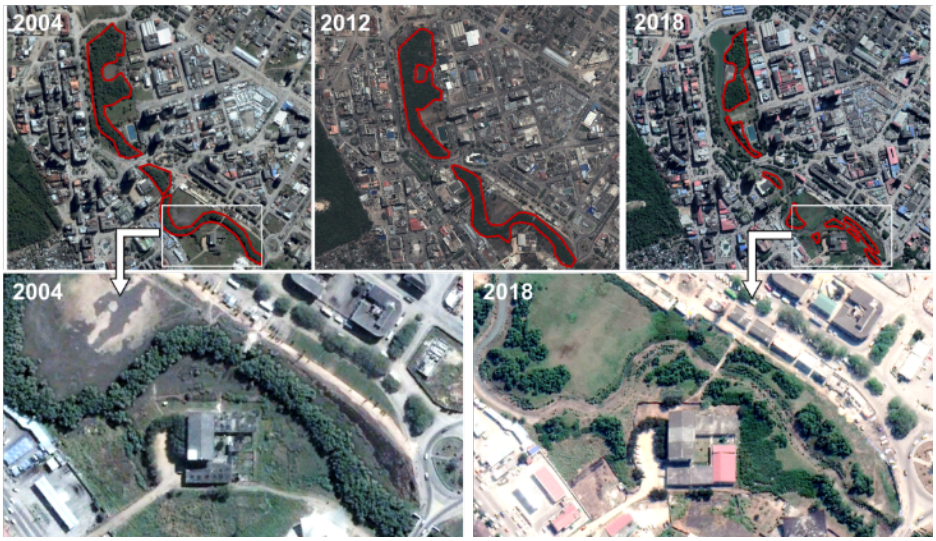


Figure 3-12 Area occupied by Mangroves around Rio Chiveve. Comparison 2004, 2012 and 2018 and Detailed View of the Area around "Casa de Cultura" *(Imagery Source: Google Earth)*

3.4.5 Lessons Learnt

The mangrove reforestation was conducted under difficult circumstances and the extent of its success still needs to be monitored. Nevertheless, the following conclusions can be made:

- Feasibility and design phases should be accompanied very closely by a mangrove / saltwater wetland expert and engineering measures verified accordingly. This allows a limitation of the impact on the mangrove habitat and an integrative approach of the rehabilitation measures to allow for a good recovery of the ecosystem post-construction.
- The extent of required clearing of vegetation, incl. mangroves and other protected species, is a critical issue for discussion. On the one side, the rehabilitation of rivers and wetlands requires excavation works resulting in the removal of vegetation. On the other side, the loss of flora and fauna should be limited as much as possible. The degree of degradation of an ecosystem may also be a key factor to decide on the extent of the intervention. Engineers and environmental experts should work very closely in defining the boundaries for vegetation clearing during the design and at the start of construction works.
- The (re)introduction of mangrove species should be assessed carefully.
- Reforestation measures already during construction through an experience local NGO showed mostly successful. While efforts were very large for watering plants during the close-off of the river, the early

establishment of mangroves along the embankment is seen as important for erosion control of the river's embankments.

- Avicennia Marina showed a very quick natural recovery. The reforestation of this species at this particular site may not have been necessary.
- The health of the mangrove ecosystem is directly linked to the operation of the gates, the best practice being the uncontrolled opening on a day-to-day basis to allow flooding of the entire mangrove area. This is currently not practiced, and operation guidelines may need to be reconsidered.
- Vegetation control of mangroves within the embankments and in the park area should not be necessary in a functioning, natural system. Due to the hybrid character of the river and specific interests, potential measures for operation shall be defined with according experts.

3.5 STAKEHOLDER COORDINATION AND PUBLIC COMMUNICATION

3.5.1 Coordination and Participation Mechanisms

A series of internal project meetings and broader stakeholder workshops took place during the course of the Feasibility Studies and Detailed Designs of both phases. The workshops were attended by the main project parties (AIAS, CMB, KfW, WB and IL/CES), government and civil society representatives, GIZ, academia, as well as other entities with special interest in or relevant for the project (e.g. the Harbour Operator Cornelder, EdM, etc.). Furthermore, two public hearings were held for each project phase as part of the ESIA, which were open for the public.

During construction of the first project phase, monthly meetings were organized by the contractor and supervisor with the local residents and other people potentially affected. These meetings allowed informing the community members about the progress of works, following activities and how this may affect them. It also presented a platform for them to raise concerns and grievances as well as to respond to general questions in regard to the project.

The relation and coordination between AIAS as the project implementing agency, the IC and financing institutions was very dynamic. Especially the engagement of AIAS (financed through World Bank) facilitated the project progress, as technically proficient staff was available and therefore able to discuss matters effectively. While the IC reported directly to AIAS and KfW, input and approval by the World Bank was provided through AIAS. Having two financing institutions involved generally increased the time for commenting and revision. This was especially the case for environmental and social aspects, where the minor involvement of the World Bank during the project planning and little direct communication between IC and World Bank led to certain delays in the preparation of resettlement and compensation measures as well as in the finalization of the ESIA.

The coordination between AIAS and the Municipality of Beira was done at a technical level, with CMB (mostly the Mayor personally) being part of all workshops. The involvement of the Municipality was crucial for this project, being the ‘owner’ of the financed infrastructure and the operator. All solutions developed during the project were presented to CMB to receive their informal approval. Considering that the Chiveve and Green Infrastructure investments gained a high political importance and international visibility, this fortunately had no effect on the project coordination between AIAS and CMB.

3.5.2 Project Visibility and Awareness Raising Campaigns

All interviewed parties agreed that the public visibility campaign for the Chiveve project was a key part of its success. The project received significant coverage in the media, who were present at main workshops as well as during official visits by state representatives from Mozambique or Germany. This included local newspapers and TV stations as well as German publications. In addition, the project concept and its solutions were presented at international conferences, professional journals and professional online platforms.

In the city of Beira, an information centre was established in a dedicated structure (“Quiosque do Rio Chiveve”). One room in the building showcases information, such as an architectural model of the project and is staffed with employees who give information and answer questions on the project. The other part of the building features a café, which is operated as a private enterprise. The building is located in a well-frequented area of the city. It was handed over to the municipality which operates it using funds generated from the café and an adjacent parking lot. According to records of the showroom, it is visited by approximately 20-50 visitors per week.

In addition, an awareness raising campaign was conducted. This included distributing a comic leaflet to schools which shows the importance of the Chiveve River and of keeping it clean. Furthermore, school classes were involved in environmental excursions along the Chiveve by ADEL. More extensive and regular awareness raising was conducted with GIZ in Goto in regard to waste collection and cleaning of drainage ditches, in order to reduce the volume of solid waste dumped in public areas, drains and the Chiveve.

Figure 3-13 Chiveve Information Center and Café (left), Educational comic strip commissioned for the project (middle), school class visiting the information center (right)

All interviewed parties named the information and involvement campaign as crucial to the project. By informing the affected stakeholders about the project at all planning stages, the progress of the project could be followed. The purpose of the project and the improvements to the community are known and understood better so that the support and therefore the sustainability of the project are improved. The large media coverage created an ownership amongst citizens, which is shown in social media and through the presence of residents during public events like the handing-over ceremony of the Chiveve works. By featuring the project in nation-wide media, also relevant authorities in Maputo as well as other provinces learnt about the project and the relatively new concept of nature-based flood protection.

3.5.3 Lessons Learnt

- Regular presentation of project progress results and direct discussions amongst the main parties involved showed to be crucial for the communication of options, solutions, preferences and thus for the direction of the feasibility studies and detailed designs.
- Public workshops should be organized at feasibility and early design stages, including as many stakeholders as possible. Alternative ideas to receive citizen input for the selection of project measures and design could be developed (e.g. online or local voting, idea contests, etc). This can familiarize residents and authorities with new and innovative concepts, generate valuable design inputs and also increase local ownership.
- Concerns and challenges by local people need to be understood and addressed. When dealing with NbS, the issue of mosquitos and wildlife is mostly associated with wetlands and highly vegetated areas. Waste dumping is a common problem in many informal settlements and often caused by inexistent collection systems. It is necessary to integrate solutions for such concerns and challenges and also slowly change mind-sets, developing an appreciation for nature and showing concrete benefits for local residents and businesses.
- Promoting public visibility and presence in the media increase the awareness and understanding for the project. On a community level it can lead to awareness and support for the project. On a political level it spreads new ideas (such as implementation of green instead of grey infrastructure) to policy makers, which might lead to a dissemination effect.
- The involvement of children in awareness raising and particularly in environmental education campaigns is considered important for the sustainability of green infrastructure projects. This can be realised through school or volunteering activities and through social media.

3.6 SUSTAINABILITY

3.6.1 Economic Sustainability / Operation and Maintenance

A main concern regarding the sustainability of the project is to ensure a sustainable operation and maintenance of the green and grey infrastructure. This was already raised during the design phase and repeated in the interviews conducted for the present consultancy (e.g. by AIAS, CMB, CES/IL, KfW). During the course of construction of the second project phase, a Park Management Entity will be set up to operate and maintain the Chiveve Park area. Accompanying measures will be financed by KfW to support the creation and management of this entity through an international consultant during a 4-year period. This comprises the legal set-up, the selection of staff, the elaboration and introduction of a business plan, an administrative system and O&M rules, capacity building measures and the support of the actual park management (incl. contract management, environmental monitoring, gardening and maintenance activities, public relations, etc.).

The Park Management Entity will be a semi-autonomous public service provider with financial autonomy. It will mainly generate revenues from rent payments, e.g. by the restaurant and two multi-purpose centers placed in the park. Operation and maintenance costs of the park infrastructure will in that way be covered independently from the city budget. It is envisaged that the operation of the park is self-sustaining and therefore free from budget constraints of the general municipal administration. However, the success of this concept depends largely on the acceptance of provided infrastructure by the private sector who is supposed to run the facilities and pay rent as well as its ability to make profits. Furthermore the Park Management Entity needs to have a good financial management capacity.

A similar approach was introduced in Maputo for the parks in Tunduru Botanical Garden and Parque dos Continuadores (Feira de Artesanato). The parks had previously been neglected due to lack of funding and were known to be crime and drug hot spots. The city for both projects received funding for the rehabilitation of the green spaces. In Parque dos Continuadores, revenue-generating businesses were created to fund the park management. Tunduru Botanical Garden is now a popular social spot in the neighbourhood, where people enjoy spending their free time. Parque dos Continuadores now has a well-known handicraft market which is well-frequented by tourists and locals alike. Part of the park is dedicated to painters, who display and sell their artwork. A restaurant offers affordable fare and enjoys increasing popularity in an area of the city which is more known for high-priced establishments. Those two examples from Maputo show that similar concepts of municipal park management have been implemented with success before. However, both parks are operated directly by the Municipality and in the case of the Parque dos Continuadores this has shown some limitations in the park management's ability to cover O&M costs in the past. Tunduru was only recently handed over to the Municipality.

On a smaller scale the concept has been proven to work in Beira as well. The information center ("Quiosque do Rio Chiveve") also features a revenue-generating café which currently is paying rent to CMB in addition to a paid parking lot. The café is well-frequented and together with the parking it cross-finances the information center located in the same building as well as the upkeep of the structure itself. Since its establishment in 2015 it was able to supply revenue to the city, who then pay for maintenance expenses. However, the functioning of the info point was not granted at all times, mainly due to unclear O&M responsibilities and uncertainty about the access to Municipal funds for repairs. Certainly, the visibility of the project and importance regarding the financing of the second phase were enabling factors.

Based on the above examples a direct operation by the Municipality was not recommended, considering that revenues would go into the overall municipal budget with no guarantee to cover the park's O&M costs. Furthermore, a municipal management would be under the responsibility of municipal staff which is under budget constraints and may not have the best capacities. On the other side, a private management of the park was seen as too risky considering that the financial analysis showed very limited profitability. The semi-autonomous service model already exists in Beira with SASB and is considered a promising concept. It may also involve some risks, considering the capacity of staff, the actual management of funds (and transparency) and the quality of O&M provided. The functioning of the Park Management Entity and quality of its services will mainly depend on a highly engaged and capable Director, as well as on good control mechanisms by CMB, the private sector and the citizens.

Regarding the funding for O&M of the drainage infrastructure in Beira, there is a long-standing debate going on in Beira regarding drainage tariffs. Such tariffs might generally be very useful for funding of the city's extensive drainage infrastructure (not only Rio Chiveve, but also other main drainage canals and the storm sewer network). Naturally, such tariffs are rather unpopular with the population and the authorities are facing lots of resistance regarding the introduction of such fees. Therefore, they could not yet be implemented. Revenue from these tariffs could however also benefit Rio Chiveve as they might help to pay for operation and maintenance if the revenues generated by the park might not be sufficient for larger maintenance works.

Not only funding can ensure proper maintenance of the area. The design team also tried to reduce the recurring maintenance cost. Lighting the area with solar-powered lights initially was a controversial proposal by the consultant due to the relatively high up-front cost. Solar-powered streetlights were finally designed for the surrounding area and are now perceived very positively. The lights are independent from the power grid and therefore are reliably lighting the footpaths, cycling lanes and public spaces after dawn. The lighted areas will also be of benefit for the residents as they provide a well-lit space for social activities after dark and reduced crime in the area considerably. The "green infrastructure" aspect of the project helps to lower the maintenance cost as well. The river itself does not require costly structural maintenance work, but only simple earthwork (for repairs / removal of sediment) and vegetation control. Both types of work can be done with minimal equipment and have almost no material costs. However the tidal outlet and all structural and leisure facilities provided under the second phase require more maintenance and related costs. In regard to landscaping, the areas which need irrigation were reduced as much as possible – the irrigation during the dry season needs to be evaluated as part of the Accompanying Measures during the elaboration of a business plan and operational rules of the Park Management Entity.

3.6.2 Ecologic Sustainability

The sustainability of the habitat in the project area largely depends on the proper operation and maintenance of the infrastructure and area. This includes operation of the tidal outlet and also the general maintenance of the area. In the interviews, some concern regarding the spread of the mangroves was voiced. Currently the mangroves are also starting to spread into the river cross sections, leading to concerns regarding the restriction of the flow capacity. In the future, vegetation might also spread into the park infrastructure (e.g. walkways) requiring some management.

Figure 3-14 Spread of mangroves in the flow cross section

During the construction phase the general approach was to minimize the removal of mangroves. This guideline should still be followed during the operation of the project. Therefore, the project owners, as well as the contractor and construction supervision consultants proposed to establish a mangrove management plan to define the proper management of the ecosystem in the area. This plan could include definitions of areas where the mangroves can be removed and also define the part of the river cross section that has to remain free of shrub and trees.

3.6.3 Social Sustainability

Due to the lack of perceived value of the old area around Rio Chiveve it was used as a disposal site for solid and faecal waste and not maintained. Especially the GUI portion of the project is aiming to change this perception by increasing the recreational value of the area. In addition to revenue-generating elements a number of other elements are integrated in the park infrastructure. This includes e.g. the walkway along the river, a market area and the amphitheatre which can host a variety of cultural events or can be used socially. Through these measures the park creates a benefit for residents and visitors of the city and aims to become a valued part of the city's leisure infrastructure. In addition to the increase of the quality of living in the city, this also encourages the maintenance of the area and discourages vandalism and further contamination of the area and therefore ensures the sustainability of the drainage portion of the project as well. The interviews showed that this part of the project is seen as highly valuable for the project by all stakeholders. Similar approaches are now also established in other projects. For example, as part of the World Bank funded Beira Storm Water Project, AIAS aims to protect the Maraza retention basin by establishing social infrastructure such as playgrounds around it.

3.6.4 Lessons Learnt

- Functioning management models and available funds for operation and maintenance are crucial factors for the project success. Therefore, sustainable concepts for this phase should be investigated during the design phase. For the establishment of new management structures, the project needs to guarantee technical support during the start of operation. But also for existing structures, capacity building may need to be required to increase the project sustainability.
- If the private sector is included in the operation and maintenance of individual facilities, an early involvement during planning stages needs to be guaranteed. This is mostly the case for urban parks with revenue-generation.
- The overall sustainability of green infrastructure projects depends on how the designed ecosystems are developing after completion of the project. As ecosystem development is a multi-faceted process, it cannot be fully predicted during the design phase. By monitoring the processes and developing monitoring and action plans for the operation phase, the risk regarding the ecological and therefore overall sustainability can be reduced.
- Social infrastructure surrounding the drainage project does create more visible benefits to the population besides the more abstract value of a functioning drainage solution (which might only be visible during storm events). This increases the acceptance such projects and helps keeping the system clean and functional.

4 RECOMMENDATIONS FOR FUTURE PROJECTS

The project implementation at Rio Chiveve is seen very positively by all involved parties. Future projects focussing on nature-based flood protection can benefit from the experience of this project. While not all practices from Beira might be applicable to every project, the different solutions used there should be taken into consideration. The process of collecting and sharing lessons learnt should be continued during the construction and operation phase of the project.

4.1 PROJECT PREPARATION

Being one of the first larger scale flood protection projects integrating NbS, the experience of Beira showed that early planning stages should provide sufficient time and budget to develop project solutions as well as flexibility to adapt solutions to the boundary conditions.

Often, the introduction of nature-based solutions is a process of awareness raising and continuous learning for most stakeholders involved. A clear communication of NbS objectives should take place with the main project entities and guide the planning phase. This should be reflected in setting up teams with relevant engineering, environmental (ecology, botany, zoology, etc.) and social expertise.

The project feasibility should look at O&M capacities for the future management of the green (and grey) infrastructure. This includes the development of a management model.

4.2 DESIGN PROCESS

Similar to the early planning stage, the design of NbS – in comparison to conventional engineering projects – requires some flexibility considering that no standard solutions can be applied. Close coordination by the main project parties is required to provide regular input during the design process.

For the rehabilitation of ecosystems, the design should carefully asses the balance of environmental and engineering measures, specifically for the clearing of vegetation. The design should develop simple and low-maintenance infrastructure solutions to facilitate operation.

A common challenge during all planning stages is the availability of data. Projects should try to support cities in establishing a database. On the other side, the design also showed the necessity to streamline topographic and georeferenced information (own and external datasets) to improve compatibility.

4.3 CONSTRUCTION

Clear guidelines should be developed for the construction phase to address special requirements for the implementation of green infrastructures. This includes specifications on vegetation clearing and the use/restriction of heavy machinery. These rules have to be enforced in addition to the normally enforced environmental standards by the construction supervision team to avoid lasting damages to the ecosystem.

4.4 OPERATION AND MAINTENANCE

Operation and maintenance is the key to the lasting success of green infrastructure projects. Detailed operation and maintenance guidelines should be developed already in the previous phases of the project. A capable operator should be identified and receive management training (incl. environmental monitoring) to increase the efficiency of the operation and maintenance efforts. Logging of key values (such as rainfall/water levels in Beira) provides a valuable database for project monitoring. Besides collection and archiving of this data, the regular data analyses and feedback are important to further optimize the operation of the project.

4.5 STAKEHOLDER ENGAGEMENT

The planning and design of NbS requires closer coordination between the main project stakeholders, considering that no standard measures apply, constant awareness raising still may take place and individual preferences also play a role in guiding the development of project solutions.

Enabling public participation already in the feasibility and design stage improves the outcomes of the project. By including the direct beneficiaries at an early stage, the acceptance of such a project in the area can be increased. Active workshops with residents also feed valuable local knowledge into the designs. Project visibility campaigns have also proven useful to ensure large public support.

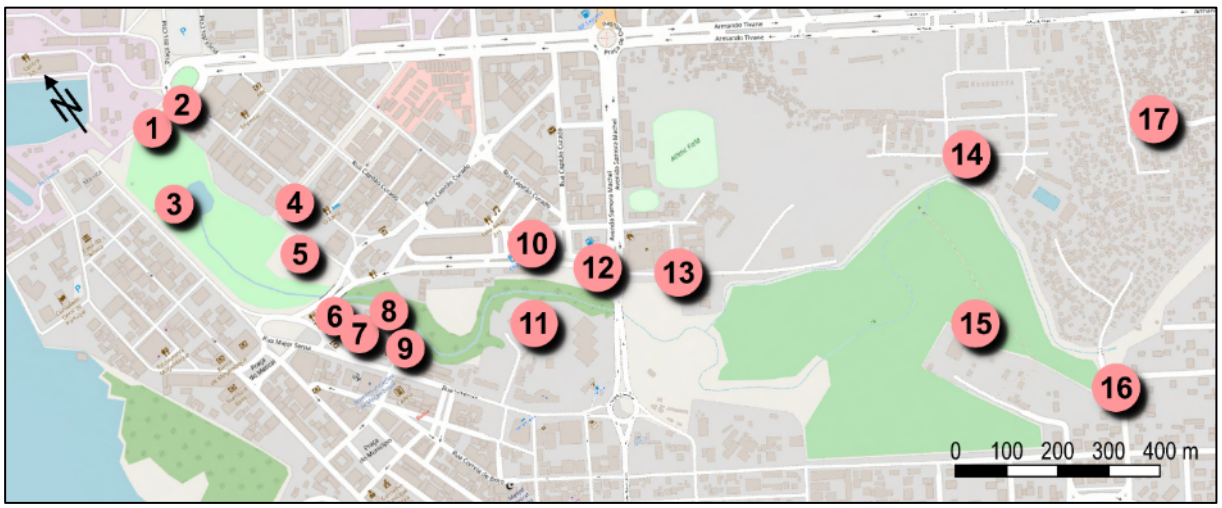
4.6 SUSTAINABILITY

The sustainability of green and grey infrastructure mainly depends on their good operation and maintenance. Besides the aspects covered under section 4.4, the project needs to assure that funding is available to cover O&M costs in the short to long term. Furthermore, ecosystem recovery and protection have to be guaranteed after the end of construction works through operational rules and management plans. Last but not least, the sustainability of green urban infrastructures is largely increased if accepted and respected by the public. This can be achieved by the inclusion of social infrastructure in the design as well as awareness raising campaigns.

ANNEX I – INTERVIEWS IN THE PROJECT AREA

Interviews regarding the perception and opinion of the Rio Chiveve Project were carried out in the area around Rio Chiveve in July 2018. Groups of interviewees were pre-defined by the Consultant to include private businesses, street vendors, residents, civil society and public facilities in close vicinity to the project area. While major businesses and public facilities are few and were thus directly selected, a random selection of residents and street vendors took place on site.

The locations of the interviews as well as the summarized results are presented in the figure and table below.



#	**Interview Result** (summary of interview result in black, consultant's comment in grey)
1	The officers of COLFOCI (Colera Fora da Cidade) perceive the project positively, especially as it gave employment to women in need. They ask the municipality to increase the subsidies for the project. They say that the project controls the mangrove areas to prohibit cutting and littering (also of faecal matter). COLFOCI is a community-based organization doing awareness raising activities against open defecation and for prevention of cholera.
2	The manager of the restaurant "Moulin Rouge" stresses the positive impact of the cleanliness and thinks of having a terrace next to the Chiveve. He speaks of an increase in robberies due to the halt of the construction works. Previously there were robberies on the streets and also local businesses have been robbed. The area was popular with robbers as they could easily escape into the densely vegetated and not well-lit area of Rio Chiveve.
3	ASSANI worker consider the Chiveve project as good initiative; her group is responsible for the cleaning of the area and the raising awareness of the residents to not dispose their garbage and faecal matter in the area ASSANI is an association doing community awareness campaigns. The group was involved by CMB to clean Chiveve's surrounding areas (solid waste collection) and is also responsible for raising awareness for cleanliness / public sanitation.

4	Merchant at the "Barreto e Filhos" building says that the rehabilitation has a very positive impact. Criminals (stealing cell phones) in front of his shop used to hide in the Chiveve area. He asks that the project should improve the drainage in the Macurungo area. Furthermore, it was noted that the first phase of the Chiveve was very positive and that there should be places for leisure. Macurungo neighbourhood is located north of the Chiveve.
5	The security manager (of the CFM swimming pool) speaks positive of the impact on the security situation in the area. There are no more robberies and theft in the area of the swimming pool. They request to install a gate opposite from the swimming pool to access the area. The cleaning efforts are working well.
6	The COMILAO Kiosk speaks positively of the project. Theft and robberies reduced. The situation is now much better, and they are awaiting the pretty and attractive things shown in the renders and model of the project
7	The manager of the Chiveve Kiosk [Info Center] speaks positively of the re-opening of the Chiveve. The security situation especially improved for women, who were previously raped and robbed in the area. She hopes for women's area in the new park space.
8	The manager of the Municipal Events Hall notes the positive impact on the security situation and the better (quieter) work environment. The project changed the area a lot. Inhabitants of the area benefit a lot, and the situation will further improve with stage 2 of the project, especially for artists and with internet access in the park area.
9	The merchants claim that they were affected by the transfer from the nearby bridge to the lower area due to the project. They continue to sell along the street and hope to get stands in the park after completion of stage 2 of the project
10	The manager of 'Handling' enterprise sees the first phase of the project positively. It saved the sales business. Previously there were many robberies who were hiding in the Chiveve. He asks for more commercial areas in the new market and playgrounds for children. He says that the impact of the Chiveve Project is especially visible during the rains in July, when there was no flooding occurring in the city.
11	The technician and choreographer of the Casa de Cultura says that the project had a positive impact. It brought safety to the visitors of the Casa de Cultura and improved the air quality. No robberies anymore and the work situation is good. They ask for spaces for artists and crafts in the new park.
12	The informal car washers are worried as they have to relocate their businesses which are their livelihood. They asked for a new location and the Municipality promised to provide one. The cleaning efforts are seen positively.
13	The workshop owner (close to fire brigade) says that the project had a positive impact in regard to cleanliness and security. He says that the police help with the security especially in the evenings and in the second phase the security and well-being in the area should be reinforced
14	The coordinator of the community development committee (CDC) sees the project positive in all ways. Now there is cleaning and bathrooms in the area and ADEG controls the cleaning

	and good hygienic practices. A second phase with additional funds and payment would be welcomed ADEG was established in the informal settlement of Goto within the project through a cooperation with GIZ.
15	The head of the golf club says that the club gained a lot with the rehabilitation of the Chiveve, namely cleanliness, safety and quality, well-being of the members and athletes, recovery of the mangroves and good circulation of water as well as a healthy ecosystem. He welcomes the second phase and is willing to cooperate with the project.
16	The district secretary likes the first phase of the project. With the installation of drainage ditches in the area and improved waste disposal the life in the community improved. The leader of the waste disposal of Goto said the positive impact is visible just by visiting and seeing the community engagement in cleaning and maintenance of the drainage ditches. They ask for a second phase which strengthens ADEG [association in Goto which conducts waste disposal] in waste disposal and with funds. He is willing to support a new project. They ask for more toilets in the area
17	The coordinator of CLGRC [local disaster risk management committee] welcomes a new project stage which would enable the whole municipality to breathe clean air. In his zone, the drainage ditches are cleaned and maintained and there are no floods any more. This experience should be spread, because it is very positive