

Sustainable River-based Urban Planning *for Sub-Saharan Africa:* **CASE STUDIES**



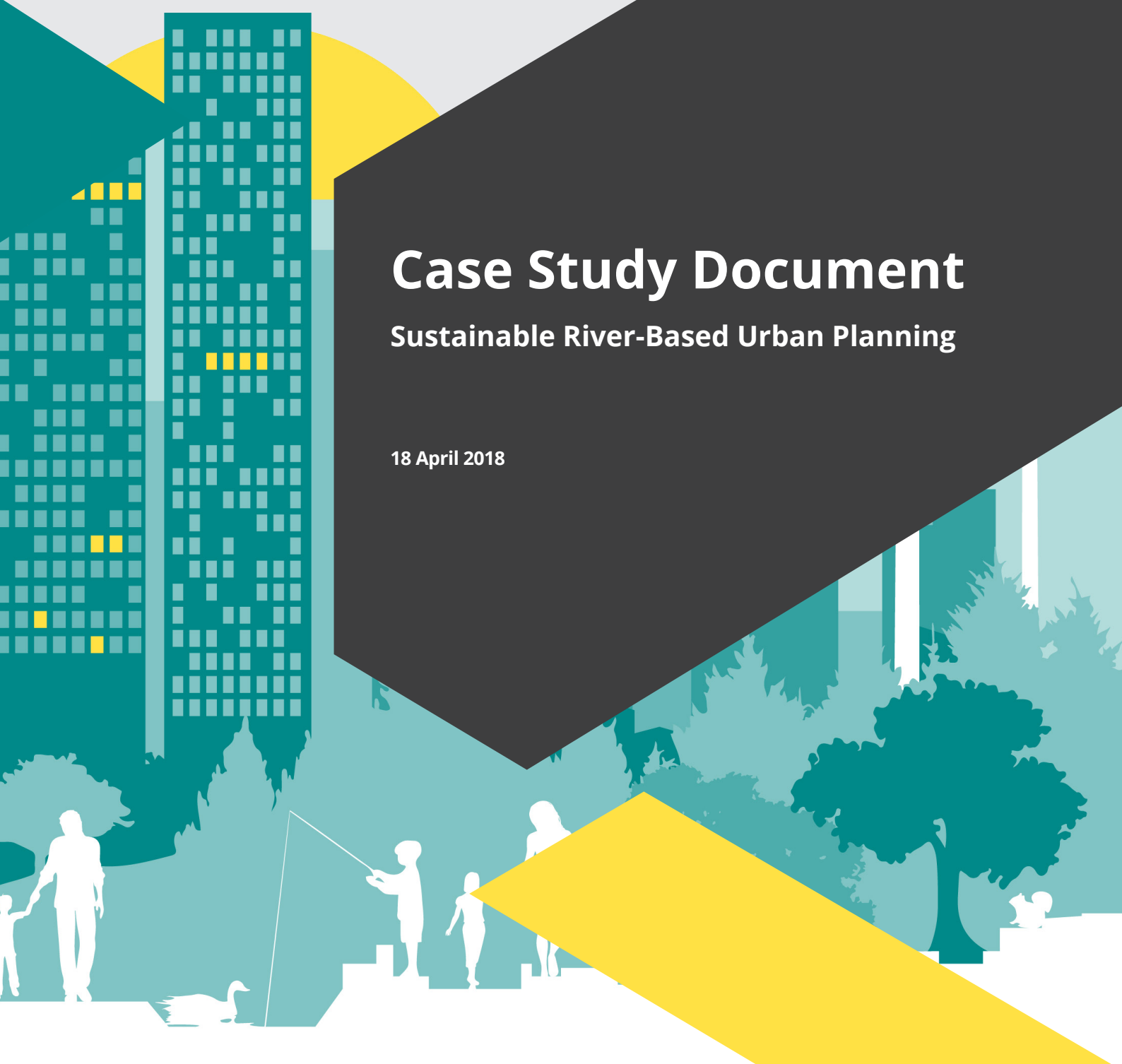
URBAN NATURAL ASSETS FOR AFRICA

Rivers for life

Case Study Document

Sustainable River-Based Urban Planning

18 April 2018



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Introduction and Objectives

This document complements ICLEI Africa's guidelines entitled 'Sustainable River-based Urban Planning Guideline for Sub-Saharan African Cities'. Produced as part of ICLEI's four year flagship project Urban Natural Assets for Africa: Rivers for Life (UNA Rivers) and funded by SwedBio (which operates from the Stockholm Resilience Centre), both were written in support of its objective of mainstreaming biodiversity and ecosystem services into land use planning and local government decision-making processes around urban river systems. It is intended that this be achieved by improving coordination and community-based activation, strengthening sustainability and resilience, enhancing human well-being and alleviating poverty. The project cities are: Addis Ababa (Ethiopia), Lilongwe (Malawi) and Dar es Salaam (Tanzania).

The purpose of The UNA Rivers Case Study Document is to provide examples of best practice in sustainable river-based urban planning in order to promote and inspire city-to-city learning exchange by examining relevant case studies in developing countries across the globe.



The case studies in this document are divided into the following four primary themes:

1. Community participation
2. Urban flooding
3. Multiple stakeholder engagement
4. Climate change adaption

Each of these themes contain case study examples of both successful and unsuccessful river rehabilitation projects, methodologies undertaken, as well as the lessons learnt from the various projects.

Sustainable Development Goals (SDGs)













Diagram Source:

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1. Community Participation

Community participation is an essential element to ensuring the success and sustainability of a river rehabilitation project. The term 'community participation' is commonly understood as the collective involvement of local people in assessing their needs and organising strategies to meet those needs (Zakus & Lysack, 1998). The local community must be informed about the issue at hand and must be involved in the decision-making process. Community participation has a number of well documented benefits and can result in community ownership, community support, lower project costs as well as enhanced decision-making and better project outcomes. The value of community participation in project processes is highlighted using four case studies, which are listed in the table below.











Case Study	Location	Overview	SDGs	Key Words	Page Number
1.1 Using local initiative and knowledge for water and soil conservation	Bogor, Indonesia	Limited water access and polluted rivers make it difficult for the Bogor Municipality to address water conservation. This case study outlines how the municipality undertook various initiatives conserve water. It showcases the approaches that were implemented to promote sustainable resource management.		Sustainable resource management; conservation; bio-pores; groundwater recharge wells; awareness.	8
1.2 Principles and processes for Supporting Stakeholder Participation in Integrated River Management	Sabie-Sand Catchment, South Africa	The Sabie-Sand Catchment experiences continual challenges which include a) global climate change b) population growth and distribution and c) changes in land use along the river. This case study elaborates on how scientists in the Kruger National Park Rivers Research Programme interact with communities and staff from the Working for Water programme to coordinate upstream and downstream activities relating to river and catchment management. It further demonstrates the effectiveness of creating a catchment-focused baseline on which to build a biophysical catchment management strategy.	  	Catchment management; capacity building; participation; stakeholder engagement; integrated river management.	11
1.3 Vaigai River Restoration Pageant Project	Vaigai River, India	This case study focuses on the successes achieved by the Vaigai River Restoration Pageant. Educational and ecological art was used to engage the local community, raise awareness of the environment, mobilise direct action and support to restore the water quality, biodiversity, habitats and health of this famous river.	  	River restoration; pollution; awareness; art; education; engaging the community; workshopping; partnerships; stakeholder involvement	14
1.4 100 Resilient Cities Pilot Project: Community Based Interventions To Improve River Health	Aller River, Durban, South Africa	Many rivers in the Durban area are under stress from invasive alien plants, waste pollution and sewage spills. To address this problem, a pilot project approach was followed for a 5.8 km stretch of the Aller River, in the eThekwin municipal area. The aim was to restore river health through assessments, rehabilitation, various restoration strategies and resource mobilisation.	  	Resilience; stakeholder engagement; river restoration; health, conservation; eThekwin Municipality	17

Sources:

Zakus J, & Lysack C. 1998. *Revisiting community participation. Health Policy and Planning*,13 (1):1-12.

2. Urban Flooding

African city governments are largely underprepared to meet the challenges of urbanisation, including the increased vulnerability to climate related hazards. African cities have undergone a massive spatial expansion in the recent decade with large proportions of the urban population living in unplanned settlements. These areas are typically characterized by limited access to adequate municipal services (water, sanitation, solid waste, electricity) and associated infrastructure (notably drainage). Together, these shortcomings contribute to a deterioration of environmental conditions and the presence of major health and safety risks, which are particularly acute at times of flooding (World Bank, 2011). While impacts are felt across the cities, major damages and public safety risks are generally most severe in populated river valleys. This puts residents and critical infrastructure assets at risk. The case studies in this section provide effective solutions to manage and overcome urban flooding challenges.










Case Study	Location	Overview	SDGs	Key Words	Page Number
2.1 Seeking Sustainable Solutions for Urban Floods	Iguaçu-Sarapuí River Basin, Rio De Janeiro State, Brazil	The Iguaçu-Sarapuí River Basin in Brazil experiences high levels of encroachment and severe urban flooding. This case study explores how a Water Resource Master Plan aimed to address this problem and analyses the different interventions proposed through the mathematical model known as MODCEL.	  	Urbanisation; flooding; land use control; MODCEL	21
2.2 Integrated Flood Management	Kampala, Uganda	Flooding in Kampala is a challenge that is exacerbated by changing climate conditions. This case study explores how a different approach to flood management through the development of a master plan and innovative drainage strategies has helped to implement solutions.	  	Urban flooding; flash floods; sustainable urban drainage system; stormwater management.	24
2.3 Controlling the Yangtze River Floods	Yangtze, China	The Yangtze River in China faces serious threats. In the recent past, the river has flooded and been subjected to the loss of its natural wetlands and erosion. This case study examines how the Chinese Government resolved these problems through the implementation of the 32 Character Policy, which aims to reduce flood threats and implement the philosophy of “working with nature rather than fighting it”.	 	Flooding; relocation; floodplains; agriculture; restoration; public participation; governance; water resource management; integrated policy.	27
2.4 Riparian Zone Conservation in a Changing Urban Land Use Environment	Nairobi River Basin, Kenya	This case study examines how the riparian buffer areas in the Nairobi River Basin were enhanced to protect the riverbanks and improve the river water quality. The study established that weak policy and institutional frameworks have led to haphazard and incompatible multiple uses of the riparian zones.	 	Encroachment; degradation; riparian zones; ecosystem; land use management; policy, Nairobi River Basin; urban land use.	31

















Sources:

World Bank, 2011. Urban Poverty and Climate Change in Dar es Salaam, Tanzania: A Case Study & Hambati, H., 2013. Weathering the storm: disaster risk and vulnerability assessment of informal settlements in Mwanza City, Tanzania.

3. Multiple Stakeholder Engagement






Multiple stakeholder engagement is an umbrella term that includes community participation (see above). Multi-stakeholder engagement refers to the need of engaging with a range of technical experts and individuals from differing backgrounds in order to develop, design and manage inclusive and holistic activities along river systems. The case studies in this section showcase the need for engaging with multiple participants as well as showcase best practice that encourages inclusive river management.

Case Study	Location	Overview	SDGs	Key Words	Page Number
3.1 Revitalising the Iloilo River through collaboration and integration	Iloilo City, Philippines	The Iloilo River was subject to severe degradation which reached an alarming level by the year 2000. This case study explores how the Iloilo City Council developed a sustainable development programme for the river's revitalisation. It showcases the City's integrated planning process to develop a 10-year master plan for the river.	 	Urbanisation; master plan; public participation; integrated planning.	35
3.2 Integrated Model for Efficient Water Management	Lima, Peru	Water supply in Lima is highly vulnerable due to pollution and climate change. This case study examines how effective water governance can address these problems and how the creation of the Water Resource Council of the Chillón- Rimac - Lurín Interregional Basin has promoted conservation and enhancement of rivers in the basin.	  	Climate change; water governance; water management; integrated solutions.	38
3.4 Restoring Urban Rivers from their Source to the Sea	Zandvlei Catchment, Western Cape, South Africa	Source to Sea is a growing network of partners and stakeholders who work together to manage water quality and quantity for the purpose of supporting the region's wealth of biodiversity while ensuring optimal utilisation of river corridors for the sustained benefit of all users. The case study discusses the need to develop a cohesive management strategy that will maximise urban natural recreational space, restore degraded natural and open space corridors for biodiversity conservation, improve water quality, and link river corridors and catchments.	 	Stakeholder engagement; management strategy; integration, public participation.	41
3.5 Trans-boundary Water Management through Multi-Level Participatory Governance and Community Projects	Volta River Basin, Ghana and Burkina Faso	This case study analyses how the project "Improving Water Governance in the Volta River Basin" addresses the challenges that the Volta River Basin experiences due to exploitation, poor consultation between stakeholders and uncoordinated policies. The project aims to improve water governance through consensus on key water management principles and demonstrate how integrated management of water resources can build trust and capacity to develop governance mechanisms.	  	Water governance; Water resource management; capacity building; public participation; climate change.	44

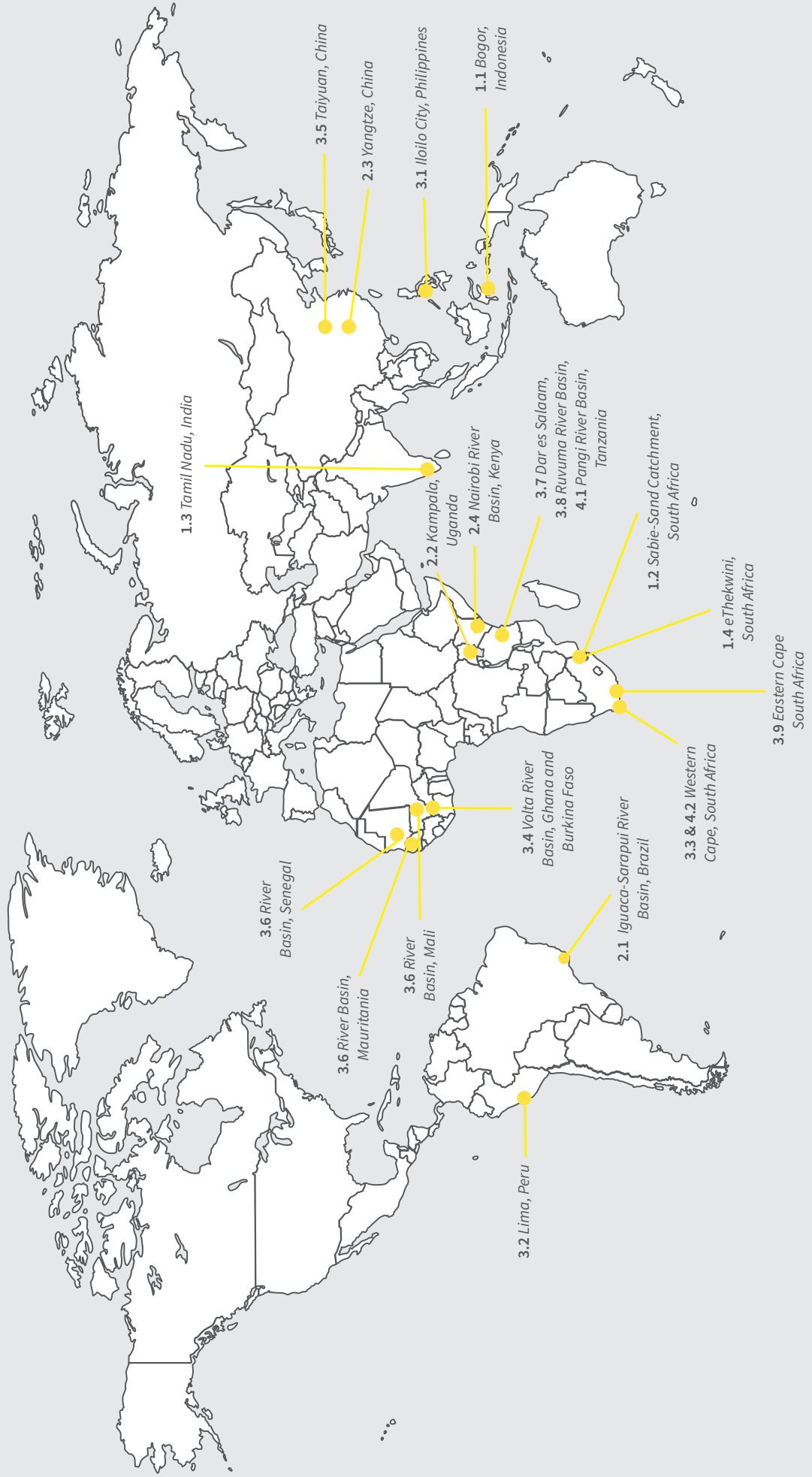
Case Study	Location	Overview	SDGs	Key Words	Page Number
3.5 The Fen River in Taiyuan, China: Ecology, Revitalization, and Urban Culture	Taiyuan, China	The Fen River in Taiyuan, China experienced deterioration due to extensive industrialization in the 1950s. The case study explores how the Government pursued an integrated, inter-municipal, and multi-objective approach to restoring the river's ecosystem through the Yellow River Diversion Project.	 	Degradation; restoration; rivers; settlements; urbanization; water pollution; development; industrialization.	47
3.6 Establishing a Trans-boundary Organisation for Integrated Water Resource Management (IWRM)	Senegal River Basin	The case study describes the institutional and legal infrastructure created by three out of the four riparian states of the Senegal River basin, namely Mali, Mauritania and Senegal. The aim was to jointly manage available water resources to meet the region's socio-economic and development needs and ensure the integrity of the environment.	  	Climate change; integrated water resource management; riparian states; river basin.	49
3.7 Mlalakua River Restoration Project, Tanzania	Mlalakua River just north of Dar es Salaam, Tanzania	Besides the above, the OMVS also sought to counter waterborne diseases, flooding in St Louis (a city on the north-west coast of Senegal), water quality degradation, the loss of mangrove forests, reduced wetland areas and the loss of biodiversity and reproduction areas that were no longer accessible to fish.	   	Waste Management; public sector capacity; marine life; and informal settlements.	52
3.8 Sustainable Water Resources Management in the Upper Ruvuma River, Tanzania	Ruvuma River Basin, Tanzania	The Ruvuma River basin is a 155500-square kilometre drainage area shared by the southern African countries of Tanzania and Mozambique, and the Ruvuma River forms the border between them for a length of approximately 650 km. This perennial river's source is located in the Matagoro Mountains in south-eastern Tanzania.	  	Water security; stakeholder harmonisation; and sustainable water usage.	55
3.9 Umzimvubu Catchment Restoration of Local Ecosystem Services	uMzimvubu Catchment, Eastern Cape, South Africa	The uMzimvubu catchment and river system lies along the northern boundary of the Eastern Cape in South Africa. The river system extends over 200 km from its source, which is located in the Maloti Drakensberg watershed and extends to its estuary at Port St Johns where it drains into the Indian Ocean. The focus area of this particular project covers more than 2 million hectares within the Eastern Cape and nearly 70% of the land on which it is located is communally owned.	   	Invasive alien vegetation; sustainable cultivation; deforestation; pollution; and degradation of soils.	58

4. Climate Change Adaptation

Climate change adaptation seeks to lower the risks posed by the consequences of climatic changes. Water resources are directly impacted by climate change, and the management of these resources affects the vulnerability of ecosystems, socio-economic activities and human health. The case studies under this section showcase a variety of adaptation options for improved riverine and water management.

Case Study	Location	Overview	SDGs	Key Words	Page Number
4.1 Building Consensus on Water Allocation and Climate Change Adaptation	Pangani River Basin, Tanzania.	Climate change and the over exploitation of water resources by competing water users is challenging the ability of the Pangani River Basin in Tanzania to provide basic water services for human needs. This case study examines how the formation and the implementation of an Integrated Water Resource Management Plan was used to inform possible water-resource planning decisions in the basin.	   	Climate change; public-private partnerships; water-resource planning/management; public participation; multi-stakeholder engagement; water scarcity.	63
4.2 Controlling Invasive Alien Species on the Rondegat River Ecosystem	Cederberg Region, Western Cape Province, South Africa	This case study showcases a project aimed at simultaneously clearing invasive alien trees and predatory alien fish in an ecologically important river ecosystem.		Invasive alien trees; predatory alien fish; river ecosystem; rehabilitation; biodiversity; Smallmouth Bass; Cape Floristic Region.	66

Case Study Locations





COMMUNITY PARTICIPATION 1

1.1 Using Local Initiative and Knowledge for Water and Soil Conservation, Indonesia

1.1.1 Background and Introduction

Bogor is one of the fastest growing urban municipalities in Indonesia due to its strategic location. The majority of its surrounding land is subject to rapid conversion to residential, industrial and public areas. This has challenged the City of Bogor's ability to provide residents with adequate access to water. In addition, striking a balance between using and conserving water and soil is required to ensure sustainability management.

According to the Case Study (ICLEI, 2011), at least 80% of the city's residents do not have access to an adequate water supply and have to rely on polluted rivers to satisfy their basic needs. People that live closer to the river are considered to be fortunate because the majority have to travel far distances to fetch water or spend substantial amounts of their already limited disposable income to buy it.

The area receives frequent rainfall, which could provide an alternative source of public water if better managed. Given the population growth rate, it is predicted that the demand for water will

increase, which will affect the quality and quantity of the city's primary water resources. It is argued that over-extraction of its already limited water supply will destabilize the soil structure and damage its biodiversity.

The City of Bogor had to create innovative ideas/ approaches to address this problem. These ideas included conserving the already insufficient water supplies while simultaneously providing the public with adequate access to usable water. According to ICLEI (2011), practical measures and supportive policies to address the abovementioned concerns were not instituted until 2004. These included the construction of 1,000 groundwater recharge wells and the implementation of a joint partnership with local communities in 2007 to help build 1,000 bio-pores and 21 spring water protectors. This process helped to regenerate the ecosystem services and will enable the City to conserve water and soil biodiversity in the long term, thereby meeting the basic needs of future generations (ICLEI, 2011).

1.1.2 Location

Bogor Municipality, Western Java Province, Indonesia.



1.1.3 Problem Addressed

Rapid urban expansion in Bogor had negatively affected the City's ability to provide water to residents. This was compounded by the poor quality and the limited quantity of primary water resources, which were rapidly deteriorating. Urban flooding is often experienced, and there is limited access to clean water, which impacts on the population's ability to meet their basic needs such as drinking, cooking, bathing, health and sanitation.

1.1.4 Approach

To address these challenges, the City's Environment Unit implemented water and soil conservation projects/activities in villages across the metropolitan area, such as those mentioned above. Low cost interventions and technology that was simple and easy to implement were chosen. The communities were made responsible for their maintenance and operation.

Activities included the following:

- Construction of groundwater recharge wells;
- Construction of bio-pores (to filter water, reduce water run-off and decrease soil erosion);
- The protection of springs to help increase water supply; and
- Improved efforts to raise community awareness about the necessity of safeguarding water and increase their participation in conserving this precious resource.

1.1.5 Benefits

Creating a source of clean water to promote community health – Since 2004, the City of Bogor has helped to construct 1,000 groundwater recharge wells. Each of these has the capacity to absorb six cubic meters per hour. Their parameters vary from 50cm in diameter and they are five meters in depth. They provide water for consumption and help to reduce flooding, which was a regular occurrence. They also aid in replenishing groundwater sources. As a result, the local community has improved access to cleaner water. In addition, methods to collect runoff surface water have been implemented in villages. This has helped the surrounding soil absorb rainwater more effectively.

Increased awareness by local communities – The involvement of local communities has been vital to the success of the overall project and proves how they can be empowered in the process.

Encouraging recycling – Various recycling initiatives have been implemented. These separate organic and non-organic waste and thereby help to reduce river

pollution. They have also aided reducing the burning of waste, which is a common local disposal method. The overall benefit is a reduction in CO² emissions, which improves air quality.

Excess run-off reduction as a result of bio-pore creation – An estimated 1,000 bio-pores have been created since 2007. Each has an absorption capacity of three litres per minute and the capacity to collect up to eight litres of organic waste.

Increase in water supply and protection of springs – It is estimated that 21 water springs have been protected since 2008 and 200 trees have also been planted. These help to increase the water supply and ensure that is of an acceptable standard. They also minimise the possibility of erosion. The local government has helped to construct 21 mini-reservoirs which support the communities' needs in drier seasons.

Cleaner water and a greater understanding of the importance of access to clean water – Besides improving access to cleaner water, the overall project has benefitted residents by improving their understanding of the importance of water conservation, and the activities/methods that have been implemented have helped them manage their water resources in a more sustainable manner.

1.1.6 Sectors and Stakeholders

These include: Bogor Municipality, local communities, Non-Governmental Organisations (NGOs), Community Based Organisations (CBOs), National Government and local universities.

1.1.7 Main Challenges

According to ICLEI (2011: 4), one of the main challenges experienced in this case study was a lack of consultation with the communities until the activity/project had been implemented. While local community stakeholders offer their full support and even co-share the costs (despite this), the actual community only becomes involved much later in the process. This is problematic because ideally one would want the local communities to be actively involved with the process since they are the ones being affected by the proposed measures to be implemented. This could be addressed by regular public awareness raising to emphasise the need for joint preservation of water resources.

Other challenges included budget limitations which limited the scale of the activities/projects. The implication is that the City does not prioritise the provision of clean water to citizens and that it is unable to afford projects/activities of this nature. To address this, public-private partnerships should be

explored. Strong political will is of great importance in ensuring that the required resources are mobilized; access to cleaner water must be an integral part of the City's development priorities. According to the City's 2005 Planning and Development Offices data, at least 51% of the area's water resources are untapped. With adequate funding, the City could invest in water infrastructure and would benefit from economies of scale.

1.1.8 Time Frame

2004 – 2008.

1.1.9 Lessons Learned

Bogor City's relevant units should support decision making that is informed and based on analytical data. Issues related to water scarcity, river pollution and its attendant sicknesses, including diarrhoea, typhoid and cholera, are all interlinked, and should be addressed by means of assessments that provide accurate data and information. This is also necessary to help to coordinate efforts between different departments and units a strong political will and effective leadership is also required. It is possible for the Planning and Development Unit to create a strong basis for the development of a comprehensive spatial plan. This will help to ensure that conservation areas and endangered zones are well protected against further degradation or development.

Environmentally focused advocacy to the general public to promote awareness. A good understanding of natural resource thresholds and ecosystem services will enable people to act more responsibly when using water resources and recycling waste. Sanitation and hygiene should be promoted in different age groups. In addition, learning about these issues at a young age followed by frequent exposure to repeated messages along the same line has been observed to gradually transform behaviour such that when mature, people understand the value of ecosystems and act with more caution in using them.

Lastly, in order to successfully replicate the activities/projects that were implemented in this case study, it is important that all stakeholders are consulted on a continuous basis. This will help to create a sense of ownership and promote responsibility from the start of the project/activities. In addition, local universities or research centres should be asked to participate in creating a comprehensive land use plan to identify potential conservation sites in the city.

Sources:

ICLEI. 2011. *Bogor, Indonesia. Using local initiative and knowledge for local water and soil conservation.* ICLEI Case Study 129. Available: www.iclei.org/casestudies [08 August 2017].



Bogor 'angkot' is the main public transport mode

Image Source:

<http://jakartaglobe.id/environment/bogor-wins-wwfs-lovable-city-title/>



Bio pore absorbing hole

Image Source:

<http://wctngcmfng.canalblog.com/archives/2010/03/25/17352930.html>

1.2 Principles and Processes for Supporting Stakeholder Participation in Integrated River Management, South Africa

1.2.1 Background and Introduction

This particular project arose from a suggestion that scientists working on the Kruger National Park Rivers Research Programme, which had been initiated to restart the year-round flow of the park's main rivers, should include the Working for Water programme. The idea behind this particular project was to coordinate upstream and downstream activities relating to river and catchment management that had been negatively affected by global climate change, population growth and distribution, overutilization, changes in land use along the park's rivers and invasive alien plants. At the time, the main activities that imposed pressure on the rivers included forestry, agriculture, tourism, municipal activity and industrialisation. The alien plants had negatively affected water use and riparian zone health.

Due to these pressures, the Sand River (amongst others) stops flowing during low flow periods and natural resources in the sub-catchment suffer from heavy pressure. The objective of this project was to create a catchment-focused baseline on which to build a biophysical catchment management strategy. The project team conducted a series of workshops with stakeholders in the catchment area to create the principles and processes that would need to be developed so as to align these to the people whose needs and values the catchment serves. At the conclusion of the project the following achievements and insights were highlighted:

- Capacity building was enabled by the project participants themselves;
- The value of undertaking a bottom-up approach to resource management was realised. This was due to government's realisation that people need to be empowered to decide on their own solutions to resource management and its role is to facilitate this process rather than to direct it; and
- The stakeholders realised that the results of the project will need to be linked to broader initiatives if they are to have a ripple effect.

The main objectives of the project were to develop, describe and communicate principles and processes that would support effective, integrated and cooperative participation in river management. It was envisaged that these would lead to the equitable and sustainable distribution of costs and benefits associated with the use of goods and services provided by the water resource. The objectives were more aligned to the intended priorities and outcomes of the new National Water Act (1998), compared to the capabilities of a collection of technical products. The aim of the project was to develop a better understanding of the tools and approaches proposed to Integrated Water Resource Management (IWRM) by scientists working in the Kruger National Park Rivers research Programme and how they can be integrated and applied through a process of collaborative research.

1.2.2 Location

Sabie-Sand Catchment, South Africa.



1.2.3 Problem Addressed

Developing a protocol to support catchment stakeholders in the development of strategies to promote cooperative river management.

1.2.4 Approach

Stakeholders were invited to participate in workshops.

The original intention of the project was to develop the above protocol using a three phase approach which entailed the following: firstly, to document the current state of the Sabie-Sand catchment, so as to provide the project team with a baseline for joint understanding and a starting point from which to build a procedure for visioning and strategy development; secondly, to work with stakeholders to define a desired state of the environment that would be acceptable to, and meet all of their needs; and lastly, to develop a set of protocols that would build on scientific best practice, and enable and empower stakeholders to work towards the achievement of improving the environment.

Development of Principles and Processes:

The project team developed a number of principles to support stakeholder participation. Commitment to these, and the application of guiding processes was used to support a governance system around the sustainable use and management of rivers.

The principles included:

- People first: the reserve provides the water that enables the delivery of goods and services to people (not water for river ecosystem animals and plants). The ecosystem is thus an invaluable resource and stakeholders define the type and level (desired state) of goods and services to be delivered;
- Co-operative stewardship between all stakeholders enables them to fairly allocate and deliver goods and services provided by the river;
- A "public good" ethic and acceptance of resource limits determines the distribution of costs and the benefits of goods and services delivery;
- Create a cooperative environment that involves formal institutions at all levels (local level through to national government) and sustains dialogue;
- Optimise the use of skills, knowledge (including indigenous knowledge), expertise and wisdom at all levels; and
- Use learning-by-doing and creative, issues-based conversation and bargaining to move communities of disinterest to communities of co-creation of vision.

The guiding processes include:

- Participatory processes to understand people's basic needs and preferences

- Capacity building to empower people to manage the state of their water resources (includes personal understanding, communication skills and institutional structures);
- Strategic adaptive management to enable the achievement of rivers that are able to deliver goods and services;
- Effective devolution of responsibility from the Department of Water Affairs to Catchment;
- The Management Agency should do the same with the Catchment Management Committee and any other appropriate local level;
- The acceptance of responsibility and accountability at the above levels;
- Facilitation, capacity building and extension support;
- Effective, honest and sustainable public participation;
- Integration of management systems and research of the rivers as an integrated system;
- Integrated research that identifies goods and services delivered by the rivers and creates awareness of them;
- Research to understand the relationship between the state of the rivers and their ability to deliver goods and services;
- Knowledge management, learning-by-doing and communicating new insights;
- Prototyping, which refers to the acceptance and use of the results from most current developmental prototypes (concepts, tools or methods) until an improved version is available; and
- Demonstration. A new concept or technology is rarely accepted without some demonstration of its worth. Results obtained through prototyping could be used to demonstrate this potential. Effective demonstration has a reinforcing effect on recognition and acceptance, resource allocation and capacity creation.

1.2.5 Benefits

The unique contribution of project was not to generate new tools and information – Adaptive management, visioning processes, state of the environment reporting and capacity building are not new concepts. The true value of this project is how these tools can be integrated and applied through a process of collaborative research, within the context of new legislation and the social processes that determine the ecological state of a common property resource.

Generation of new knowledge – As a consequence of new understanding, the research team and other participants developed the capacity to act meaningfully in the river management environment, which is highly complex. Although the team's collective knowledge may not currently be widespread, it is likely to have significant influence on the future thinking

and actions of the wider community (research, implementation and resource users).

Commitment to a single, integrative, stakeholder consultation process – It provided the platform for building a genuine ‘team’ that can take responsibility for the management of their shared resource. Successful implementation of the new National Water Act (1998) will depend largely on the realization of truly cooperative relationships and joint resource stewardship.

1.2.6 Sectors and Stakeholders

These include: the environmental, forestry, economic, agriculture, tourism, irrigation and industrial sectors. In addition, various stakeholders were included, such as the Department of Water Affairs (DWA), farmers and traditional leaders, the Council for Development and Cooperation, the Kgarudi Tribal Authority, the South African National Civic Organisation (SANCO), the Bushbuckridge Water Board, Sappi, the Kruger National Park Conservation Section, Local Government representatives and Sabie River Working Group.

1.2.7 Main Challenges

These can be summarised as water scarcity, land degradation and siltation of canals.

1.2.8 Time Frame

1999-2002

1.2.9 Lessons Learned

Using all (as opposed to select) knowledge sources – The overall project promoted a platform that stimulated a conducive environment for discussion,

equitable resource utilisation and equal opportunity. All participants were afforded the opportunity to contribute and express their needs and insights.

Dialogue and shared understanding are essential for effective co-operative governance – The fundamental deficit in a cooperative decision-making system is that communication has to filter through different levels of society and government. This can often be time consuming and difficult to coordinate. Therefore, there remains a great need to understand and facilitate the various barriers that hamper effective communication.

Defining the most efficient and effective levels at which government and society engage can enhance governance – Due to government’s impact being increasingly less effective the further away it is from civil society, it is imperative to identify the different gaps between them, and how they can cooperate more effectively. The cultivation of effective communication can foster and leverage better policy interventions around river management.

The river management process therefore offers opportunities for forging quality relationships – This occurs by developing community characteristics that support cooperation around river management decisions. Research, being a social service, has a significant role to play in this process.

The application of scientific information is necessary – This helps develop an understanding that informs people’s behaviour, directing it towards sustainable use of the resource. In order to achieve this, scientists must consider the influence of stakeholder perceptions and the policy/regulatory environment on behaviour relating to the state of the resource. Communication practices can and must be improved.

Sources:

Van Wilgen, B.W., Breen, C.M., Rogers, K.H., Roux, D.J., Sherwill, T., van Wyk, E., & Venter, F. 2003. *Principles and processes for supporting stakeholder participation in integrated river management. Lessons from the Sabie-Sand catchment.* Water research Commission Project K5/1062. [Online]. Available: <http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/1062-1-03.pdf> [08 August 2017].



Community school children

Image Source:

<https://www.morecommunitytrust.co.za/>



David maintaining the 45,000-acre reserve

Image Source:

<https://singita.com/community-development/farm-to-table-david-shilabe-story/>

1.3 Vaigai River Restoration Pageant Project, India

1.3.1 Background and Introduction

The Vaigai River Restoration Pageant Project was a community based effort to rehabilitate India's famous Vaigai River ecosystem which is situated in the ancient temple city of Madurai, Tamil Nadu, South India. This educational and ecological project aimed to mobilise environmental awareness in industries that use the Vaigai River.

The project aimed to mitigate the severity of the pollution and contamination affecting the river. Additional goals included promoting sustainable solutions for drinkable water and agricultural irrigation.

The above aims were achieved using community based and theatrical pageants over a three month period (January-April 2015). The pageants were held on the banks of the river for additional impact and helped the community directly implement solutions to address not only the above aims but the necessity of restoring the river to its natural state and future climate change challenges.

In addition, a series of educational workshops was conducted over the same period. These entailed the amalgamation of community members and artisans and were premised on a 'place-based' learning process.

1.3.2 Location

Vaigai River, Madurai, Tamil Nadu, India.



1.3.3 Problem Addressed

The pollution in the Vaigai River has toxic effects on the natural environment and has made it unsafe for human consumption. Various waterborne diseases have been identified, such as Cholera, Diarrhoea, Malaria and Typhoid. The pollution stems from the release of untreated effluents from small dyeing, tannery and pharmaceutical companies, automobile workshops, chemical and electroplating units. It is worsened by the release of slaughter house waste and mixing of domestic sewage water into the river. The pollution leads to the destruction of biodiversity and has negative knock-on effects on other ecosystems.

1.3.4 Approach

The project aims for the Vaigai River Restoration included the following:

- Raising awareness for better waste management practices in communities;
- Raising awareness for the restoration of water quality, promoting efforts to provide safe drinking water and the Development of Humane Action (DHAN) Foundation's existing projects, such as the Vayalagam Tankfed Agriculture Development Programme (VTADP);
- Building partnerships between stakeholders and engaging City officials, corporations, environmental organisations, activists, farming groups, schools and universities to mobilise and participate in solutions to restore the river;
- Encouraging community participation in a creative ecological art project and pageant to bring attention to the river, its history, and restore its health. Highlighting the benefits of drinking water and its use in agriculture, recreation, and peaceful open spaces within the city; and
- Highlighting and initiating proposals for visions for the river's future such as a park along its banks and other recreational uses that promote care and appreciation of the river, its historical legacy and future as an ecological oasis in the city.

1.3.5 Benefits

- **Highlighted the need for river restoration** – The pageants highlighted the issues of pollution, waste dumping and climate change and mobilised efforts to restore the river;
- **Encouraged stakeholder engagement** – Partnerships were formed with multiple stakeholders, who were encouraged to participate in creating solutions to rehabilitate the river;
- **Educating residents** – Better informed and educated residents exhibit long-term behavioural changes;
- **Cleaner water** – Illegal dumping of waste into the river was reduced; and
- **Driving good management practices** – Good sanitation and solid waste management practices in the management of the river were institutionalised.

1.3.6 Sectors and Stakeholders

These included: local environmental organisations, schools, universities, farming groups, activists, government representatives, cultural institutions, artisans, performers, women's empowerment groups, local organisations and the people of Madurai.

1.3.7 Main Challenges

The main challenge was obtaining the necessary funds. As a result, the project was solely limited to community engagement and education, and did not involve the physical restoration of river. The next challenge is to utilise the awareness that has been created in order to do so. The different stakeholders will have to work together to develop a mutually agreed on long-term vision for the river and should be supported by appropriate policies and legislation that discourage pollution.

1.3.8 Time Frame

The project was officially launched on the 2nd of October 2014. The actions that followed included: stakeholders meetings in Madurai being organised by the DHAN Foundation, building of partnerships and collaborations with schools and organizations, enlisting artisans and identifying key environmental educators to work alongside the artisans. . Educational Workshop series was run for three months from January 2015 to April 2015, which culminates to the Vaigai River Restoration Pageant event held in April 2018.

1.3.9 Lessons Learned

Promoting ownership and responsibility towards the river: Educating people about the impact of pollution on the river empowered them to assume responsibility for creating a sustainable future. The awareness campaigns and educational programmes provided a basis for all future educational Community –Building Workshop Series that is part of the Vaigai River Restoration Pageant Project. .

Sources:

Earth Celebrations & DHAN Foundation. [2015]. *Vaigai River Restoration Pageant Project Madurai, Tamil Nadu, South India*. [Online]. Available: <https://www.indiegogo.com/projects/vaigai-river-restoration-pageant-project-#/>. [07August 2017].



Vaigai River in Madurai, India

Image Source:

<https://www.indiegogo.com/projects/vaigai-river-restoration-pageant-project-#/>



Filed workers clean up Vaigai River

Image Source:

R_Ashok, <http://www.thehindu.com>

1.4 100 Resilient Cities Pilot Project: Community Based Interventions to Improve River Health, South Africa

1.4.1 Background and Introduction

At the end of 2013, Durban was selected as one of the first 32 cities to be included in the Rockefeller Foundation's international 100 Resilient Cities Programme. A key output of this was the development of a 'Resilience Strategy'. This is currently being finalised. The project began in 2014 with a scoping and

research phase to understand some of Durban's key resilience challenges. Stakeholders then participated in various engagement processes and identified a number of issues as playing a critical role in either enhancing or undermining the city's resilience.

1.4.2 Location

Aller River, eThekweni Municipality, Durban, South Africa



1.4.3 Problem Addressed

The project addressed the restoration of the health of selected rivers within the eThekweni Municipal Area. The rivers are under stress from the growth of invasive alien plants, waste pollution and sewage spills. These are regarded as threats to human health and the environment.

1.4.4 Approach

A pilot approach was followed for a 5.8 km stretch of the Aller River, which passes through New Germany and Clermont. This was part of the 'Take back our Rivers' initiative flagship project of the Kloof Conservancy, which seeks to restore the health of selected rivers across the municipal area by means of river assessments, rehabilitation activities, restoration strategies and the mobilisation of resources for implementation. Whilst the project is coordinated by the Kloof Conservancy, it is important to stress that it is also part of the eThekweni Conservancies Forum (ECF). The ECF is part of the regional node of conservancies, 'Conservation KZN' and represents all conservancies in the eThekweni Municipal Area. The piloted area is situated across different communities (middle class residential areas; industrial areas and low income/informal housing areas), and provided an opportunity to mobilise diverse members of the community to ensure the sustainability of the project. The type of approach chosen provided an opportunity to assess how river ecosystems can be managed and monitored by the active engagement of citizens who have been appropriately capacitated to undertake the work that is required.

1.4.5 Benefits

Reduction of alien vegetation: Significant progress was made in the clearing of alien plants and waste in this section of the Aller River.

Leveraging funding: The conservancies were able to leverage co-funding for alien clearing from the Duzi Umngeni Education Trust (DUCT). Moreover, they secured additional support in the form of volunteers, which contributed significantly to the project's success.

Establishment of working relationships and improvement of communication with municipal line functions: There was a steady flow of information such as status quo updates and incident reports (e.g. sewage spills) to stakeholders, project managers and relevant municipal departments such as the eThekweni Water and Sanitation Pollution control unit. As a result, problematic sewerage manholes were fixed timeously, which improved the water quality. Moreover, water quality tests from the Duzi Canoe Marathon reflect a decrease in the E.Coli

count. This is a significant success.

Livelihoods improvement: Livelihoods for people living along the river improved as did the unbearable smell that resulted from ongoing sewer spillage.

Local socio-economic upliftment through the employment of seven 'Eco-Champs': These Eco-Champs assist with river health maintenance, waste reduction, monitoring and community awareness. They work under the leadership of a capacitated Team Leader and Community Liaison Officer. Local capacity has been developed to deal with local problems.

Stakeholder mobilisation and capacity building: Different types of stakeholders were identified and mobilised by means of various community awareness campaigns. Events were held to raise awareness of the importance of the river for various community groups such as schools, traditional healers, art groups and other local leaders. Activities such as a river cultural festival, art campaigns, a river revival festival and litter cleaning campaigns were also held. Value of building partnerships: The project provided significant lessons on the value of partnerships between civil organisations and the municipality to achieve needed grassroots behavioural change. These partnerships also facilitated cross-departmental collaboration (Health, Water and Sanitation and Environmental Planning and Climate Protection Departments) in the monitoring of the river.

1.4.6 Sectors and Stakeholders

These included: the eThekweni Municipality and Conservancies Forum, the Environmental Planning and Climate Protection Department (EPCPD) Municipal Department, the Municipal Department of Water and Sanitation, the District Health Services (Provincial Department of Health and the Local Government authority), local schools, communities and local NGOs.

1.4.7 Main Challenges

The project achieved a number of successes such as those outlined in the Benefits section above. However, it is acknowledged that a year is insufficient time for an initiative of this magnitude. In addition, more funding is required to maintain a clean, alien invasive free Aller River and sustain the Eco-Champs in their very important tasks. The money provided by eThekweni Municipality for the pilot project enabled the project team to leverage funding from Cambridge University for phase 2 of the project, which is currently underway. This will fund the project from June 2017 until January 2018.

There is significant potential for the Take Back our Rivers (TBOR) approach to be applied to other rivers. For example, it could be adopted and adapted into the Palmiet Rehabilitation Pilot Project (PRP). The Palmiet River is situated in KwaZulu Natal, a province in South Africa.

The PRP is a climate change adaptation project that focuses on the conservation, rehabilitation and restoration of natural systems within the Palmiet catchment to improve the river's health and the resilience of the surrounding community. It has received funding from the Aqueduct Programme which will be used for the rehabilitation of ecological infrastructure within the catchment area.

The Climate Protection Branch within the EPCPD, which oversees the PRP, is pursuing a similar partnership with the Kloof Conservancy to replicate, upscale and apply the Aller River concept to the Palmiet catchment.

1.4.8 Time Frame

July 2017–ongoing

1.4.9 Lessons Learned

Key learnings include the importance of the natural environment in providing the foundation for human well-being, development and resilience. Issues relating to biodiversity, water and climate change were assimilated, as was the need to address these as part of Durban's overall resilience strategy.

The importance of active and engaged citizens in contributing towards said strategy was also highlighted. As history has shown, government cannot work in isolation to implement what is needed to build a sustainable city.

Capacity building was also shown to play a key role in creating awareness, building knowledge and equipping citizens with the skills they need to find employment and contribute towards building a resilient society and economy.

Sources:

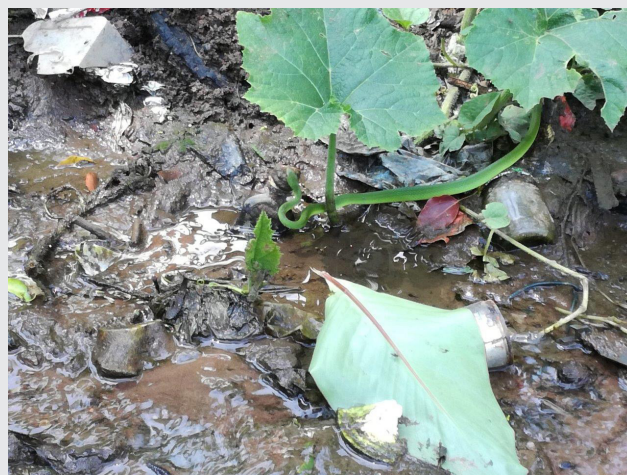
C40. 2017. *C40: 100 Resilient Cities Pilot Project: Community Based Interventions to Improve River Health*. [online] Available at: http://www.c40.org/case_studies/community-based-interventions-to-improve-river-health [Accessed 28 Mar. 2018].



Field worker, Aller River

Image Source:

<https://umngeniriverwalk.wordpress.com/2016/12/14/take-back-our-rivers/>



Vegetation on the Aller River

Image Source:

<https://umngeniriverwalk.wordpress.com/2016/12/14/take-back-our-rivers/>



URBAN
FLOODING **2**

2.1 Seeking Sustainable Solutions for Urban Floods, Brazil

2.1.1 Background and Introduction

The Iguaçú-Sarapuí River Basin is a densely populated metropolitan area situated in the western portion of the Guanabara Bay Basin in Rio de Janeiro, Brazil. The region experiences frequent, severe flooding as a result of poor occupation and land use in the broader Fluminense Lowlands. This is compounded by a lack of bulk urban infrastructure (deficiency of sewage services, illegal occupation of riverbanks and inadequate drainage systems), which is necessary to house and sustain the population. As in other developing cities, the rapid chaotic roll-out of

urbanization in rural zones has been characterised by the occupation of main river beds, inadequate sanitation, the acceleration of the sedimentation of rivers and canals, and the uncontrolled removal of vegetation. The repercussions pose complications for maintaining the waterbeds and solid waste disposal, and cause impervious surfaces. To address these issues, the Federal University of Rio de Janeiro conducted a study to revise the State Institute of the Environments Water Resource Master Plan.

2.1.2 Location

Iguaca-Sarapui River Basin, Rio de Janeiro state, Brazil.



2.1.3 Problem Addressed

The study aimed to address the frequent urban flooding in the Fluminense Lowlands as these causes major damage to urbanized areas. Various flood mitigation strategies were recommended and the need for better land use control was highlighted.

2.1.4 Approach

The aim of the study was to propose actions to control flooding, maintain open spaces that are free of urbanisation along rivers, establish Environmental Preservation areas, develop urban parks, create public consortiums to integrate the planning of policies, and revise and adapt the municipality's urban planning instruments.

Hydrodynamic modelling (MODCEL), a mathematical technique, was used to evaluate the possible impacts of the expansion of urbanisation towards the interior of the basin as is currently being proposed via the construction of axial highways, the most important being the Metropolitan Ring Road. The modelling was also used to measure the impact of the Intergovernmental Panel on Climate Change's forecasted average rise in the sea level on drainage conditions in the basin. Plans are required to control the negative future impacts of both

scenarios, as the human and material losses could become irremediable. With the aid of this model it was possible to analyse flows and variations in water level caused by spates, as much in water bodies as on stretches in plains. The modelling through cells was extended only from Baía da Guanabara to the confluence with the Botas River.

The figure below illustrates some of the outputs achieved using the model. Areas that are susceptible to flooding are clearly indicated. It was established that urban expansion will have repercussions on the sea level, causing it to rise. This will impact existing urban areas of the basin. Despite the contribution of independent variables, the above factors, when combined, would seriously impact the population. It will be very difficult to mitigate damage if the planning measures detailed in the study are not actioned in advance.

The National Government also provided support by engaging with municipalities in the Guanabara Bay Basin to implement the proposed plans, create controls for urban land use and develop environmental education campaigns. It did so with financing from the Federal Government, through a specific channel known as the Programme of Developing Acceleration.

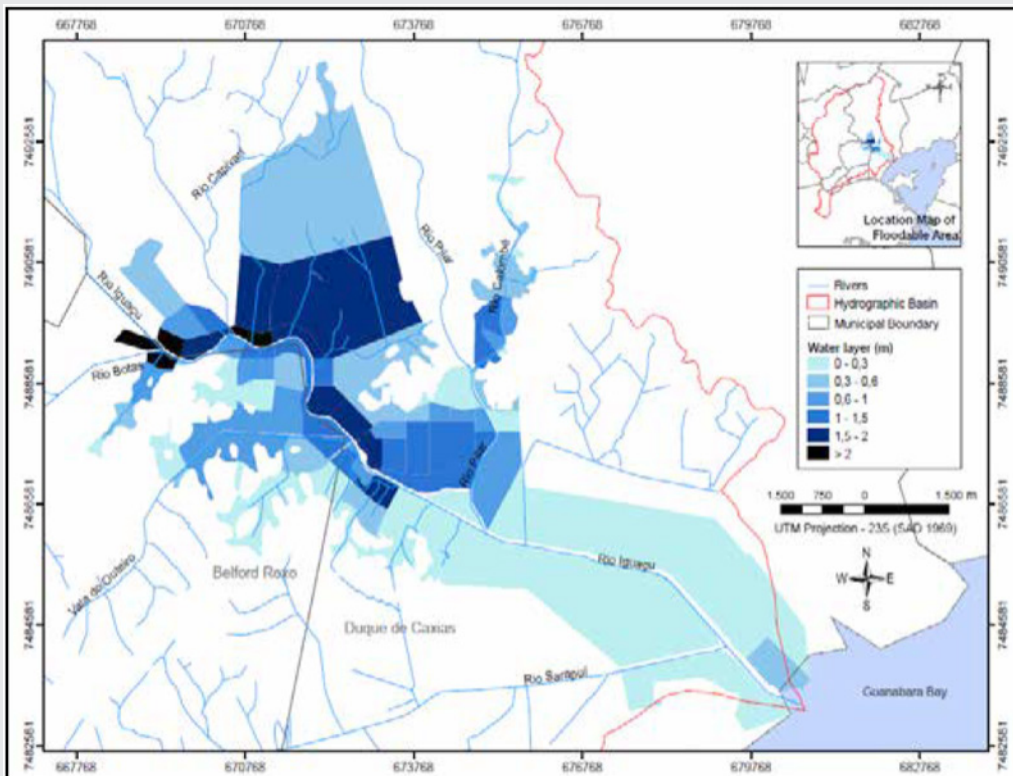


Figure 1. Example of a map created using hydrodynamic modelling.

Figure Source:
Miguez et al. 2011

2.1.5 Benefits

- **Large-scale intervention has a far-reaching positive impact** – these interventions will indirectly and directly benefit the three million inhabitants in the Baixada Fluminense.
- **The study recommends the following proactive actions to reduce risks** – these include:
 - The recovery of 80 km of degraded riverbanks;
 - Promoting the resettlement of 2,200 families from high risk areas to new housing developments in neighbouring areas;
 - The development of parks and recreational areas to protect the recovered riverbanks from new occupations and for temporarily stopping floods;
 - The definition of new areas for environmental preservation purposes;
 - The construction or recovery of approximately 70 km of streets along the areas of intervention; and
 - The recovery of narrow crossings, bridges, aqueducts, gates and polders. It is also estimated that 200,000 trees have been planted along the riverbanks.

The Instituto Estadual do Ambiente (INEA) has been developing the process of monitoring and evaluating this project by local committees and the regional forum of participation and social control. The aim is to mobilise local communities to counter social and environmental problems, and emphasise the importance of participation and social control in the achievement thereof.

2.1.6 Sectors And Stakeholders

Stakeholders include: National Government, the State Institute of the Environment (INEA), local municipalities, local committees, and the Federal University of Rio de Janeiro.

2.1.7 Main Challenges

The project required the considerations of a range of stakeholders. This proved to be a challenge because it became evident that stakeholders had different viewpoints about how to address urban flooding and there was a lack of cooperation between different government departments. Another challenge was the availability of data to support accurate analysis and future projections. This makes it difficult to replicate the project elsewhere.

2.1.8 Time Frame

2005 – 2011.

2.1.9 Lessons Learned

The Iguaçú-Sarapuí River Basin continues to feature conditions favourable to planning for urban flooding, albeit devised for application in the long term. A significant part of the territory has not been incorporated into the urban fabric – notably the land situated between the mountains that rise abruptly and the lowland areas. These assist in the maintenance of urban areas with high soil pervious rates, provided the urban fabric does not expand to them.

Sources:

Miguez, M.G., Mascarenhas, F.C.B., & Veról, A.P. 2011. MODCEL: A Mathematical Model for Urban Flood Simulation and Flood Control Design. *Acqua E Città 2011 - 4° Convegno Nazionale Di Idraulica Urbana Venezia*, 21 - 24 Giugno 2011.

Miguez, M.G., Veról, A.P., & Carneiro, P.R.F. 2012. *Sustainable Drainage Systems: An Integrated Approach, Combining Hydraulic Engineering Design, Urban Land Control and River Revitalisation Aspects*, Drainage Systems, Prof. Muhammad Salik Javaid (Ed.), ISBN: 978-953-51-0243-4, InTech, Available from: <http://www.intechopen.com/books/drainage-systems/sustainable-drainage-systems-anintegrated-approach-combining-hydraulic-engineering-design-urban-land> [07 August 2017].

2.2 Integrated Flood Management, Uganda

2.2.1 Background and Introduction

Flooding is a recurring problem in Kampala, Uganda, and is thus a pressing environmental concern. The city is predominantly built on former low-lying valleys and wetlands, and climate change is expected to cause major disruption for a large percentage of the city's low-income residents. Despite the short duration of the floods and the Kampala Capital City Authority's (KCCA) efforts to mitigate their impacts in flood-prone areas, the problems persist. The KCCA has therefore adopted a more strategic approach to addressing them. It aims to weave its flood plan into the United Nations-Habitat Cities and Climate Change Initiative master plan, which has been developed in response to climate change.

The KCCA's Project on Integrated Flood-Risk Management (IFM) aims to showcase an integrative, multi-dimensional and participatory approach to addressing flood risk. It also aims to capacitate the

city for future climate change trajectories. The project objectives are to:

"(1) carry out a comprehensive, city-wide assessment of the flooding risks based on the principles of integrated flood management; (2) to undertake a more detailed spatial flood risk assessment in a representative vulnerable neighbourhood (Bwaise slum area), and (3) mainstream improved and integrated flood management into Kampala Capital City Authorities' practices and operations". (Sliuzas & Kehew, 2013: 1).

In addition, the KCCA has adopted Sustainable Drainage Systems (SuDS) principles to prevent runoff through flood retention upstream. This has been made possible by support and maintenance from public bodies and stakeholders in civil society.

2.2.2 Location

Kampala, Uganda.



2.2.3 Problem Addressed

Flash floods are rapid flooding of geomorphic low-lying areas, and are characteristic of the area in which the city is located. They cause destruction and have costly socio-economic effects on the urban poor.

2.2.4 Approach

The Action Plan for Integrated Flood Risk Management for Kampala, a key output, suggests four pragmatic areas that evoke adjacent strategic responses to managing the city's flood risk. These include:

- Reducing flooding by improving drainage maintenance and solid waste management practices along drainage systems, together with SuDS measures. Collectively, these reduce the extent, depth and duration of floods;
- Mitigating the effects of flooding, enhancing the data and information services needed to plan and manage development in flood-prone areas and combining measures to improve sewerage disposal. This reduces the health risks associated with faecal waste disposal;
- Reducing susceptibility to flooding by implementing legal, planning and information awareness measures to reduce the number of structures and people exposed to it, as well as implementing public awareness campaigns and a strict enforcement regime; and
- Legally defining and protecting the remaining natural flood plains in Kampala. It is important to develop a clear and enforceable boundary definition of flood plains, including hazard zonation.

To ensure that its integrated flood management plans and stormwater management practices are sustainable, the KCCA implemented a multi-disciplinary engagement process with relevant bodies.

Officials cooperated with these bodies and implemented their recommendations in the KCCA's plans and actions. As a result, in late 2014, the KCCA was able to secure funding for the Terms of Reference necessary for a major consultancy to update the 2003 Kampala Drainage Master Plan in a manner that reflects approaches advocated by the project.

The KCCA has formulated a stormwater management policy in support of the effective implementation of the drainage master plan and continuously aims to update it.

2.2.5 Benefits

- **Implementation of the SuDS approach** – A reduction in flooding using the different strategies elaborated on above;
- **Using land use planning as a tool to promote environmental sustainability** – Better urban planning practice serves to locate and regulate the different types of land uses, and is thus a powerful tool for environmental conservation; and
- **Involvement and awareness in local communities is key** – The local community will become more aware of the dangers of flooding, as well as how they can help reduce it. Their involvement contributes to environmental sustainability through the protection of flood plains and other natural resources.

2.2.6 Sectors and Stakeholders

These include: the University of Twente; Makerere University; the Kampala Capital City Authority (KCCA); the National Slum Dwellers' Federation; the Buganda Land Board; and the Office of the Prime Minister.

2.2.7 Main Challenges

Flash floods result from a combination of factors which include:

“periods of intensive rainfall during the wet seasons, the landscape of the city which features many hills that drain into numerous relatively flat valleys and wetland areas, the densely developed hills and valleys, the high rates of rainwater run-off, inadequate drainage networks and water management, the spread of unplanned development, and inadequate solid waste management”.

(Siluzas & Kehew, 2013: 1).

2.2.8 Time Frame

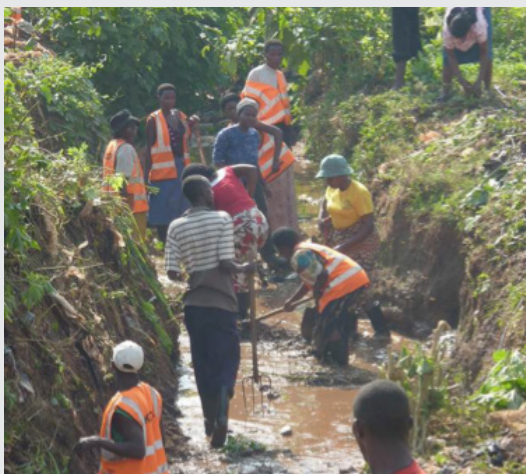
2012 - 2013.

2.2.9 Lessons Learned

Unregulated urban development is the key cause of increased surface water runoff and the speed of flash floods. The lack of well-designed bulk infrastructure e.g. integrated drainage systems poses a significant challenge. Moreover, the capacity of drains and bulk infrastructure maintenance is crucial. At the time of the project, the drains were in a critical condition and were characterised by solid waste blockages and sedimentation.

Sources:

Sliuzas, R. & Kehew, R. 2013. *Integrated Flood Management Kampala*. [Online]. Available: <http://uni.uninhabitat.org/wp-content/uploads/sites/7/2015/03/ifm-kampala-policy-brief-final.pdf>. [06 August 2017].



Maintenance of drains

Image Source:

Sliuzas, (2012) in Sliuzas & Kehew, 2013.



Open areas and wetlands

Image Source:

Sliuzas, (2012) in Sliuzas & Kehew, 2013.



Flood waters damage properties

Image Source:

Sliuzas, (2012) in Sliuzas & Kehew, 2013.

2.3 Controlling the Yangtze River Floods, China

2.3.1 Background and Introduction

The Yangtze River is located in the People's Republic of China. It is the third longest river in the world and covers a length of 6 380 kilometres and a catchment of 1.8 million km². It runs through 11 provinces and is the main source of livelihood for approximately 400 million people. Unfortunately, it has been subject to degradation and other threats such as: "the loss of natural wetland functions due to fragmentation and degradation, and upstream erosion leading to accelerated downstream siltation" (Ramsar: 2007:18). Compounding this, decision makers seem to be uninformed about its function and value and the various wetlands found within the riverine area. In 1996 and 1998, China experienced devastating floods.

In 1996, large flooding took place on the Yangtze, Huanghe and Huaihe rivers. It is estimated that the flood have taken the lives of 1 760 people and have costed farmers and businesses billions of dollars. The areas mentioned, were hit by severe thunderstorms since early July 1996 and water levels rose significantly. It is estimated 1.68 million people had to be evacuated, 18 200 enterprises have stopped production either partially or completely. Transport, communication and access to water and electricity have been cut off in some towns (Tyler 1996; Mufson 1996).

In the summer of 1998, the Yangtze River flooded after heavy rains. According to various sources, approximately 4 000 people were killed and economic losses were estimated at between \$24 billion and \$25 billion USD. To address this crisis and ensure that it does not recur, the Chinese National Government implemented its so-called '32 Character Policy' which reflected a change in approach by 'working with nature, rather than fighting it'.

The policy comprised four major elements: "(a) increasing forest coverage by enhancing protection measures and increasing the afforestation of steep farmlands; (b) restoring floodplains by removing embankments and returning agricultural polders to them to increase floodwater retention capacity; (c) resettling farmers by building new townships and providing them with jobs instead of subsidies; and (d) strengthening other levees and dredging riverbeds" (Pittock and Xu 2010: 1).

According to Pittock and Xu (2010:1-2), the policy helped to restore 2 900 km² of floodplains and increased the flood retention capacity of the riverine environment. In addition, biodiversity conservation was improved, the generation of ecosystem services was observed and the livelihoods of local people were improved.

2.3.2 Location

Yangtze River, China.



2.3.3 Problem Addressed

The flooding experienced in 1996 and 1998 in the central and lower regions of the river threatened people, ecosystems and the local economy. The damage was severe partly because people had reclaimed land along the floodplains for agricultural purposes. This eroded the watershed, causing an increase in siltation which in turn forced floodwaters into smaller areas with higher flood peaks that are harder to adequately manage. The irregular weather conditions caused by climate change have fuelled concern that more extreme floods can be expected in the basin area.

2.3.4 Approach

The '32 Character Policy' was developed by central government in an attempt to address these risks. The policy was backed up by national policy directives, recommendations and targets, substantial funding and reporting mechanisms. These enabled it to be effectively implemented at different scales, ranging from provincial level to local counties.

The approach that was followed promoted institutional and legislative development, public participation in decision-making, financial incentives and innovation in the development of appropriate technology. The Yangtze Forum was established in 2005 by the China Council for International Cooperation on Environment and Development (CCICED) to facilitate the implementation of the recommendations (stated below). Primarily conceived of as a platform to promote the active participation of all stakeholders dedicated to protecting, managing and developing the Yangtze River, it also enabled them to share information and knowledge on the development of the basin area. The first forum was held in Wuhan on 16 and 17 April 2005 and was attended by officials from the central government and all 11 provinces and municipalities in the Yangtze River Basin. Other attendees included representatives from 14 countries and a number of international organizations, including the WWF and the Global Water Partnership (GWP).

The following recommendations were approved:

- *"A ban on logging in the upper catchments;*
- *Returning cultivated steep slopes to forest;*
- *Relocating settlements from flood-prone areas to higher ground safe from flooding;*
- *Restoring wetlands in the Yangtze floodplain;*
- *Reinforcing embankments; and*
- *Maintaining river courses e.g. by dredging."*

(Ramsar: 2007:19)

2.3.5 Benefits

One of the key outcomes of the forum was the establishment of an Integrated River Basin Management Taskforce, which led to better governance of water resources, management of ecosystems and conservation of biodiversity. These successes are due to the Chinese Government's creation of a cross sectoral National Development and Reform Commission (NRDC), which helped to develop an integrated policy and oversaw its successful implementation. The policy was regarded as a success due to the manner in which it enabled China to create a 'moderately prosperous ecological civilization' through five year plans on a national level. These plans emphasised the importance of creating 'harmony' between people and nature and between the different social classes in urban and rural areas (Pittock and Xu 2010: 2).

Multiple benefits ensued from the project. There was a rise in fish stocks and a return of some of the native fish species that had been eradicated. Migratory water bird populations also grew due to the increase in the number of floodplains. The quality of the water in the floodplain lakes also improved substantially. These changes are attributed to the cessation of unsustainable aquaculture practices, the dilution of pollutants and the restoration of aquatic vegetation. In order for the interventions to be successfully implemented, various people had to be relocated. These people were from the poorer section of the area and suffered greater risks from flooding and poor health. According to Pittock and Xu (2010), the relocations improved their living conditions, giving them access to better health, housing, basic services and minimising the risk of floods. It has to be noted, however, that not everyone seems to have benefited as the interventions were forced and complaints were raised by people who felt they were being treated unfairly. They asserted that there was corruption with regards to the distribution of subsidies and other resources.

2.3.6 Sectors and Stakeholders

Stakeholders included local communities, the Chinese National Government, Provincial Governments, the Yangtze River Forum, NGOs and the tourism industry.

2.3.7 Main Challenges

Four different river-wide authorities managed the river and this led to uncoordinated management and institutional barriers. Cross sectoral and boundary conflicts between competing users also occurred. The complex task of relocating people was an additional challenge. The Chinese National Government used a 'development type resettlement' plan, which includes developing the economy

and related infrastructure in the area around the reservoir. This was designed to guarantee sufficient employment rates and living standards. Methods to assure this included opening new land for agriculture, improving the quality of existing land and establishing new business opportunities in the area. The government compensated people who were forced to move by means of a “lump sum” method. This type of compensation for displaced people took place from the late 1950’s to the late 1970’s. This granted people the total net worth of their home and land, according to criteria established by the government. However, this does not always translate into equal and effective resettlement (O’Hara, 2005). Developmental Resettlement Scheme

As previous relocation projects that were exclusively based on compensation payments had proven insufficient due to the fact that they do not address the downward spiral into impoverishment relocated people often find themselves in (Yuefang 2010) the government implemented a new type of programme for the relocation of people along the Yangtze River from 1981, when corrective regulations were introduced.

This ‘resettlement with development’ approach treats the relocation of people as a development project in its own right and aims to benefit those affected. It includes the following dimensions: restoration and improvement of agriculture production conditions and living standards as an objective; proper compensation as the economic foundation; the development and implementation of resettlement planning that combines resettlement and local economic development as the backbone; participation of affected people in all stages of planning and implementation; a resettlement administration system that is accountable and transparent; a series of assistance measures such as a reservoir construction fund, long term assistance and the redistribution of funds from the beneficiaries to those affected (Yuefang 2010).

To give effect to the programme, the government promulgated the Regulations on Resettlement for the construction of the Three Gorges Project on the Yangtze River.

Clause Three of Chapter One stipulates that the State will implement a development resettlement policy during the construction period. The government allocated 40 billion Renminbi (the official currency) to the project for compensation investment. In addition, it also created investment assistance measures such as an assistance fund to support the later resettlement period, an industry development fund, the retention of tax revenue for local government in the Three Gorges Reservoir Area, tax exemptions and partnership programmes (Yuefang, 2010).

It is however evident that the relocation did not take place without resistance and that it caused a range of social, political and economic problems. The impacts include among others, the social aspect of the displacement of people and the loss of certain religious, cultural and archaeological sites. It also had negative financial implications. For example, families were forced to buy homes at a higher price than they were compensated for and there was insufficient land to accommodate farmers/farming families. Some of the land that was given to farmers was far less fertile than their original land. As a result, many of them were forced to cultivate other commodities and crops, which negatively impacted their finances. Many people are currently in debt due to the relocation. In addition, many citizens claim they did not receive the compensation that was promised to them by the government (Yuging, 2016).

2.3.8 Time Frame

1998 - Ongoing.

2.3.9 Lessons Learned

The case study illustrates the radically different approach taken by the Chinese government to address the country’s disastrous floods of 1996 and 1998. This was ‘softer’ and more harmonious and led to the restoration of thousands of square kilometres of floodplains. These have sufficient capacity to slowly hold and release peak floodwaters, even in heavy rains.

The approach had various beneficial impacts for the environment such as: “improved water quality, recovery of flora and fauna, conservation of threatened species and designation of nature reserves. While 2.4 million people were relocated from the most flood-prone lands to adjacent, higher ground, their livelihoods and resilience have improved” (Pitcock and Xu 2010: 8). The relocation thus had a beneficial effect on many people’s livelihoods.

In addition, the possibility of regular future flooding was averted, the local economy was diversified and the majority of the population were given access to services that they had not previously enjoyed. Pitcock and Xu (2010:10), argue that a large majority of the people who were relocated had already been displaced by previous floods and the relocation was therefore the most practical means of resolving the problem. As climate change will potentially increase the severity and amount of flooding, the decision to relocate people carried many social, economic and environmental benefits.

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Gap of a broken dike in Huarong county

Image Source:

http://www.chinadaily.com.cn/china/2016-07/12/content_26048930.htm



Water levels swell

Image Source:

<http://www.scmp.com/news/china/policies-politics/article/1932867/chinas-yangtze-river-face-catastrophic-spring-floods>

2.4 Riparian Zone Conservation in a Changing Urban Land Use Environment, Nairobi River Basin, Kenya

2.4.1 Background and Introduction

Much of the riparian ecosystems in the Nairobi River Basin area has been encroached on and degraded in a short period of time. Riparian vegetation been cleared, wetlands drained and rivers have been straightened and canalized to increase spaces that can be used for urban activities and structures. This rapid change has caused the loss of a great amount of biodiversity and has had profound effects on both the physical appearance and the ecological health of these zones and their associated rivers.

This case study emphasises the importance of conserving the riparian buffer areas in the basin to protect its riverbanks, improve water quality and ensure that these resources are sustainably

managed. Its main findings are that the riparian zone has been degraded from highly disorganised and discordant multiple uses which are due to weak policy and institutional frameworks. The study also found that planning and development control mechanisms are weak, and that there are no clear land administration guidelines and procedures to secure the riparian width and vegetation.

The main objective of the study was to identify the main reasons for the degradation. The following main areas were identified as possible causes: policy and institutional factors, land use and biophysical factors professional and land users' factors influence.

2.4.2 Location

Nairobi River Basin, Kenya.



2.4.3 Problem Addressed

Weak policy and institutional framework has led to haphazard and incompatible multiple uses of the riparian zones in the basin. This has led to indiscriminate invasion and ecological degradation of riparian zones in the basin.

2.4.4 Approach

The approach that was adopted to conserve the basin's riparian zones centred on developing an integrated model that assessed factors affecting their determination, use and management. The model included factor inputs (economic, socio-cultural and population), process inputs (policy and institutional factors, bio-physical, land users/use factors and professional factors) and factor outputs (the state of the zones) to ensure that the area's physical extent and ecological conditions were conserved. This was necessary to assist in the determination, use and management of the riparian zones and improve their value and function.

2.4.5 Benefits

The following strategies were implemented to support the integrated model described above:

- **Secure and regulate the use of the riparian zones within the Nairobi River Basin** – The protection of its riparian zones is the most necessary action to ensure the long-term quality of its rivers and watershed resources;
- **Land use planning** – a riparian zone acts as a buffer between land and water bodies and enhances property values. It also reduces the loss of property due to excessive erosion and flooding and protects water quality;
- **Land surveying of the riparian zones** – this action enhances wildlife habitat, contributes to the natural beauty of the land and dissipates noise from traffic and nearby properties. The zones also provide privacy and beauty, screen unattractive sights and enhance scenic views;
- **Improve water quality** – this is done by trapping sediment and chemicals (fertilizers, pesticides and heavy metals) from any runoff before they reach water courses and wetlands;
- **Mitigate environmental impact** – this is achieved by stabilizing stream banks to prevent soil erosion (as an example); and
- **Increasing stakeholder involvement in conservation** – this is particularly important as involving different communities in the conservation of grazing and watering areas for livestock is greatly beneficial to them.

2.4.6 Sectors and Stakeholders

These include: The Ministry of Environment and Mineral Resources, Department of Nairobi River Basin Restoration and Rehabilitation, the Department of Resource Surveys and Remote Sensing (DRSRS), the Water Resources Management Authority (WRMA), City Council of Nairobi, the Departments of Lands, Surveys and Physical Planning (in the Ministry of Lands), and public and private land owners.

2.4.7 Main Challenges

Respondents working for public institutions were unwilling to volunteer information on issues such as illegal land allocation on riparian zones. In addition, there were conflicting objectives as to the management of the basin area.

2.4.8 Time Frame

2014 - Long term implementation.

2.4.9 Lessons Learned

The study concludes that there is improper determination, use and management of riparian zones in the basin. In addition, the areas that physically and ecologically should be riparian zones have been encroached on and degraded by urban land use. The following specific conclusions can be drawn from the main findings of the study:

- Existing policies and laws have not influenced the proper determination, use and management of riparian zones in the study area.
 - Existing institutions have also not influenced the proper determination, use and management of riparian zones in the basin.
 - Some urban land use and biophysical factors influence the determination, use and management of riparian zones in the basin.
- The riparian zones are adversely affected by the perceptions and behaviour of land users towards them. The effective determination, use and management of riparian zones is compounded by the capabilities of officials, which are weak and ineffective.
 - Sectoral approaches to the determination, use and management of riparian zones exclude sustainability issues and are thus ineffective models. An integrated approach to the conservation of riparian zones offers a more effective alternative.
 - The implication of the above conclusions is that riparian zones in the basin are under serious threat from encroachment and degradation by urban land users.

Sources:

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Boys wade through the Nairobi river

Image Source:

<http://news.trust.org/item/20150711122759-wyb63/?view=quickview>



Nairobi River basin rehabilitation and restoration

Image Source:

<https://www.pambazuka.org/land-environment/nairobi-river-basin-rehabilitation-and-restoration-succeeding-building-lessons-past>

MULTIPLE
STAKEHOLDER
ENGAGEMENT

3

3.1 Revitalising the Iloilo River Through Collaboration and Integration, Philippines

3.1.1 Background and Introduction

Iloilo City has experienced continued rapid economic growth over the past two decades and continued growth is expected for the city. The Iloilo River runs through the city and fulfils an important role as a major natural resource. It provides economic ecosystem services, enhances the quality of the environment and helps to sustain biodiversity within the city. As the river was in a severe state of degradation and deterioration in 2000, it was necessary to rehabilitate, protect and restore it to an ecological balance. In 2001, the Mayor of Iloilo City consequently made a commitment to develop a sustainable development programme that would revitalise the river. The concept of the Iloilo River Rehabilitation Project was presented at the Mayors of the Asia-Pacific Summit in Honolulu, Hawaii. This led to an offer by the United States Asia Environmental Partnership to finance the development of the Iloilo River Development Master Plan (IRDMP). An inclusive and integrated planning process was then initiated by the City government in partnership with the Iloilo Business Club to help establish a public-private partnership to develop the ten year Iloilo River Development Master Plan (IRDMP).

Cities in the developing world are characterised by rapid urbanisation, the spread of informal settlements, increasing pollution and poor waste management. To address these challenges, a *“new sense of urgency has prompted cities to adopt flexible approaches to urban design to incorporate ecology and biodiversity into urban planning”* (ICLEI: 2011: 1). Iloilo City is one of these, and has developed a Master Plan in collaboration with various stakeholders, including the public. This plan, which integrates a wide variety of policies and strategies, aims to rehabilitate the river and restore its ecological balance, protect it from further degradation and develop its economic potential. It is testament to how a combination of effective public participation and the integration of a variety of policies and activities can lead to the creation of a commonly agreed on vision and agenda.

2.2.2 Location

Iloilo City, Philippines.



3.1.3 Problem Addressed

Commercial and industrial expansion in Iloilo city has created competing demands for space and resources. Consequently, the areas in and around the river have been subject to rapid urbanisation and high population growth. These increases in urban activity have destroyed the natural habitat, reduced the marine population and resulted in a general environmental degradation. The Master Plan aims to redress the damage.

3.1.4 Approach

The Iloilo River Development Council (IRDC) was created to institutionalise the Master Plan's early and sustained implementation. Various meetings, consultations, stakeholder workshops and public and City Council hearings were conducted to identify the issues and concerns relating to the river's environmental quality. This process helped to integrate a diverse set of goals and aided in developing activities, programmes and projects that could be potentially implemented. Its key output, the IRDMP, was developed in 2003 and is described as "a ten-year plan that blueprints the rehabilitation, improvement and sustainability agenda of the Iloilo River" (ICLEI, 2011: 3). The Iloilo City Council approved and adopted the plan in July 2003. The Plan proposes the following three development thrusts:

- *"Improving the environmental quality of the Iloilo River;*
- *Providing economic development opportunities; and*
- *Sustaining the quality of life in and around the river"*

(ICLEI 2011: 3).

3.1.5 Benefits

The IRDMP's importance and uniqueness can be attributed to it being the product of a collaborative effort, as well as its strong emphasis on preserving the river's biodiversity and ensuring its ecological balance. Other achievements include:

- An increased awareness of what is occurring to the river and substantially improved level of public participation in stakeholder decisions
- Improved cooperation and coordination between stakeholders and relevant agencies. This resulted in better coordination of development strategies/policies concerning urban design and land use, socio-economic improvement, environmental protection, institutional mechanisms and

infrastructure facilities

- An improvement in the adoption of the idea that responsibility for the river must be shared and acceptance of the need to cooperate to ensure its proper rehabilitation and development. This is attributed to the multi-stakeholder approach that was followed from the start of the project
- Based on the findings of the IRDMP, the City enacted two policies (Basic Fishery Ordinance and the Environment Code). These may be considered as proof that not only does joint action by all stakeholders make a difference, but their efforts and concerns are equally important. They can thus be regarded as empowering.
- The IRDMP has enabled mangrove reforestation by means of a collaborative project between the Iloilo City and the Department of Public Works and Highways. Fifty-four thousand mangrove seedlings were planted along the river bank. In addition, the IRDMP enabled the establishment of the Bantay Suba' (River Watch) to help manage and protect the river. This is a collaborative effort between the City government and 200 volunteers. Their duties include helping to prevent illegal fishing and construction of any structure along the river bank and the cutting of mangroves.
- Another output of the IRDMP is an annual river clean-up. Various parties from the private sector, NGOs and citizens partake in a bi-monthly removal of solid waste debris from the river

3.1.6 Sectors and Stakeholders

These included: the United States Asia Environmental Partnership; Iloilo Business Club, the City government, local volunteers, the Department of Public Works and Highways. The environmental, economic and water management sectors were also involved, as were representatives from civil society, volunteers and NGOs.

3.1.7 Main Challenges

In order to develop integrated solutions, a variety of stakeholders were involved from the early stages of the project. Public-private partnerships and multi-sector consultative groups were created comprising representatives from different backgrounds and a variety of beliefs. The main challenge in this regard was to secure stakeholder commitment and create a shared vision. In addition, ensuring that all stakeholders actively participated was another challenge, as was addressing their needs and desires. This was overcome by the establishment of the Iloilo River Development Council (IRDC), which improved cooperation by boosting credibility.

3.1.8 Time Frame

The IRDMP was completed in 2003 after a two-year consultation process. It is a 10 year strategy.

3.1.9 Lessons Learned

Public-private-partnerships were beneficial to the government and the Iloilo Business Club – the establishment of a public-private partnership between the City government and the Iloilo Business Club, to help develop the IRDMP resulted in a win-win scenario. The partnership was beneficial to both stakeholders, who complemented each other well. The Iloilo Business Club assumed responsibility for providing direction and a framework for the short and long term plans to develop the river.

Through the creation of the IRDC the project gained a sense of credibility – this encouraged stakeholders to actively participate in workshops, meetings and consultations.

The importance of political will and leadership – this was once again highlighted by the project. In this case, the Mayor of Iloilo City drove this project and helped mobilise the correct people and stakeholders to make the project a success.

Collaboration between private and public sectors helps to increase effectiveness – the Master Plan was a product of continuous engagement between the private and public sectors and showcased how joint action and the integration of policies and strategies can result in a shared vision and agenda.

The success of integrating stakeholders early on – integrating the wide variety of stakeholders at a very early stage of the project helped to ensure its success.

Proper research and analysis – this has the ability to enhance assessments of the river's condition. More comprehensive research (which includes data gathering) and analysis at the early stages of the project would have made it possible to obtain a more accurate assessment. (City of Iloilo, 2003).

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Annual river clean up.

Image Source:

City Environment and Natural Resources Office, Iloilo City 2011, http://archive.iclei.org/documents/Global/case_studies/CaseStudy_134-Iloilo_final20110418.pdf



Non-destructive fishing gears used in the river.

Image Source:

City Environment and Natural Resources Office, Iloilo City 2011, http://archive.iclei.org/documents/Global/case_studies/CaseStudy_134-Iloilo_final20110418.pdf

3.2 Integrated Model for Efficient Water Management, Peru

3.2.1 Background and Introduction

Current climate change forecasts indicate that the water supply in Lima, Peru is highly vulnerable. This problem is intensified by the fact that the various river flows that serve the Lima metropolitan area are highly polluted. The urban water supply in the Lima-Callao Metropolitan Region is reliant on three surface and groundwater basins, the Rimac, Lurin and Chillón. These are estimated to lose up to 30 cubic meters of flow every two years due to the impact of climate change. As the average monthly rainfall is 6.4mm, these factors combined will in future result in a shortage of water supply for Lima's agricultural and non-agricultural needs. The city's water quality is also a concern, with high levels of heavy-metal contamination and microbiological load having been found in the three streams.

The 2035 Metropolitan Urban Development Plan was devised by the City of Lima together with the UN-Habitat Organisation in 2014, to address and reverse these challenges. The Plan will strengthen existing water governance laws by establishing an environmental water authority and allocating

adequate financial resources to it. Subsequently, the Lima Metropolitan Municipality and the regional governments of Lima and Callao presented a proposal to the National Water Authority to create the Water Resources Council of the Chillón-Rimac-Lurin Interregional Basin.

This initiative is funded by the regional governments of Lima and Callao, and Lima's City Hall, This initiative will be the first in Peru to integrate three regional governments and three basins.

The 2035 Metropolitan Urban Development Plan, which also maintains a territorial and environmental perspective, includes specific proposals for interventions in urban land. It also sets standards to promote, guide and recommend actions and measures to achieve equity and sustainability in targeted land areas. The Plan includes actions for the conservation and enhancement of rivers, and contains a number of projects to improve their environmental quality and restore their utility to the public.

3.2.2 Location

Lima, Peru.



3.2.3 Problem Addressed

Future climate change scenarios suggest that Lima's water supply is highly vulnerable. Its poor quality is made worse by high levels of pollution and substandard management practices, which are clearly evident. By following an integrated approach to improving governance, water management structures and plans have been improved and implemented.

3.2.4 Approach

To protect Lima's water supply from the present and future effects of pollution and climate change, the Lima Metropolitan Area is strengthening its water governance by creating an interregional Water Resource Council for the Chillón, Rímac and Lurín river basins. The Council has formed a single, participatory water management authority to investigate, implement and finance integrated solutions for the three watersheds.

3.2.5 Benefits

The benefits of an integrated model for efficient water management in Lima included:

- **The creation of tools and instruments** – The Lima Metropolitan Municipality implemented a series of measures for the efficient use of water;
- **Integration of water management concept with planning tools** – The water management concept has been integrated with territorial planning tools which enabled the City of Lima to set standards and guidelines that contribute to the conservation and enhancement of its rivers. Various projects that will improve their environmental quality and restore their utility for the public have also been identified;
- **Facilitating the Enactment of law** – The Water Basins Resource Management Plan has contributed to the enactment of the Hydrological Resource Law. This was in response to the need for active and ongoing participation by members of the National Water Resources Management System in the planning and coordination of the sustainable use of water resources;
- **Improved water quality** – Another benefit of the study was the construction of five wastewater treatment plants. The treated water is used to irrigate zonal parks and green areas within residential areas, thereby creating good quality and desirable public open spaces; and

- **Combining flood prevention with recreation opportunities** – Various project areas were identified for riverside parks. These contribute to the prevention of flooding and provide citizens with public open spaces for sport, recreation and urban agriculture. They thus have a beneficial effect on the quality of life for residents and increase food security.

A plan has been developed to create coastal parks. Two of these will be connected to allow for vehicle commuters, which will improve citizen mobility.

3.2.6 Sectors and Stakeholders

These include more than 1,000 stakeholders representing agriculture, industry, mining, energy, recreation, aquaculture and local communities.

3.2.7 Main Challenges

Establishing effective stakeholder collaboration and partnerships was a substantial challenge. As the approach that had been adopted was participatory in nature, it was necessary to note each stakeholder's concerns and desires and integrate them so as to encourage their active participation. The fact that water management depends on various public-sector stakeholders and departments which operate within different levels of Lima's government was also problematic.

These challenges were overcome by the creation of the Basin Council. In 2009 a national Hydrologic Resources Law was passed to replace legislation that had been enacted in 1969. The new law emphasized water as the property of the nation and the fact that human consumption is the top priority for its use. Its enactment reflected the need for members of the National Water Resources Management System to participate actively on an ongoing basis in planning and coordinating the sustainable use of water resources. The Water Basins Resource Management Plan is focused on making the spirit of the law a reality. Due to the need to involve stakeholders in the interregional Lima basin, 19 representatives were designated and elected to the Council of the Interregional Water Basins de Chillón, Rímac, and Lurín. The Council is composed of the Administrative Authority of Água Cañete Fortaleza, land users, non-land users, regional and local governments, universities, professional schools and labourers.

In total, 30 meetings were held in the three basins, Chillón, Rímac, and Lurín, accounting for interaction with 70% of the identified stakeholders. The meetings were facilitated by the Regional Government of Lima, the Callao Regional Government, and the Municipality of Metropolitan Lima (MML), who were also jointly responsible for the creation of the Council.

3.2.8 Time Frame

2011-2014.

3.2.9 Lessons Learned

The following lessons were learned from the interventions that were implemented:

- **“Supporting integrated projects which allow for mutual benefits and reduced costs.** *The recovery and protection projects for river environments have the potential to change the long-term city landscape. It is therefore necessary to plan them in an integrated manner to fully take advantage of the connection opportunities;*
- **Water management presents both challenges and opportunities** – *Managing water demand is an important source of opportunities to increase resource and system efficiency, and should be*

treated as a priority area of intervention. However, in order to manage it well, it is necessary to involve and coordinate the interests of the various stakeholders involved, which can be challenging;

- **A good governance structure is essential for efficient water management** – *The Basin Council has been created to arrive at and promote a feasible agreement between all parties. The hope is that this will prevent conflicts in the future and foster cooperation between government sectors and departments; and*
- **Connect sectoral approaches to strategic aims** – *It is valuable to embed such sectoral approaches in the urban master plan to enable a win-win approach”.*

(ICLEI 2016: 65).

Sources:

ICLEI. 2016. *Moving towards an integrated model for efficient water management in Lima.* [Online]. Available: <http://www.iclei.org/index.php?id=1163> [09 August 2017].



Overflowing river threaten to flood Lima neighborhoods

Source:

Photo by El Comercio / Juan Ponce <https://perureports.com/2016/03/02/overflowing-lima-rivers-threaten-to-flood-neighborhoods/>

3.3 Restoring Urban Rivers From Their Source to the Sea, South Africa

3.3.1 Background and Introduction

Source to Sea is a network of businesses, communities and stakeholders that collectively seek to manage water quality and quantity to support the Cape Town region's abundant biodiversity. The network also aims to ensure optimal utilisation of river corridors for the sustained benefit of all users. Its main driver is a partnership between the City of Cape Town and South African National Parks (SANParks). Civil society also plays a crucial role. An important focus area for both the City of Cape Town and Source to Sea is the Zandvlei Catchment, which is one of several river catchments in the Peninsula mountain range. The Zandvlei Catchment links various types of critical fynbos vegetation which is only found on the southern tip of Africa and is home to types such as mountain fynbos, granite fynbos, sand fynbos and dune strandveld to the low lying urban area of the Cape Flats. To restore these urban rivers is important because they support the natural processes such as flood prevention, waste decomposition and soil generation, all which we are dependent on for survival. The quality and quantity of water will improve and there are many social benefits which restoring such a vital wetland will bring.

The close proximity of the Zandvlei Catchment to Table Mountain National Park which contains critical fynbos vegetation means that there are critically endangered vegetation types in sections of the broader municipal area. Source to Sea aims to demonstrate the potential benefits of collaborative action, which encompass ecological, social and economic dimensions. The partnership arose out of the need to connect areas that are protected by the City and the national government, whilst integrating communities along the catchment. The network promotes the idea that it is not solely the responsibility of government authorities to protect ecologically sensitive areas, but that all communities should play an active part because people use the land around urban rivers for agriculture, industry, recreation and living.

Zandvlei Catchment, from a biodiversity perspective, is one of the most important catchments within the Cape Town area.

3.3.2 Location

Zandvlei Catchment, Cape Town, South Africa.



3.3.3 Problem Addressed

The main reason for the formation of the network was to develop a cohesive management strategy to rehabilitate and maintain the Zandvlei Catchment in order to restore healthy ecosystems, create jobs, build climate resilience and offer increased recreational and mobility benefits.

3.3.4 Approach

The network aims to maximise urban natural recreational space, restore degraded natural and open space corridors for biodiversity conservation, improve water quality, link river corridors and catchments via recreational multi-use trails and enhance eco-heritage. Additional goals include providing educational and tourism opportunities and developing short and long term local employment opportunities. A participatory approach was adopted to ensure that all stakeholders were included. Regular workshops were then held to develop guiding principles and processes to achieve the vision, which was established through a river management strategy.

3.3.5 Benefits

- **Uniting a diverse group of stakeholders interested in the Zandvlei Catchment** – This entails putting stakeholder engagement values and principles into practice;
- **Alien invasive vegetation removal/ environmental restoration, water quality monitoring, and animal conservation** – This is necessary to protect the natural environment;
- **Creating recreational opportunities such as picnicking, walking, biking and birding trails** – These have proven to be essential for public mental health;
- **Infrastructure maintenance** – Paths and bridges need to be maintained;

- **Environmental education and community awareness** – Ensuring that the community is educated about the importance of sustainably managing this important ecological area for the benefit of all; and
- **Social benefits** – Village Heights, a community library, soccer pitch, food allotments and a children's playground are included as projects in the making.

3.3.6 Sectors and Stakeholders

The Zandvlei Catchment has many stakeholders, including SANParks, the City of Cape Town, ICLEI Local Governments for Sustainability, Wildlife and Environment Society of South Africa people caring for the earth, World Wildlife Foundation, Table Mountain Fund, Cape Action for People and the Environment, Cape town Tourism, Aurecon, South African National Biodiversity Institute, The Watershed Project, NGOs, private organisations and land owners, as well as volunteers. Most of them have been involved in previous rehabilitation efforts in the Catchment.

3.3.7 Main Challenges

- The main challenges that Source to Sea faces in organising collaboration between the various sectors and organisations are:
- Additional resources and funds to fully implement the ongoing management plans;
- The need for greater connectivity and coordination along the Catchment; and
- Safety concerns for users along the river, which must be addressed.

3.3.8 Time Frame

The Zandvlei Catchment Management Plan started in 2003 and is an ongoing, long term project.

3.3.9 Lessons Learned

- **The importance of an integrated approach**
 - This is necessary to promote coherence within government and between government and non-government collaborations. It builds metaphorical bridges between communities and stakeholders, and creates physical linkages between nodes along the rivers
- **An integrated approach requires coordination**
 - It is underpinned by having a coordination function in place to ensure collaboration, coherence and partnership building

- **Strategic advantages can be achieved** – The network optimises opportunities for job creation and cost-efficiency in its approaches. This also provides the basis for promoting the City of Cape Town, and for stimulating the local economy. Investing in natural assets can leverage relatively high economic values through tourism, recreation, the provision of buffering services that build resilience to climate change and reduce vulnerability; and through increased property value.

Sources:

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Princess Vlei

Image Source:

<http://sourcetosea.org.za/catchment-treasures/things-to-see-and-do/>



Princess Vlei

Image Source:

<http://sourcetosea.org.za/catchment-treasures/things-to-see-and-do/>



Silvermine

Image Source:

<http://sourcetosea.org.za/catchment-treasures/things-to-see-and-do/>



Zandvlei Estuary Nature Reserve

Image Source:

<http://sourcetosea.org.za/catchment-treasures/things-to-see-and-do/>

3.4 Transboundary Water Management through Multi-Level Participatory Governance and Community Projects, Volta River Basin, Ghana and Burkina Faso

3.4.1 Background and Introduction

The Volta River Basin, which is the ninth largest river basin in Sub-Saharan Africa, covers an area of 400,000 km² and serves six countries: Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali and Togo. The basin faces numerous development challenges such as poverty and increasing population growth. These have created numerous problems, such as the exploitation of natural resources, which leads to water scarcity, land degradation and the siltation of river channels.

As the Volta River Basin stretches across six countries, a transboundary water management system needs to be established and implemented to ensure that the area can cope with the above development challenges. However, due to a lack of consultation and communication between Burkina Faso and Ghana (which is necessary as 85% of the Volta River Basin is located in these two countries), there are no formal policies and development initiatives. This creates serious threats to the sustainable management of the basin. This has created tensions between the two countries, although these are also

due in part to misconceptions with regards to the cause of climate variability and changes in water resource flow patterns. For example, downstream floods in Ghana were attributed to spillage from dams in Burkina Faso and at times when the amount of water in the dams in Ghana was low (due to climate variability and changes in flow patterns of the river) water consumption in Burkina Faso was suspected as being the main reason (Welling, Cartin, Baykono and Diallo, 2012).

To address the basin's development challenges, Water and Nature Initiative (WANI) which is run by the International Union for Conservation of Nature (IUCN) launched a project called 'Improving Water Governance in the Volta River Basin' (or PAGEV – *Projet d'Amélioration de la Gouvernance de l'Eau dans le bassin de la Volta* in 2005). The main objective was to facilitate change in how the basin was managed. WANI and its partners were mandated to improve water governance by creating an agreement on new key water management principles. They also aimed to institutionalise and improve coordination mechanisms.

3.4.2 Location

Volta River Basin, Ghana and Burkina Faso.



3.4.3 Problem Addressed

The project aimed to address the lack of water governance by creating a consensus on key water management principles. Another objective was to institutionalise coordination mechanisms.

3.4.4 Approach

WANI and its partners established a demonstration site in the Volta River Basin to launch 'Improving Water Governance in the Volta River Basin', which was initially a pilot project.

3.4.5 Benefits

- **Support for livelihoods projects** – WANI and its partners (The Directorate of Water Resources in Burkina Faso, the Water Resources Commission in Ghana and community municipal assemblies), supported the implementation of livelihood projects which aimed to demonstrate integrated water resource management at the local level. It was intended that these would build trust and capacity by establishing linkages between livelihood benefits and water governance;
- **Assistance and empowerment of local communities** – through these livelihood projects, PAGEV provided the knowledge, technical advice and funding to help communities combat environmental degradation and provide income opportunities;
- **Volta Basin Authority formed and regional forums held** – National forum meetings were held in 2006 to consolidate the local partnerships in Burkina Faso and Ghana. Participants in the meetings included executives from the Riverbanks Protection Committees, District Chief Executives, Technical Services (of the local administration) and NGOs. The gatherings validated the Strategic Plan for implementation in 2009. The forum was an integral part of the project and fostered participatory planning towards a concerted management approach of the Volta basin resources;

- **Code of Conduct established between Ghana and Burkina Faso** – To manage water resources across national boundaries, a management tool that could clarify the roles and responsibilities of the different actors was needed. This was necessary to enable conflict resolution, build a collective understanding of how to manage water resources and respond to environmental problems more effectively;
- **Local transboundary participation in governance** – The Joint Transboundary Committee coordinates joint activities across the border, solves any local level water use problems and disputes, and strengthens cooperation between the two countries. It must be noted that this is transboundary water governance at the local community level, whereas the Volta River Basin Authority operates at higher governmental levels; and
- **Greater knowledge through the water audit and other studies** – Without crucial information about the state of water resources in the basin, key decisions could not be taken on how to manage and govern them. It was therefore necessary to gather essential baseline data to better inform decision-making processes at all levels.

3.4.6 Sectors and Stakeholders

The different sectors included the private sector, public sector, Environment, Water, and Economy. In addition, various stakeholders such as the Water and Nature Initiative (WANI), the Water Resource Commission, the Directorate of Water Resources, the Volta Basin Authority (VBA), the Burkina-Ghana 'Joint Technical Committee on IWRM' (JTC-IWRM), local communities and interested and affected parties were involved.

3.4.7 Main Challenges

The main challenges to be resolved were water scarcity, land degradation and siltation in canals.

3.4.8 Time Frame

2010-2011.

3.4.9 Lessons Learned

- **Tangible results encourage participation**
 - An understanding was developed that stakeholders and partners are more willing to participate when they see tangible results and improvements in their everyday lives;
- **Transboundary community participation is possible** – It was shown that community-level participation in transboundary water resource management is not only achievable but that it adds value to conventional transboundary approaches; and
- **Government support facilitates multi-level governance** – It is also clear that multi-level governance can be achieved across large river basins with the government's backing of a structured framework.

Sources:

Welling, R. Cartin, M. Baykono, D. & Diallo, O. 2012. Water and Nature Initiative (WANI) Case Study. *Volta River Basin: Ghana and Burkina Faso*. [Online]. Available: <https://portals.iucn.org/library/efiles/documents/2012-010.pdf> . [16 August 2017].



The Volta River

Image Source:

Welling, R. Cartin, M. Baykono, D. and Diallo, O. (2012).



The Volta River in dry season

Image Source:

Welling, R. Cartin, M. Baykono, D. and Diallo, O. (2012).

3.5 The Fen River in Taiyuan, China: Ecology, Revitalization and Urban Culture

3.5.1 Background and Introduction

The Fen River valley in China was an early centre of civilization and has remained a significant route that connects the Beijing area to the strategically vital Shanxi province and to key land routes to Central Asia via Gansu Province. The Fen River is one of the largest tributaries, eastern tributary, of the Huang He (Yellow River). After rising in the Guancen Mountains in north-western Shanxi, it flows south-east into the basin of Taiyuan. The Fen River Irrigation District comprises two reservoirs and three weirs which divert water from the river into five core channels for irrigation and industrial use. In recent years, drought and growing demand from domestic and industrial water users have created critical water shortages in the Shanxi Province.

As a result of this rising demand, the Fen River has become a dry riverbed. The construction of four rubber dams by the municipal government in the late 1990s has positively contributed to its current condition. This initiative was aimed at artificially replenishing Taiyuan's major body of water and beautifying the riverbed. Although the river remains ecologically dead and nearly dried-up, the landscaping and beautification of its river banks boosted its appearance.

3.5.2 Location

Fen River, Taiyuan City, China.



3.5.3 Problem Addressed

There were multiple problems that needed to be addressed, including water pollution, deforestation, soil erosion and the river’s ecological health.

3.5.4 Approach

In its attempts to rebuild the Fen River’s ecosystem, the provincial government directed its attention to the Yellow River Diversion Project, which included the Fen River. This project was based on an integrated, multi-objective and inter-municipal approach. The objective was to increase water retention and mitigate soil erosion adjacent to active water restriction measures e.g. water conservation policies and the upgrade of Shanxi’s irrigation network. Since its commencement in 2007, the project has made a significant contribution to restoring groundwater levels, although doing the same for the river’s natural water flow may take decades.

3.5.5 Benefits

The benefits of the integrated, inter-municipal and multi-objective approach included environmental beautification measures to boost the appearance of the river. These increased the value of real-estate. The project was also successful at replenishing water bodies and addressing deforestation through afforestation programmes. Finally, it addressed the problem of soil erosion and successfully curtailed extensive water use.

3.5.6 Sectors and Stakeholders

Stakeholders included local government, economic stakeholders, local communities along the Fen River, provincial government, industries (especially coal) and agriculture.

3.5.7 Main Challenges

According to Chinese national standards, the Fen River Reservoir currently complies with good quality water standards. However, water pollution remains critical. According to research undertaken in 2014, major pollutants are “sulphate, chloride, and volatile phenol, as well as nitrate and petroleum, with ammonia nitrate and petroleum exceeding national limit values by four and five times, respectively” (Falke, 2016: 1). It is of concern that these persist despite the mitigation measures taken regarding policy interventions for environmental protection.

3.5.8 Time Frame

2007-ongoing.

3.5.9 Lessons Learned

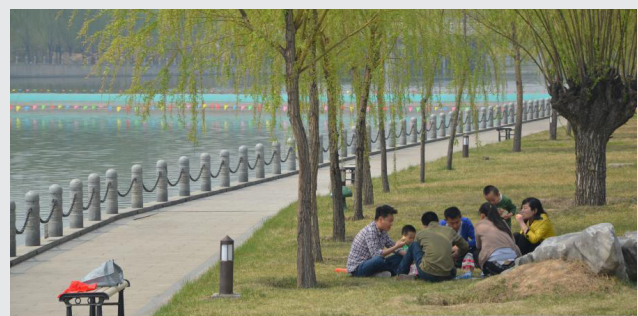
Understanding the severity of the Fen River’s condition and how the management of it is filtered to different levels of government and relevant stakeholders can impact implementation processes. This was made evident by the different vested interests of industrial development paths and lack of compliance from local political leaders. Although environmental awareness is growing in the Chinese urban population, they continue to be passive in public participation processes aimed at improving the sustainable management of rivers.

Sources:

Falke, Matthias. 2016. The Fen River in Taiyuan, China: *Ecology, Revitalization, and Urban Culture*. *Environment & Society Portal*. *Arcadia Autumn*, no. 17. *Rachel Carson Centre for Environment and Society*. [Online]. Available: <http://www.environmentandsociety.org/node/7679>. [16 August 2017].



Southbound view of Fen River Park near Yingze



Waterfront of the Xiaohe, a tributary of the Fen River

Image Source:

<http://www.environmentandsociety.org/arcadia/fen-river-taiyuan-china-ecology-revitalization-and-urban-culture>

Image Source:

<http://www.environmentandsociety.org/arcadia/fen-river-taiyuan-china-ecology-revitalization-and-urban-culture>

3.6 Establishing a Transboundary Organisation for Integrated Water Regional Management (IWRM), Senegal River Basin

3.6.1 Background and Introduction

The case study describes the institutional and legal infrastructure created by three of the four riparian states of the Senegal River Basin, namely Mali, Mauritania and Senegal. Their main objective was to jointly manage the basin's water resources to meet their socio-economic development needs and ensure the integrity of the environment. The Senegal River is roughly 1600 km long with a basin area of 289 000 km² and a mean annual runoff of 24 billion m³. There has been a considerable amount of population migration towards the basin, and the added pressure of a worsening drought and desertification, loss of arable and pasture land and pollution from industrial and domestic waste.

The basin has a high variability in yearly rainfall which ranges from 200 mm to 800 mm between wet and dry seasons. Similar to the rest of West Africa, it

has experienced a decreasing mean annual rainfall over the last two decades. Due to the desertification process (desertification is the process whereby fertile land becomes desert), the basin has potential for a 275 00 ha area of arable land with irrigation and a 200 mW hydropower station.

To fully unlock this potential and address the above problems, in 1972 the Senegal River Organisation (OMVS) was established by three of the four riparian states. The OMVS aimed to promote inter-country cooperation and coordination of technical, economic studies and other activities related to the basin such as irrigation, hydropower generation, environmental protection and conservation. It also sought to regulate the Senegal River's flow for irrigation, navigation, flood control, power generation, domestic and industrial water supply purposes.

3.6.2 Location

Senegal River Basin, Mali, Mauritania and Senegal.



3.6.3 Problem Addressed

Besides the above, the OMVS also sought to counter waterborne diseases, flooding in St Louis (a city on the north-west coast of Senegal), water quality degradation, the loss of mangrove forests, reduced wetland areas and the loss of biodiversity and reproduction areas that were no longer accessible to fish.

3.6.4 Approach

The following approaches were followed to establish an Integrated Water Resource Management Plan (IWRMP):

- Linking the management of the basin to that of the estuary and the coast;
- Due to evidence that the relevant management authorities do not communicate with each other, it is necessary to improve communication channels and implement accountability measures;
- The OMVS provides an inter-governmental structure through which activities in the river basin can be linked to better management of resources; and
- It is necessary to understand the pressures and driving forces that generated issues of concern as well as promote awareness and certain level of consensus between user groups.

The objectives also included the development of policy, and the planning and programming of construction works and the execution of studies relating to regional infrastructure. The organisation also aimed to improve the management of the regional infrastructure headworks, allocation and utilisation of water resources. Its scope also included promoting the coordinated management of the basin's resources in order to increase sustainably the income of basin inhabitants, decrease the vulnerability of member states' economies to climate variability, and accelerate economic and inter-state cooperation. Overall, it enabled Mali, Mauritania and Senegal to effectively manage the basin.

3.6.5 Benefits

- **Hydroelectricity generation by the Manantali Hydroelectric Plant** – The hydroelectricity generated from one of five turbines has a total capacity of 200 mW. Power is presently being supplied to Bamako (Mali), while construction of the transmission lines and sub-stations that are to connect to Nouachott (Mauritania) and Dakar (Senegal) is nearing completion;
- **Provision of water for irrigation** – Irrigated water is supplied to the Valley and Delta areas for farmers during the dry season and/

or to supplement rainwater in the poor wet seasons. Farmers are also supplied information, infrastructure, market access and credit; and

- **The Permanent Water Commission has been provided with regulations** – These have been created to support and advise it and include recommendations on principles and modalities for the fair distribution of the Senegal waters between member states and water use sectors (power, irrigation and navigation). The regulations also address the issues around the construction of water utilisation infrastructure that is likely to sensibly modify characteristics of the Senegal River flow, its conditions of navigability, agricultural and industrial exploitation. It is specifically stated that construction should not affect its sanitary condition, the biological characteristics of its fauna and flora and its water level.

3.6.6 Sectors and Stakeholders

These include: the public and private sectors, local industries, Economic, Agriculture, Environment, the Senegal River Development Organisation (OMVS) and local farmers.

3.6.7 Main Challenges

Although there was sufficient funding to implement the various projects, political and ethnic conflicts between Mauritania and Senegal led to delays in the mobilisation of money to maintain them. Cost recovery was another challenge. The projects take time to become economically and financially viable, and debt collection was consequently a challenge. For example, it took more than ten years for the power generation and supply component to reach its full potential. In addition, only 10% of the potential 375,000 ha available for irrigation development has been developed. To compound this, the price of imported rice and sugar is also lower than that produced by local farmers and factories. The flow of benefits has thus been delayed and the burden of this is carried by the member states.

3.6.8 Time Frame

The commencement date was 1972. This is a long term project of 30 to 40 years.

3.6.9 Lessons Learned

The following lessons were learned from the interventions that were implemented:

- “A declaration must be made that it is essential to manage a shared international basin jointly – The riparian states should manage it as a common resource for their equitable benefit. This will aid in the creation of a common vision and encourage cooperation and consultation. It will also aid in socio-economic development and maintaining environmental integrity throughout the basin;
- Conventions that establish similar river basin organisations should use the management of the common water resource as a tool to integrate regional development in the riparian countries involved. The provisions should be flexible and forward looking. When building infrastructure, it is important to be clear about the geographical area that it is going to serve and who the beneficiaries will be;
- Environmental issues should include the maintenance of the integrity of the aquatic ecosystems as well as the specific environmental impacts produced by building and operating infrastructure. A river flow simulation model is useful for planning and maximising facility operations. It can also be used as a decision support tool by the Permanent Water Commission; and
- The establishment of a credible regional planning and development programme early in the life of the organisation enabled it to focus on the implementation of its activities rather than the extended period it takes to complete studies. The provision of knowledge infrastructure, markets and finance are important for local people to succeed. The institutional arrangements that are established to encourage the involvement of water users such as farmers should take account of these.”

(Unknown, 2013: 1-2)

Sources:

Unknown. 2013. Senegal – *Establishing a Transboundary Organisation for IWRM in the Senegal River Basin*. Case #45.[Online]. Available: <http://www.gwp.org/globalassets/global/toolbox/case-studies/africa/transboundary.-establishing-a-transboundary-organisation-for-iwrm-in-the-senegal-river-basin-45.pdf> [27 August 2017].



Road way on river

Image Source:

<http://ganatransport.com/nos-destinations/>



River Basin

Image Source:

http://www.ks.undp.org/content/kosovo/en/home/operations/projects/environment_and_energy/enabling-transboundary-cooperation-and-integrated-water-resource.html

3.7 Mlalakua River Restoration Project, Tanzania

3.7.1 Background and Introduction

Wami/Ruvu Basin is one of the nine River and Lake Basins located in the eastern part of Tanzania and has a catchment area of 66,294 km². The basin consists of two major rivers, the Wami and Ruvu with an approximate area of 43,742 km² and 17,789 km² respectively and it has coastal rivers located to the Eastern part of the basin flowing into the Indian Ocean, most of which are located in the Dar es Salaam Region (MWI, 2018).

The Ruvu sub-basin extends from Morogoro to the west of Dar es Salaam covering an area of about 18,000 km². Apart from the main Ruvu river system, there are other small rivers draining the basin into the Indian Ocean. These rivers are Mkusa, Mpiji, Msimbazi on the southern part of the Ruvu River and Msimbazi, Kizinga, Mzinga, Mbezi and Luhute in the extreme south of the basin (IUCN, 2010).

The Mlalakua River is situated to the north of Dar es Salaam, Tanzania. The river originates from the Mzinga and Kizinga Rivers and drains into the Indian Ocean. Kizinga has a total length of 17.5 km and a catchment area of 432 km² where Mzinga has a total length of 10.4 km and a catchment of 41 km². Land uses found along the Mlalakua River, include crop agriculture, livestock breeding, residential usage, public and commercial purposes.

3.7.2 Location

Mlalakua River north of Dar es Salaam, Tanzania

The Mlalakua River is subject to severe pollution by various parties that operate in close proximity to the river. This has led to the river becoming highly polluted carrying health related threats and risks. The river's degradation has negative knock-on effects on the marine ecosystems which can be found along the coastline of Dar es Salaam. The beaches of Dar es Salaam serve as an example of how polluted the area has become due to the upstream pollution. Waste pollution contributes to litter strewn on the beaches having negative impacts on tourism and recreational industries.

Factors having an impact on this situation include:

- Waste management infrastructure services which are inadequate and which cannot sustainably manage and dispose of waste;
- Public sector capacity is low and public institutions do not have adequate capacity to monitor and enforce environmental regulations;
- Public institutions have waste management responsibilities which are overlapping. The overlapping of responsibilities causes confusion and lead to unaccountability;
- Lack of sense of responsibility and ownership by businesses and communities that rely on the river and are located in close proximity to the river; and
- The presence of low income settlements and industries along the river contributing to pollution and illegal dumping into the river.



3.7.3 Problem Addressed

The Mlalakua River is subject to severe pollution. Openly discharged raw sewage, toxic liquid and solid waste is often dumped into the river. The main culprits contributing to illegal dumping are predominantly local residents, farmers, businesses and institutions located in close proximity to the river. Illegal activities such as these have resulted in the river becoming highly polluted and are the cause of health related risks.

3.7.4 Approach

Implemented by the International Water Stewardship Programme (IWaSP), the Mlalakua River Restoration Project was initiated to engage with relevant stakeholders on improving water quality and governance in the Mlalakua River, by implementing measures which would enhance healthy living conditions of the riverine communities and which would prevent further waste pollution. The centre of the partnership is focussed on the commitment to catalyse multi-stakeholder action and to support formal institutional change within the community, businesses and public bodies involved with the River. This project was established in 2012 when a group of stakeholders from the public, private and civil society sectors jointly committed to find solutions to and to address pollution along the Mlalakua River.

A formal agreement has been signed by relevant stakeholders, a steering committee was set up and a participatory planning approach was adopted that would conduct community consultations and planning workshops with partners. The participatory approach enabled the alignment of objectives and interest from a variety of stakeholders and partners. The outcome of the meetings, workshops and community consultations included:

- Physical clean-up activities in the river;
- The establishment of sustainable solid waste and wastewater management systems. This entailed introducing private waste collectors and setting up recycling centres and wastewater treatment plants; and
- Creating and building capacity of the applicable service providers and raising awareness among local leaders and communities on various issues such as health impacts, implantable solutions for household sanitation and law enforcement measures.

Other outcomes of the partnership included addressing industrial and institutional wastewater management, and implementing environmental regulations and best practices of industrial waste management along the river.

3.7.5 Benefits

The main benefits of the project entail:

- The river clean-up and waste removal project which led to a larger Mlalakua River clean-up event with city-wide community engagement and participation which took place in 2014;
- The Municipality has implemented on-going professional clean-up services and local communities are now actively involved with clean-up events;
- Professional service providers in solid waste management have been trained accordingly and are delivering positive results;
- Community wastewater and sludge management plans have been developed and implemented; and
- Awareness campaigns on waste management and sanitation practices have taken place and have had a positive impact on reducing unsustainable practices.

At the time of writing this report, an agreement has been reached between the public sector stakeholders enforcing environmental protection regulations.

3.7.6 Sectors and Stakeholders

Sectors: River Basin Management, River Restoration, Waste Management.

Donors: The Coca Cola Africa Foundation (TCCFA), Federal Ministry for Economic Cooperation and Development (BMZ), UK Department for International Development

Stakeholders: The Wami Ruvu Basin Water Board (WRBWB), National Environment Management Council, Kinondoni Municipal Council (KMC), Coca-Cola Sabci, Nabaki Afrika, BORDA, SADC, Nipe Fagio.

3.7.7 Main Challenges

The main challenge that has been identified in this case study was to align varying interests and capacities of stakeholders. Coupled with this, was to obtain the local community's buy-in with regard to the Mlalakua River Restoration Project. An additional challenge has been to get active involvement of the private sector since there is no clear incentive for commercial participation.

It is however worth mentioning that the stakeholders' efforts to build trust and to harmonise the varying interests from different parties have been successful. According to the case study, strides have been made to reach a common understanding between stakeholders on issues relevant to the partnership. In addition, implementation activities are showing positive and concrete results.

3.7.8 Time Frame

2013 - 2016

3.7.9 Lessons Learned

At the time of writing this case study report, the project was in the process of being phased out and its documented results will be used to guide restoration projects of a similar nature. Clear lessons learned have however not been documented.

Sources:

IUCN Eastern and Southern Africa Programme, 2010. *The Ruvu Basin: A Situation Analysis*, xvi + 96 pp. International Water Stewardship Programme (IWaSP). 2016. Tanzania: Mlalakua River Restoration Project. Available: <http://www.iwasp.org/what-we-do/partnership/tanzania-mlalakua-river-restoration-project> (12/03/2018).

Ministry of Water and Irrigation. 2018. *Wami/Ruvu and its associated Coast Rivers*. Available: <https://www.maji.go.tz/?q=en/content/wamiruvu-and-its-associated-coast-rivers>



Mlalakua River, stream

Image Source:

<http://www.iwasp.org/what-we-do/story/facilitating-collective-action-mlalakua-river-tanzania>



Mlalakua River, facilitating collective action

Image Source:

<http://www.iwasp.org/what-we-do/story/facilitating-collective-action-mlalakua-river-tanzania>

3.8 Sustainable Water Resources Management in the Upper Ruvuma River, Tanzania

3.8.1 Background and Introduction

The Ruvuma River basin is a 155 500-square kilometre drainage area shared by the southern African countries of Tanzania and Mozambique, and the Ruvuma River forms the border between them for a length of approximately 650 km. This perennial river's source is located in the Matagoro Mountains in south-eastern Tanzania. The river has a total length of 760 km, and flows eastward into the Indian Ocean. The upper Ruvuma River flows to the confluence with its largest tributary, the Lujenda River. Other major tributaries to the Ruvuma River include the Lucheringo, Likonde, Muhuwesi, and Lumesule rivers (Encyclopaedia Britannica, online: 16.03.2018). The Ruvuma River mouth is an arc shaped delta nearly 2 km wide that gives rise to Cape Delgado promontory.

Of the estimated 2.4 million people that depend on the water supply of the Ruvuma River Basin, 1.5 million live on the Tanzanian side of the river. The fertile soils of the upper river basin in the south-west of Tanzania provide favourable conditions for agriculture, and there has been significant growth in this sector and related industry in recent years. Agriculture generates important income for the region, but also places increased pressure on the natural resources. The Ruvuma River has limited hydrological observations and therefore uncertainties in historic conditions (Minihane, M. 2012), but the river reportedly has reduced flow regimes in recent years that coincide with increased agricultural production, development and land use mismanagement (IWaSP 2016).

Authorities are concerned that depleting water resources might lead to conflict between the different

water users. The current capability of the Tanzanian government to manage the water resource is lacking, and many public institutions also lack capacity to effectively address growing pressures on the resource (IWaSP 2016). Weak water governance could have detrimental effects on the various water users of the resource.

In order to address this growing concern and to find a sustainable solution for all the water users, a voluntary dialogue was initiated by the Aviv Tanzania Ltd, which is a subsidiary of Olam-Aviv who have been operating in Tanzania since 1994, and have had a presence in the Ruvuma region in since May 2013. The outcome of the dialogue was the formation of the Upper Ruvuma Catchment Basin Steering Committee (URCBSC). The mandate of the committee was to decide on common actions to support the improved management of the shared resource. The URCBSC offers a platform of communication where stakeholders can share monitoring data, information and action plans for more efficient and sustainable water resources management of the Upper Ruvuma River and its tributaries (Water Action Hub, available online 16.03.2018). The URCBSC strives to maintain good cooperation between members, and good relations with the Ruvuma Water Board, to ensure transparent water monitoring activities and water use that is fair, to encourage research initiatives for sustainable water management. It is however important to note that the URCBSC is not incorporated into the Tanzanian legal framework, but that a parallel structure exists instead.

3.8.2 Location

Ruvuma River Basin, Tanzania



3.8.3 Problem Addressed

The reportedly lower flow of the Ruvuma River coincides with increased anthropogenic activities in the basin. Poor water governance and lack of capacity of many public institutions further exacerbate problems of a depleting resource. In order to negate a potential conflict between water users, and to address the concerns of the authorities, the URCBSC was established.

3.8.4 Approach

The aim and objective of the URCBSC partnership was to improve water security. It was envisioned that this could be done by supporting water users so that they can be adaptive to water usage and to help manage threats to water security in the river basin. Furthermore, the aim was to harmonise what the steering committee is trying to achieve with the purpose of the newly established Water User Association (WUA) is mandated to achieve. The purpose of this harmonisation was to ensure that a platform is created on which dialogue can be conducted between the key stakeholders.

By working with the WUA, water abstraction can be monitored, and the availability of water can be studied. Through such a study, detailed information can be collected and analysed, and may potentially lead to concrete activities that can be implemented. Such activities may help to allocate and use the resource in a more sustainable and efficient manner.

3.8.5 Benefits

Water security for stakeholders in the Ruvuma River Basin has been improved through:

- Stakeholder analysis and through the organisation of a stakeholder exchange event. This enables the various stakeholders to become informed about each other's water usage needs and how to reach an agreement that would satisfy everyone's needs but at the same time ensuring the environmental sustainability of the resource;
- Support to the formation of a Water User Association (WUA). Through the WUA better management of the resource can be conducted by studying data of water abstraction and proposing interventions such as promotion of

better agricultural practises to small-scale paddy rice farmers;

- Mapping of planned water abstraction points.
- Identification of sources of pollution; and
- The recalibration of the Upper Ruvuma Hydrological Model.

The concept for a more extensive partnership is being prepared so that the project can have a bigger influence in water use management:

- It is expected that the established partnerships and proposed interventions will contribute to the overall improvement of sustainable water resources management in the Upper Ruvuma Basin. This will be achieved by developing tools to be implemented and through consolidating interactions between different stakeholders; and
- Olam-Aviv showed strong interest in expanding the partnership to Zambia and possibly Uganda as well.

3.8.6 Sectors and Stakeholders

Sectors: River Basin Management, water quality, water use efficiency

Stakeholders: Olam-Aviv, the Ruvuma Basin Water Board, the Water User Association, URCBSC.

Donors: German Federal Ministry for Economic Cooperation and Development (BMZ), UK Department for International Development (DFID)

3.8.7 Main Challenges

The main challenges that have been experienced include:

- Building the case for actions to be implemented;
- The capacity to implement the proposed interventions are weak; and
- Institutional embedding, which entails how the involvement of stakeholders and the decisions they make can eventually be implemented to the extent where it will lead to change in policies are poor.

3.8.8 Time Frame

2014 – 2018

- **Phase 1:** 2014 – 2015
- **Phase 2:** 2016 – 2018

3.8.9 Lessons Learned

None have been identified in the literature.

Source:

Encyclopaedia Britannica. 2018. *Ruvuma River (River, Tanzania)*. Encyclopaedia Britannica, inc. July 20, 1998. Available: <https://www.britannica.com/place/Ruvuma-River> (16/03/2018).

International Water Stewardship Programme (IWaSP). 2016. *Tanzania: Sustainable Water Resources Management in the Upper Ruvuma River*. Available: <http://www.iwasp.org/what-we-do/partnership/tanzania-sustainable-water-resources-management-upper-ruvuma-river>. (12/03/2018).

Minihane, M.R. 2012. *Evaluation of streamflow estimates for the Rovuma River*. Physics and Chemistry of the Earth Parts A/B/C. Volumes 50-52, 2012, Pages 14-23. Available: <https://www.sciencedirect.com/science/article/pii/S147470651200112X>. (12/03/2018).

Water Action Hub. *Upper Ruvuma Catchment Basic Steering Committee*. Available: <https://wateractionhub.org/projects/view/165/>. (16/03/2018).



Aerial view of catchment basin

Image Source:

<https://wateractionhub.org/projects/view/165/>



Ruvuma River

Image Source:

<http://magazine.africageographic.com/weekly/issue-45/african-river-expedition-ruvuma-tanzania/>

3.9 Umzimvubu Catchment Restoration of Local Ecosystem Services, South Africa

3.9.1 Background and Introduction

The uMzimvubu catchment and river system lies along the northern boundary of the Eastern Cape in South Africa. The river system extends over 200 km from its source, which is located in the Maloti Drakensberg watershed and extends to its estuary at Port St Johns where it drains into the Indian Ocean. The focus area of this particular project covers more than 2 million hectares within the Eastern Cape and nearly 70% of the land on which it is located is communally owned.

The river system has been identified as a priority river because it is one of the few “near-natural rivers”. The river system is however classified as being vulnerable due to rapid rates of degradation in the watershed. The catchment and river system is also well known for having four distinct key biodiversity areas (KBAs). The presence of the KBAs support numerous species of plants and animals, a range of ecosystem services and poverty alleviation with water provision, erosion control, infrastructure protection, fodder for livestock and food security, and materials for household and community use.

Key problems that the uMzimvubu Catchment, especially the upper uMzimvubu Catchment experiences, can be attributed to inappropriate land uses and alien plant infestation. This has a degrading

effect on the sustainability of the catchment area. The most prominent types of degradation that are observable include soil erosion, damage to infrastructure, water supply shortages and loss of grazing land. The degradation of the catchment as a whole has a direct negative impact on both the livelihood impacts of the people and on the ecosystem, itself.

In order to address these problems, a proposal for an action learning and systems approach was prepared by Conservation South Africa (CSA) in partnership with Environmental and Rural Solutions (ERS). The proposal is aimed at restoring and protecting catchment integrity and stability, improving livelihoods and resilience of ecosystems and economies, through sound institutional co-operation. In order to achieve this, a project was launched by CSA and ERS that proposes the establishment of a catchment management strategy and restoration plan for the uMzimvubu River corridor. The project aimed to launch with strong stakeholder collaboration and through implementing demonstrational projects in the upper catchment. The purpose of the demonstrational projects is to expand and implement the project’s principles and techniques to the wider catchment over the next twenty years.

3.9.2 Location

uMzimvubu Catchment, Eastern Cape, South Africa



3.9.3 Problem Addressed

Various issues have been identified as existing threats:

- The presence of alien plants which constitute a major threat to the catchments and riparian zone. Alien species reduce water availability and lead to loss of natural habitats and changes in ecosystem flows and functions by reducing basal flows. However, according to the CSA and ERS (2011) report, the largest problem is the alien species known as the wattle (*Acacia dealbata* and *Acacia mearnsii*). The wattle is the cause of natural bank vegetation loss and an increase in bank erosion;
- One of the major contributors of habitat destruction in the catchment area is the cultivation of land for agriculture. The practice of ploughing land, especially contour ploughing, degrades grasslands and removes natural groundcover which in turn increases run-off and silt loss;
- Population growth, increased economic activity and intensification of land use practices in the uMzimvubu River Basin are increasingly degrading the resource. Pollution through solid and liquid waste is increasing with domestic and commercial sewage, agricultural runoff, and litter all contributing to the deterioration of the water quality within the uMzimvubu and its tributaries;
- The expansion of irrigation schemes has contributed to perennial streams and floodplains becoming less productive. The streams and floodplains rely on regular flooding and have become more and more attenuated due to the expansion of irrigation schemes and infestation from alien invasive plants; and
- Deforestation and degradation of indigenous forests are perceived to be a threat. Indigenous forests are often located alongside commercial plantations and large scale commercial operations tend to crush the undergrowth of the indigenous forests and destroy second generation growth of saplings.

3.9.4 Approach

To address the problems and/or threats discussed above, a programme has been launched which consists of 4 phases for 5 years each. The vision as stated in CSA and ERS's, Phase 1 Strategy Outline, entail: "To build stewardship capacity among community groups in the upper uMzimvubu catchment through establishing replicable demonstration projects which restore watershed functions, and to position these groups as sellers of such services to be integrated into the Green Economy" (CSA and ERS 2011:5).

The time frame and phasing of the full 20-year programme is outlined as follows:

Phase	Timing	Key Objectives and Activities of each phase
1	Years 1 - 5	Awareness & Action learning: focus on establishing demonstration projects in collaboration with existing initiatives, develop baselines for the area through research and M&E framework, formalise collaboration and extract lessons learnt. Establish seller side of PES structures through stewardship. Identify possible buyers / markets. Develop basic policy strategy.
2	Years 6 - 10	Replication: share lessons learnt into possible models/approaches, replicate or upscale projects in wider river basin geography based on models from demonstration, formalize governance processes, policy influence through advocacy based on lessons learnt.
3	Years 11 - 15	Policy influence & Adoption: supporting governance structures to adopt working models for improved catchment management, expand in wider catchment, bigger policy focus and influence
4	Years 16 - 20	Entrenchment: measure wider ecosystem impacts from initial phases, provide ongoing support for improved governance and policy, continued monitoring and advocacy, finalise exit strategy with responsibility for communal PES management resolved

3.9.5 Benefits

According to the SANBI and Wildlands Conservation Trust's (2015:2) case study document, the following benefits have been derived from projects which operate in the catchment areas:

"Partners of the Umzimvubu Catchment Partnership Programme (UCPP) have had a significant impact on many aspects of catchment management within the area. Together they have spent more than R50 million on projects in the sub region over three years. More than 30 permanent staff members are employed and most have local offices. Another 800 people have been employed in short term 'green jobs' such as alien plant clearing or as Eco rangers. In total, over 800 ha of alien plant infestations have been cleared and more than 5 000 ha of grazing land have been restored. Four MSc and four BSc students have conducted research in the Mzimvubu catchment. One of the most effective interventions of the partnership are the regular learning exchange workshops, which have included topics such as fire management in grasslands, alien plant management, environmental outreach, aquatic monitoring, Eco ranger functions, career development and biodiversity stewardship incentives. The partners are also producing 'best practise' media for use by a wider audience".

In addition to the above-mentioned benefits, CSA & ERS report Phase 1 Strategy Outline (2011:11) has also identified the following outcomes of the first phase of the project as beneficial outcomes to the upper region's river catchment's restoration:

- "Improved land conditions and watershed services at 6 project sites in the upper catchment covering at least 100 000 ha;
- Establishment of a range of stewardship groups which can position themselves as sellers of ecosystems services towards the end of the first phase;
- Three project areas with six demonstration sites forming the basis of replicable models for policy and advocacy towards a Green Economy;
- Increased returns to land rights holders and owners (sellers) through improved ecosystem health, in the form of livestock quality, income for maintenance activities and sale of land based products;
- Identification of interested buyers for ecosystem services and income streams which will contribute towards the maintenance of these services by sellers;
- A comprehensive database of monitoring information providing indicators of ecosystem status;
- The restoration and maintenance of riparian zone to increase water release and basal flow, with decreased infestation in grassland and improved basal cover and composition; and

- Transformed grazing regime and adherence to burning plan to improve basal cover and grassland biodiversity and vigour".

3.9.6 Sectors and Stakeholders

- African Solutions for African Problems (ASAP)
- Alfred Nzo District Municipality
- Alfred Nzo Development Agency
- Amazawa Agricultural Co-op
- Bakoena Traditional Council
- The Cedarville Conservancy
- Conservation South Africa (CSA)
- The Department of Agriculture Forestry and Fisheries (Eastern Cape)
- The Department of Environmental Affairs (DEA)
- The Department of Economic Development, Environment Affairs and Tourism (DEDEAT Eastern Cape)
- The Department of Rural Development and Agrarian Reform (Eastern Cape)
- The Department of Water Affairs & Sanitation (DWAS Eastern Cape region)
- Eastern Cape Parks and Tourism Agency (ECPTA)
- Eastern Cape NGO Coalition
- Endangered Wildlife Trust (EWT)
- Environmental & Rural Solutions (ERS)
- Freedom Challenge
- LIMA Rural Development Foundation
- Maloti Drakensberg Transfrontier Project (MDTP)
- Matatiele Local Municipality
- Mehlooding Trust
- Moshesh Traditional Council
- Mount Currie Community Development Organisation
- South Africa National Biodiversity Institute
- Save Act
- Sikhululiwe Bawo Women's Co-operative
- Sustaining the Wild Coast (SWC)
- Wildlife and Environment Society of South Africa (WESSA)
- Wildlands Conservation Trust (WCT)

3.9.7 Main Challenges

For a project with the magnitude of this one, various challenges will have to be overcome. Based on interpreting the literature it is evident that for the project to be a success there will have to be strong collaboration between local and national role players and between the various stakeholders involved with the project. This can be a complex and sensitive task and it is often difficult to integrate different perspectives in a collaborative project such as this one. The project requires buy in from various stakeholders and partners and can be challenging to reach consensus on certain decisions which may cause delays

The cost of the first phase of the project was estimated to be approximately R28 784 000 million. This is a large amount, taking into consideration there are 4 phases for the entirety of the project. Funding for the project will require extensive support, from donors, stakeholders and government input.

The project is very reliant on demonstration projects in various locations. The challenge with regards to this is that the demonstration project must be successful in order for it to be replicated elsewhere

It is evident from the literature that the project is reliant on precise scientific information and studies. It can therefore be a challenge if poor quality baseline studies are done which in turn will lead to poor scientific findings that can result to negative effects on the outcome of the project.

3.9.8 Time Frame

The time frame for the project is 20 years, it is phased into 4 distinct phases as outlined below:

2013 – 2032

- **Phase 1:** 2013 – 2017
- **Phase 2:** 2018 – 2022
- **Phase 3:** 2023 – 2027
- **Phase 4:** 2028 – 2032

3.9.9 Lessons Learned

Since the project is still in phase 1 of its implementation, no lessons learned have been identified which can be elaborated on. No reference is made to lessons learned in the literature as well.

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uMzimvubu Catchment



Bridge over uMzimvubu Catchment

Image Source:

<https://umzimvubu.org/about/#jp-carousel-34>

Image Source:

<https://umzimvubu.org/about/#jp-carousel-38>

CLIMATE
CHANGE
ADAPTATION

4

4.1 Building Consensus on Water Allocation and Climate Change Adaptation, Tanzania

4.1.1 Background and Introduction

Similar to many other regions in the developing world, the Pangani River Basin in Tanzania is suffering from the effects of climate change and the over-exploitation of water resources. Competition for water is challenging the sustainability of the basin and creating tensions between the stakeholders that rely on it. Delivering basic water services for human needs is proving to be a challenging task.

To address this, the Water and Nature Initiative (WANI), Tanzanian government and other donor partners helped to implement an Integrated Water Resource Management Plan (IWRMP). It was intended that this would function as a platform to enable stakeholders to engage and collaborate with each other and thereby agree on – and reach – a common goal. For the above to become feasible, it was first necessary to develop a roadmap to help establish the Kikuletwa Sub-Catchment Forum. This consisted of various stages and components, including a preparatory phase which comprised a water-use audit, a policy review and an institutional mapping exercise. In addition, various training workshops were conducted, supported by a series of consultations with the local government. During these sessions it

became evident that there were concerns about the establishment of the IWRMP and the effects of climate change on the river basin. Due to the complexity of local water management issues, it was recognized that operationalising the forum was a longer term process than originally anticipated.

As a result, the Pangani Basin Water Board (PBWB) coordinated input from various sectors and stakeholders to help lay the basis for developing the IWRMP. They were given the opportunity to interact with the PBWB and submit applications to participate in the management of the basin.

The overall project to implement the IWRMP helped to embed climate change into national and sector development planning. It also assisted in improving the management of freshwater resources for livelihoods. It was widely regarded as a success as it resulted in active stakeholder participation and strong governance structures. The key technical capabilities that evolved out of the project were aligned to the long term vision for the basin, and resulted in the achievement of key outcomes. The project continues to yield positive results.

4.1.2 Location

Pangani River Basin, Tanzania.



4.1.3 Problem Addressed

The Plan was initiated to solve a number of problems, which include the following:

- Tension between stakeholders and competing water users due to diminishing water resources in the basin;
- Over-exploitation, ineffective management of the remaining water resources, and limited knowledge about ecosystems in the area; and
- Climate change impacts were addressed by developing a climate change model for the basin.

4.1.4 Approach

The IWRMP was developed by facilitating continuous dialogue between stakeholders. This enabled them to discuss key issues relating to water management, future climatic vulnerability and risk. In addition, WANI implemented effective monitoring and data collection systems, and agreed to increase the human capacity required to collect and analyse flow assessment information. This improved the generation of reliable data which in turn helped to create a comprehensive assessment of environmental flow requirements. It also enabled stakeholders to understand the environmental, economic and social implications of the different flow scenarios that could be expected from climate change.

WANI and other donor partners also facilitated public participation and negotiation sessions to increase community participation. In addition, they provided the necessary support for legal reviews and multi-stakeholder consultation. This helped to improve management planning and their ability to implement rational and fair water allocation systems.

The Pangani River Basin was facing an uncertain future, with over-exploitation and rising conflicts being its predominant challenges. Various interventions were tried, while others were adapted. This resulted in the development of some solutions and action plans. The interventions discussed in the preceding two paragraphs above should help water managers and stakeholders cope with climate change and water scarcity in a more adaptive manner than those considered in the past. The sub-catchment forums also empowered water users through the use of dialogue. They are now able to contribute to the IWRMP as a result of decentralised water governance.

4.1.5 Benefits

The benefits of the project included:

- Increased institutional capacity at basin management level and increased knowledge about water resources;
- The collection of information and data on environmental flows, climate change and water governance. This was used to help develop the IWRMP;
- The empowering of the local community and water users, who were thus able to help implement the IWRMP;
- The application of environmental flows to assess water flow in the basin as a basis for developing scenarios for managing the sustainable allocation of water. Cutting edge methodologies were used to gather specific information on hydrology and the economic, social and ecological impacts of changes in river flow regimes; and
- Increased information and knowledge from comprehensive assessments on water resources and their vulnerability to climate change.

4.1.6 Sectors and Stakeholders

Stakeholders included the Pangani Basin Water Board (PBWB), the Tanzania National and Local Governments, the PAMAJO TRUST (Local NGO), the International Union for Conservation of Nature (IUCN), the Water Users' Association (WUA) and local community stakeholders.

4.1.7 Main Challenges

The main challenge in this project was the increasing competition for the water sources in the basin. This led to numerous conflicts which was compounded by high population growth, deforestation, an increase in the amount of livestock and cultivated land in proximity to the basin, fishing, mining and hydropower activities. As a result, ecosystems and aquatic resources have declined, and this has had a negative impact on the poor people who rely on water for their survival.

4.1.8 Time Frame

2005 - 2011.

4.1.9 Lessons Learned

The case study document according to Welling et al. (2009:8) list the lessons learned as follows:

Increased understanding has led to pilot actions – Increased understanding of environmental, economic and social implications of different river flow scenarios under expected climatic conditions and increased capacity to collect and analyse such information. The water sector's vulnerability to climate change is now better understood and pilot actions have generated lessons in adaptation (Welling et al. 2009:8).

Information gaps have been bridged – Institutional and information gaps between the basin and national level processes have now been bridged through studies, exchange of knowledge and collaboration between climate change and water sectors. The Pangani Basin Water Board now has the information needed to manage the basin in ways which support nature, as well as people and their livelihoods (Welling et al. 2009:8).

The creation of the Wami Ruvu project and others – The Pangani River Basin Management project was also a catalyst for the creation of the Wami Ruvu project which is focusing on building water governance capacity to secure the future of the Ruvu River in the Wami Ruvu Basin. The results from Pangani and the lessons learned have supported the roll-out of the Wami Ruvu project and activities at the national level. It has also resulted in water governance projects in Uganda and Kenya and wider across the Western Indian Ocean Region through projects such as Wio-Lab (Welling et al. 2009:8)

Sources:

Welling, R. Cartin, M. Barchiesi, S. & Cross, K. 2009. International Union for Conservation of Nature: Pangani River Basin, Tanzania. *Building consensus on water allocation and climate change adaption. Water and Nature Initiative.*



Herd of cows

Image Source:

Welling, R. Cartin, M. Barchiesi, S. & Cross, K. (2009).



Pangani River Basin

Image Source:

Welling, R. Cartin, M. Barchiesi, S. & Cross, K. (2009).

4.2 Controlling Invasive Alien Species from Rondegat River Ecosystem, Cederberg Region, Western Cape Province, South Africa

4.2.1 Background and Introduction

This case study describes a project that was implemented to simultaneously clear invasive alien trees and predatory alien fish from a degraded but ecologically important river ecosystem in the Cederberg region of the Western Cape Province, South Africa. The aim of this 'coordinated and pioneering alien species control project' was to restore the native biodiversity of the Rondegat River. The river is regarded as nationally important and has become subject to the invasion of alien species and fish. To address this problem, from 2010 to 2012, dense infestations of the invasive Australian Acacia and Eucalyptus species were cleared from the riparian zone. The clearing took place in the lower reaches of the river and was followed up by the eradication of the smallmouth bass (*Micropterus dolomieu*), using piscicide rotenone (a commonly used pesticide to eradicate fish populations). This method was used to ensure that the native fish, which had become a threatened species due to presence of the smallmouth bass, could recolonise from the upper reaches of the river.

The presence of invasive alien species in the Cape Floristic Region (CFR) has negative consequences on the rich biodiversity and endemism on the region. To control this problem, a national-scale programme was launched, namely the Rondegat River Rehabilitation Programme. This has a budget of approximately R1 billion, which provides employment opportunities to poor rural communities. The programme initially focussed solely on controlling invasive alien plants, and cost approximately R3.2 billion over 15 years. However, its mandate has recently been expanded to help control invasive species from all taxonomic groups. As with all projects, there were a number of obstacles that had to be overcome when it was first implemented. For example, various concerns were raised about how effective these interventions would be in achieving their goals. However, with careful planning and effective implementation, previous interventions have proven to yield results and ecosystems that have experienced heavy invasions have been restored to a state similar to pre-invasion conditions.

4.2.2 Location

Rondegat River, Cederberg Wilderness Area, Western Cape Province, South Africa.



4.2.3 Problem Addressed

The problems addressed in this case study were two-fold – the invasion of alien trees and predatory alien fish along the riparian zone of the lower reaches of the Rondegat River. It was necessary to eradicate these so that the native threatened fish species could recolonise from the upper reaches of the river.

4.2.4 Approach

The two approaches implemented to clear invasive alien fish and plants by Impson et al. (2013) are described below:

Invasive alien fish control

River surveys were conducted to document the short term impact and effectiveness of the first rotenone and second rotenone treatments in eradicating the smallmouth bass, as well as to assess the recovery rates of native fishes and invertebrates following treatment. The total cost of the fish eradication project was ~ R3.3 million, of which R2 million was received from Working for Water, R1 million from CapeNature, and R300 000 from the Water Research Commission.

Fish populations were monitored at 42 sites between February 2011 and March 2015. Fish abundance at each site was estimated using two independent methods: underwater video analysis (UWVA) and snorkel surveys. Underwater Video Analysis was carried out using GoPro® HD Hero® cameras. Cameras were placed at each site and recorded footage for a minimum of 30 minutes. The footage was viewed to obtain estimates of fish abundance and diversity. Snorkel surveys used the two pass method where all fish encountered by the observer were counted on each pass and an estimate of abundance was derived from the mean of the two counts. (Impson et al. 2013: 2).

Invasive alien plant control

Systematic clearing of the alien invasive trees (Australian Acacia and Eucalyptus species) began in July 2010, and continued for 2 years until June 2012. The trees were felled, and the stumps treated with herbicides to prevent re-sprouting. Felled material was removed for use as firewood, or was piled on sandbanks and burnt. In total, 437 ha were cleared at an approximate cost of R900 000.

The Rondegat River is typical of many invaded streams in the Cape Floristic Region. The 28 km-long single-channel river is shallow (<1 m deep) and relatively narrow (2-4 m wide). The river receives most of its

flow in winter and early spring (May to September), and the groundwater-dependent summer discharge is very low (0.07-0.08 m³/s). The river flows into an 1124-ha warm-water impoundment, namely the Clanwilliam Dam, where alien smallmouth bass populations have been established since 1948. Historically these fish had invaded the lower Rondegat River up to a waterfall located 5 km upstream of the dam. The subsequent construction of a weir some 4 km below the waterfall (sometime in the 1960s) effectively isolated the smallmouth bass in the 4 km stretch of river between the waterfall and weir. This section of river was treated using rotenone in February 2012 and March 2013 based on the assumption that the removal of smallmouth bass from the bounded section of river would result in the recovery of the native fish (Clanwilliam yellowfish, fiery and Clanwilliam redfins and Clanwilliam rock catlets) (Impson et al. 2013: 2).

4.2.5 Benefits

Awareness creation – The project promoted awareness of the impact of alien species on aquatic environments via facilitating meetings with riparian landowners and water users, and by providing stakeholders with regular progress reports.

Recovery/recolonization – The smallmouth bass species was successfully eradicated and recovery/recolonization of native fish species and insects was observed. The fish that were absent from the treatment area prior to the smallmouth bass removal and their presence one year later suggests that a large number of native fish were previously consumed by the bass, and that they are likely to rapidly recolonise areas where these were eradicated. In addition, there has been successful regrowth of some of native vegetation at the cleared sites.

4.2.6 Sectors and Stakeholders

These included: CapeNature, Working for Water, University Stellenbosch, Rhodes University, the Centre for Invasion Biology, the South African Institute for Aquatic Biodiversity and the National Research Foundation.

4.2.7 Main Challenges

Follow up treatment may be required to remove any recurring alien plant species. Some germination of alien wattles from 'soil stored seed banks' has been observed. This has not been extensive and can be successfully managed by means of regular follow-up treatments.

4.2.8 Time Frame

2010 - 2012.

4.2.9 Lessons Learned

Early results suggest that the native riparian vegetation and fish are recovering well. Valuable lessons were learned and the project illustrated the success of various aspects of good practice. These include, amongst others: careful planning; close and enthusiastic collaboration between affected State and private landowners; public participation to

address concerns; the simultaneous and coordinated application of mechanical, chemical and biological control of alien plants and chemical control of alien fish; and direction by qualified ecologists.

It is not yet possible to assess the longer term success of the project. The lessons learned should be considered for similar projects in other locations. Impson et al. (2013:1) is of the opinion that the project "*paves the way for the more widespread use of similar approaches in selected areas that are a priority for conservation*".

Sources:

Impson, N.D. Van Wilgen, B.W. & Weyl. O.L.F. 2013. *Coordinated approaches to rehabilitating a river ecosystem invaded by alien plants and fish*. *S African Journal Sci* 109(11/12)[Online] Available: <http://dx.doi.org/10.1590/sajs.2013/a0041> [16 August 2017].



A Field worker collecting samples and conducting experiments

Sources:

Weyl, OLF. Barrow, S. Bellingan, T. Dalu. T. Esler. K. Impson, D. Gouws, J. Jordaan, M. Villet, M. Wasserman, RL. and Woodford, DJ. (2016).



Cederberg landscape

Sources:

Impson et al. 2013

