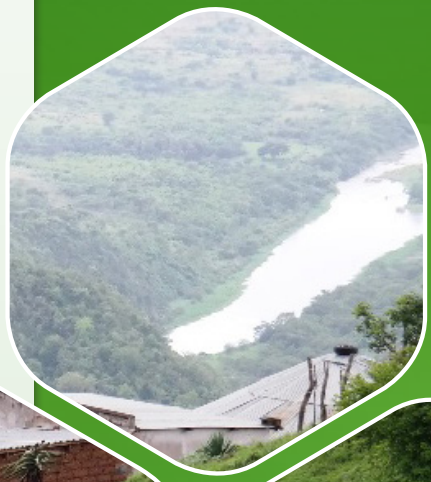
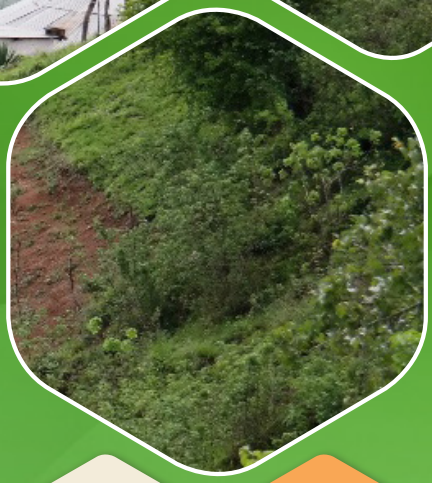
CASE STUDY

ECOSYSTEM-BASED ADAPTATION (EBA) in SOUTH AFRICA

Nature helping people adapt to climate change





environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

NDP 2030

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SANBI
Biodiversity for Life
South African National Biodiversity Institute

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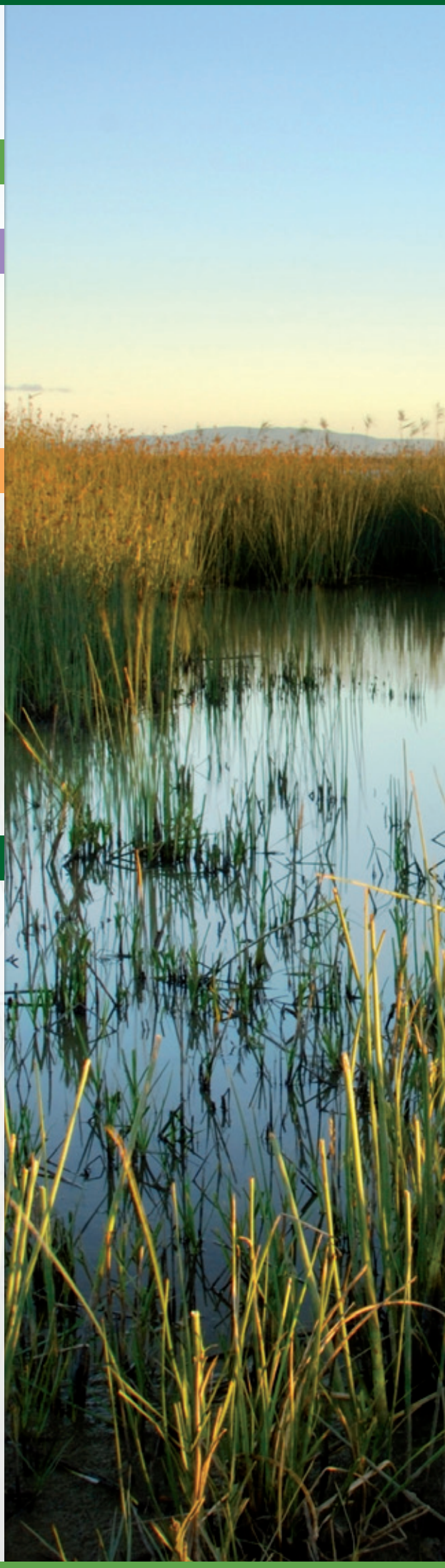

Published by Department of Environmental Affairs

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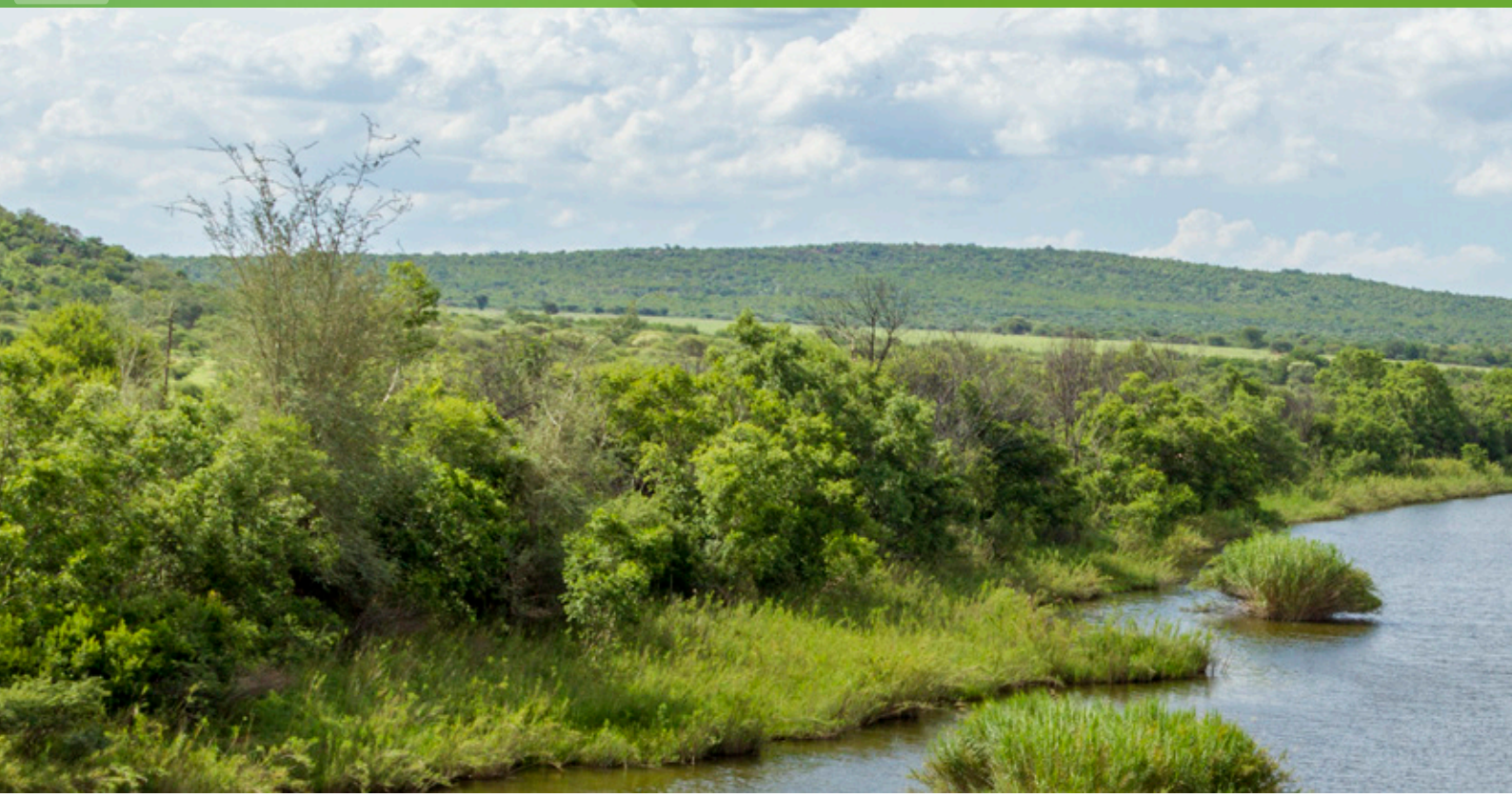
This publication was supported through the GIZ implemented Climate Support Programme and the Global Project Mainstreaming Ecosystem-based Adaptation, which are part of the International Climate Initiative (IKI). The Federal ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports the IKI on the basis of a decision adopted by the German Bundestag.

ABBREVIATIONS

ABET	Adult Basic Education and Training
ADM	Alfred Nzo District Municipality
AIS	Alien Invasive Species
AIPs	Alien Invasive Plants
CBAs	Critical Biodiversity Areas
CCT	City of Cape Town
CML	Coastal Management Line
EbA	Ecosystem-based Adaptation
EDRR	Early Detection & Rapid Response
EPCPD	Environmental Planning & Climate Protection Department
EPWP	Expanded Public Works Programme
ESAs	Ecosystem Support Areas
EWT	Endangered Wildlife Trust
GIS	Geographic Information System
GKNP	Greater Kruger National Park
ha	Hectare
IAPs	Invasive Alien Plants
IPCC	Intergovernmental Panel on Climate Change
K2C	Kruger to Canyon Biosphere Reserve
KZNSS	Kwa-Zulu Natal Sandstone Sourveld
MSDF	Municipal Spatial Development Framework
NGOs	Non-Governmental Organisations
NPOs	Non-profit Organisations
NRM	Natural Resource Management
SANBI	South African National Biodiversity Institute
SANPARKS BSP	South African National Parks Biodiversity Social Projects
SMME	Small, Medium and Micro Enterprises
WFE	Working for Ecosystems

1 INTRODUCTION



Climate change is ranked amongst the biggest global change challenges of the 21st century facing the world. The fifth assessment report (AR5) of the Intergovernmental Panel on Climate Change highlighted the observed impacts of climate change on natural and human systems across the world (IPCC 2017). Evidence for the observed impacts are strongest and most comprehensive for natural systems. The impacts on natural systems include change in rainfall regime, melting of glaciers, shifting of geographical range of species to mention a few. On the other hand, climate change attributed impacts on human systems are variable. Some of these are climate related extremes that include heatwaves, droughts, and wildfires to mention a few (IPCC 2017).

Similarly, South Africa went through a cycle of extreme to moderate weather events over the past decades. Such changes included the shift towards more arid conditions due to a decline in rainfall exacerbated by warming. The El Nino Southern Oscillation (ENSO) plays an important role in the inter-annual variability of rainfall in most parts of southern Africa. Climate change projections indicate that heat stress will negatively affect the productivity of a range of functional types especially agricultural productivity. For instance, South Africa was hit by a dry spell between 2000 and 2011 and this largely affected the eastern seaboard of the country. The effect of drought was significantly pronounced between 2003 and 2006. This was followed by the 2015-2016 El Nino event that resulted in devastating impacts in the region. A range of impacts were observed during and post this dry spell and this affected among others water and agricultural sectors.

A range of impacts on both natural and human systems were observed in South Africa with huge costs to the economy. For instance, the following climate change related impacts were observed:

- Reduction of cattle from approximately 1.8 million by 2011 to 1.7 million in 2013, after remaining mainly between 1.75 and 1.8 million since 2005 (DAFF 2019).
- The death of over 40 000 cattle due to drought was recorded by the end of 2015 in KwaZulu-Natal alone, and there were also huge increases of slaughter rates towards the end of the year (AgriSA 2016, 12).
- Drought-induced recessionary pressures on the agricultural sector during 2015 resulted in year-on-year declines in seasonally adjusted sectoral GDP for the first three quarters of 2015 (AgriSA 2016, 5)
- South Africa is the main regional exporter of maize this was reduced by approximately 40% (Archer, Landman, Tadross et al. 2017).

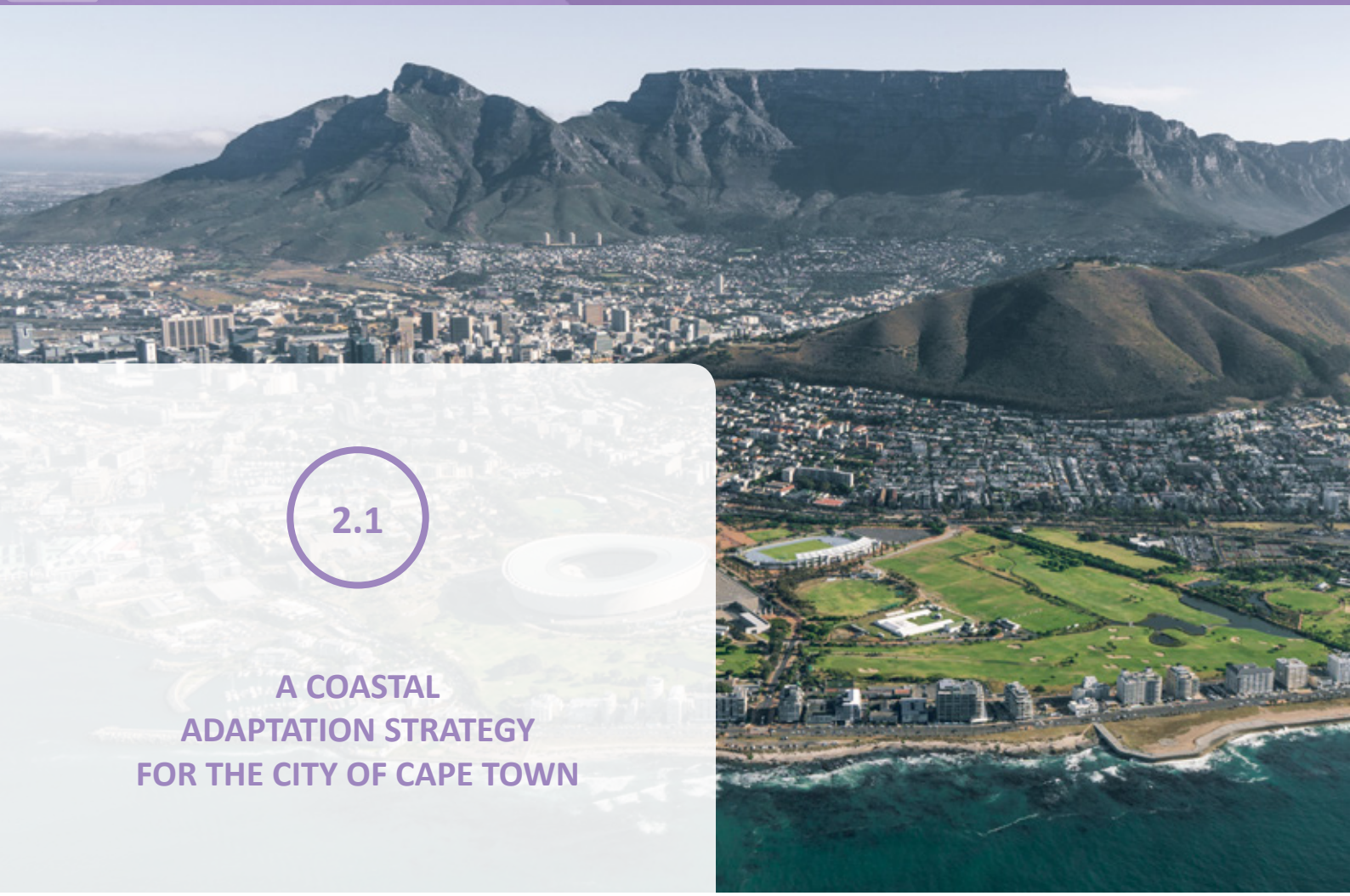
- Sugarcane production during the drought of 2015/16 dropped from an annual norm of 19 million tons to 14 million tons (AgriSA 2016, 10).
- Finally, the average dam levels of the province during the 2015/16 hydrological year were below 30% (Botai, Botai, De Wit et al. 2017).
- A combination of higher than normal tides and extreme weather events resulted in damage to property along the KZN coastal areas in 2019 (Alfreds 2019).

South Africa developed a climate change adaptation plan for affected biomes subsequent to a vulnerability assessment. The biome adaptation plan recommended four major responses namely:

- Ecosystem-based Adaptation (EbA),
- Biodiversity Stewardship,
- Management approaches and spatial planning

Consequently, South Africa adopted EbA as an important component of the country's overall climate change adaptation response, as indicated in the National Climate Change Response Policy (NCCRP) (DEA 2011) and other strategic documents. EbA is defined as 'the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. Ecosystem-based adaptation is most [effective when] appropriately integrated into broader adaptation and development strategies' (Secretariat of the Convention on Biological Diversity (CBD) 2009, 41).It is a fairly recent approach which was developed about a decade ago. It is agreed globally as arguably an ideal response approach to climate change in a bid to enhance the resilience of people and biodiversity. The growing awareness of the provisioning, regulating, supporting and cultural roles of ecosystem services has also contributed to the emergence of the concept of "Ecosystem-based adaptation" (EbA) (Roberts, Boon, Diederichs et al. 2012, 167). The current document captures a sample of EbA projects currently being implemented across South Africa. The main aim is to widely disseminate examples of such projects as a way of sharing examples of EbA projects and best practise (IPCC 2018).

2 COASTAL INTEGRATION OF ECOSYSTEM-BASED ADAPTATION



2.1

A COASTAL ADAPTATION STRATEGY FOR THE CITY OF CAPE TOWN

The City of Cape Town (CCT) is the legislative capital of South Africa and is home to approximately 3.8 million people. The city is the economic hub of the Western Cape province, South Africa's second main economic centre and Africa's third main economic hub city. The city's coast provides a variety of goods and services, which include tourism, recreation, economic and employment opportunities, discharge of storm water and the assimilation of pollutants from land-based activities. The coast is central to Cape Town's economy therefore it is necessary to undertake proactive interventions to protect the coast and to further harness its potential to improve the livelihoods of previously disadvantaged communities.

According to Jack et al. (2016), within the city itself, the climate and weather are expected to have direct impacts and contribute to various types of risk. There are obvious first order risks such as flooding, infrastructure damage, or economic losses through extreme events where the climate is the direct cause. There are second order risks such as health where weather extremes or specific conditions can be contributors or aggravators of existing drivers of increased health problems. Finally, third order risks, where climate causes behaviour changes that increase risk, such as increased use of air conditioning which places strain on electricity supply (Jack, Wolski, Steynor 2016, 8).

Due to environmental factors and pressures, the ability of coastal ecosystems, to provide regulatory, provisional and cultural services is being reduced. The most prominent of these factors are the fragmentation and loss of natural areas, degradation of terrestrial ecosystems owing to unregulated recreational activities and inappropriate development, which has also resulted in the privatisation of sections of the coast.

Although these are significant pressures, they are an indication of a lack of a strategic city-wide coastal planning and decision support framework. To address this, the CCT initiated a process of developing a coastal set-back line. This is in effect a spatial planning mechanism that intends to guide and inform decisions relating to coastal development more

City of Cape Town
Source: Unsplash | Photo by Tobias Reich

effectively. The CCT thus developed a key coastal adaptation strategy that focuses on harnessing ecosystem services as a means to minimise risk to the city from coastal hazards. Because this strategy largely depends on functioning ecosystems, it became critical to manage the development pressures impacting on these coastal ecosystems.

It is vitally important to understand the vulnerability during the process of effectively adapting to the impacts of climate change. As such, a key requirement of the Sea-Level Rise Risk Assessment was to generate information and transform it into practical applications in order to effectively manage risk and promote sustainable coastal development. To understand the different dimensions of vulnerability within the context of a complex urban setting such as Cape Town; as a starting point to understanding risk from sea level rise and storm surges, a Geographic Information System (GIS) was used to develop a risk model. This model spatially demarcates areas that may be physically affected and therefore vulnerable to storm surges and sea level rise.

Ecosystem-based approach

The vulnerability assessment depicted two primary impacts. The first is encroachment into the space in which coastal dynamic processes take place, where the built environment of the city is exposed to increasing hazards; namely, the potential for damage of coastal infrastructure from coastal erosion. Second, is that by reducing the spatial scale of these open and dynamic areas through encroachment, the critical threshold that ecosystems require to remain functional is lost. Encroachment into sand dune systems along Cape Town's coast helps to illustrate these points. Sand dunes provide a critical buffer against storm surge events. A critical ecosystem service within the context of managing coastal risk is the ability of dune ecosystems and coastal wetlands to provide an effective buffer against storm surges. Retaining open spaces and harnessing ecosystem services to promote a risk-averse approach to urban development is only one step in the broader process of building a resilient coastal city. Another factor is remaining sensitive to the combined historical legacy and current socio-economic complexities that characterise Cape Town. It is of paramount importance to take these into consideration in the decision-making process of balancing development with coastal ecosystem protection. At this point short to medium term economic imperatives are primarily driving the nature and priority of government strategies.

Using coastal development as a means of addressing socio-economic issues is, however, contributing to the existing and longer-term pressures along the coast. This will both increase the vulnerability of newly established coastal developments and dependent communities, through the loss of ecosystems and their services, and also ultimately lock the city into an economic burden through having to protect and maintain such developments from the impact of sea level rise and coastal erosion in the future.

As the above states, careful consideration is necessary within this complex socio-ecological system, requiring a balance between promoting an ecosystem-based management approach while simultaneously addressing socio-economic imperatives. The CCT is developing a coastal setback line as a key spatial planning and urban design mechanism. The intention of the setback line is essentially to guide city planning decisions relating to coastal development, with the aim of achieving three main outcomes. First, by determining a development-free zone along the coast, so that the functionality of ecosystems is retained, thereby improving

the flow of ecosystem services. Second, the retention of open spaces along the coast promotes the coast as a shared and common resource. This is important considering South Africa's history of segregation. Third, and as previously discussed, by retaining these remaining spaces and coastal ecosystems, the CCT will prevent existing problems of infrastructure that are currently at risk from coastal erosion and storm surges. The CCT realises that, through protecting natural processes and the associated goods and services provided, the city has the potential to reduce risk over a long-term period.

Evidence of success

This study highlighted the importance of understanding and incorporating 'hard' as well as 'soft' issues, in developing practical and workable adaptation strategies. The hard issues include vulnerability to inundation from sea level rise and storm surges, coastal dynamic processes and the presence of biodiversity networks. This study has also shown that central to the resolution of the coastal issues experienced in Cape Town, is the presence and preservation of healthy coastal ecosystems.

This Strategy led to the development of the Coastal Management Line (CML), which led to the implementation of pilot EbA projects in the CCT.

Lessons learnt

The successful implementation of the CCT's coastal setback line as a key planning intervention relies on a supporting legislative environment that will enable the realisation of its intent. As such, the CCT is currently in the process of developing a Coastal Protection by-law that aims to provide for the protection, regulation and integrated management of the space between the setback and sea. Acceptance of the Coastal Protection by-law by the city and the success of its implementation rest on the ability of the municipality to follow through with the necessary financial commitment evaluated against other priorities, this includes the need to connect previously disadvantaged communities to the coast.

Key challenges

One key challenge is the conflict between growing the city's rates base and retaining open spaces. This requires taking decisions that are in the interest of the broader community and remaining objective and that are farsighted in the process of weighing the trade-offs.

Key message

In striving to find a balance between the pressing needs and rights, dialogue is a critical tool in navigating a resolution, therefore trade-offs are unavoidable.

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2.2

CAPE TOWN HARNESSING THE POTENTIAL OF ECOSYSTEM-BASED ADAPTATION

▲ Houtbay coastal line project By Ntando Mkhize

zthe City of Cape Town, there is increasing exposure of both private property (houses) as well as public infrastructure (roads) to pressures which are being amplified as a consequence of a warming climate. These include exposure to migrating dune systems (driven by stronger south easterly winds), sea-level rise and storm surges. Not only is both public and private infrastructure being damaged, but beaches (as public spaces) are gradually being lost as a consequence of sea-level rise.

A city-wide project was implemented to harness the benefits of coastal ecosystems and 'green belts' in response to escalating pressures associated with climate change, such as sea-level rise, storm surges and shifting wind regimes. The value of this approach is immense given that Cape Town is known as the 'Cape of Storms', has a lengthy coastline and is particularly vulnerable to the impacts of climate change.

The City has established a Coastal Management Line (CML) that has been incorporated into the City's Municipal Spatial Development Framework (MSDF). Within the MSDF the CML represents the Coastal Urban Edge. There are a number of regulatory provisions within the MSDF activities that address the seaward part of the Coastal Urban Edge, but generally development is prohibited. It is prohibited as the strip of land seaward of the Coastal Urban Edge consists of green belts and biodiversity networks. Thus the MSDF is a framework that provides protection of the sensitive coastal systems from various inappropriate development pressures. As mentioned above, the City is also in the process of developing a Coastal by-law which will be another mechanism to regulate the activities that may have a negative impact on ecosystem services.

The MSDF was subject to an extensive public participation process – the intention was to receive as much comment and input from stakeholders on the MSDF, which included the concept of the CML/Coastal Urban Edge. The concept of the CML/Coastal Urban Edge received much support during the public participation process as it promotes a number of priorities. These include:

- Promoting nodal development along Cape Town's coastline in areas where there are no biodiversity or coastal risk concerns.
- Promoting the conservation of coastal biodiversity networks in sensitive areas along Cape Town's coastline.
- Benefiting from the ecosystem services provided by these networks.
- Ensuring risk averse approaches to all activities along Cape Town's coastline.

▲ Rehabilitation in the Houtbay Dunes by Ntando Mkhize

Ecosystem-based approach

Typically, these ecosystems include estuaries, wind-blown sand dune systems, vegetated dune systems, rocky shores, sandy beaches and intertidal zones. The City is still awaiting formalisation of the CML in terms of the Integrated Coastal Management Act. The MSDF regulates activities from a land use planning perspective seaward of the Coastal Urban Edge. The MSDF and regulatory mechanisms (which include the City's Municipal Planning by-law) control what happens seaward of the CML/Coastal Urban Edge. The position of the CML/Coastal Urban Edge is highly variable along the City's coastline. In other words, it is a 'squiggly' line along the coast. The reason for this is because the line recognises the complexity of the coast (from a socio-political, environmental and risk perspective) and that the CML/Coastal Urban Edge must take into consideration and make provision for the various issues along the coast namely to promote nodal development for socioeconomic upliftment, to ensure that any development is risk averse, to conserve green belts and to benefit coastal communities.

The determination of each of these priorities was based on broad scale engagement with a wide range of stakeholders to make sure that there is a clear understanding of what issues need to be considered in building a resilient coastal city.

The determination of the CML/Coastal Urban Edge commenced in 2009 and was completed in 2014. It took a number of years as the City felt it was important to understand key issues along the coast that define the CML/Coastal Urban Edge. It was also critically important to get buy-in and support from all stakeholders which required a number of years to do. Whilst the CML has been incorporated into the MSDF as the Coastal Urban Edge, the City is still awaiting the promulgation of the CML in terms of the Integrated Coastal Management Act, which is the responsibility of the Western Cape Provincial Department of Environmental Affairs and Development Planning.

This project responds to the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008), the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996), the Environmental Conservation Act. 1989 (Act No. 73 of 1989) now largely replaced by the National Environmental Management Act, 1998 (Act No. 107 of 1998) but certain provisions remain in force, by the Western Cape Climate Change Response Strategy (2014) and other frameworks.

Evidence of success

The City has actively engaged in rehabilitating areas within the CML/Coastal Urban Edge. Primarily this includes dune restoration and maintenance. This is done in accordance with the City's Dune and Beach Maintenance Management Plan (City of Cape Town, Transport and Urban Development Authority (TDA), Coastal Management Branch 2017). Major projects currently undertaken within the CML/Coastal Urban Edge include the rehabilitation of the Hout Bay Dunes, Witsands dunes as well as investigations into the Table View Dunes.

The systems seaward of the Coastal Urban Edge/CML are now protected from negative impacts. As such these systems are returning to a more functional state thus improving the value of services they provide. There has been:

- Prevention of wind-blown sand smothering coastal infrastructure through rehabilitating vegetated dune cordons.
- Provision of a 'buffer' to storm surges, sea-level rise and coastal erosion.
- Retention of coastal aesthetics and 'sense of place' associated with Cape Town's coastline.
- Provision of access to the coast through promoting nodal coastal development in an environmentally sustainable manner.

Stakeholders have learnt the value of retaining 'green belts' along Cape Town's coastline as a means to avoid the current risks that Cape Town is experiencing along certain areas of the coast due to inappropriate development.

Considerable work still needs to be done in the rehabilitation and maintenance of green belts along Cape Town's coastline and this will be an ongoing process. Additional projects also included promoting a planned retreat approach to current infrastructure at risk and re-establishing green belts within these spaces. This is an expensive process and will require that creative funding mechanisms are established.

Lessons learnt

- Effective EbA requires an enabling framework that is best located in spatial frameworks. These frameworks are critical in shaping urban form and typology – what type of development should go where – this is critical to EbA.
- Incorporating EbA into spatial frameworks takes time. This is required to make sure that all stakeholders are engaged with and are included in the process. This approach is more likely to result in the support of stakeholders in the development of EbA approaches through CMLs/spatial frameworks.
- It is critical that a multi-disciplinary approach is taken in establishing CMLs/Coastal Urban Edges – the coast is a complex socio-ecological space which requires a holistic understanding to determine the most effective approach to EbA.

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▼ Private and Public infrastructure behind the rehabilitation area by Ntando Mkhize

3 Removal of Alien Invasive Species (AIS) for resilient ecosystems

3.1

WORKING FOR ECOSYSTEMS (WFE) IN THE CITY OF DURBAN

Climate change is anticipated to result in an increased frequency of floods and droughts, with projected impact on residents and infrastructure of the eThekwini Municipality in Durban, KwaZulu Natal. However, natural landscapes can help to reduce the impacts of climate change through ensuring better storm water attenuation, improved water filtration and topsoil stabilisation. These ecosystem services can be enhanced through management of natural landscapes and protection of biodiversity, such as through the control of invasive alien species. Invasive alien plants (IAPs)pose a significant negative threat to local biodiversity and have negative impacts on ecosystem services provided to the citizens. As such, the eThekwini Municipality has allocated funds for the control and eradication of IAPs.

The Working for Ecosystems programme became operational within the Municipality in the year 2007. It is a poverty relief/ sustainable development programme aimed at delivering optimal control of invasive alien plants by clearing invasive alien plants within preselected areas, whilst providing job opportunities to communities This intervention provides a platform for indigenous species to thrive with less negative competition from IAPs. The programme has a strong focus on controlling emerging weeds, which requires less resources compared to when infestation levels are high. The project also provides awareness, skills development and empowerment opportunities, which help to ensure more resilient communities.

Sites are chosen by the Environmental Planning & Climate Protection Department (EPCPD) of eThekwini Municipality. Site selection is based on a number of factors, such as:

- Systematic Conservation Assessment information which indicates Critical Biodiversity Areas (CBAs), Ecosystem Support Areas (ESAs) as well as other important biodiversity features (namely a biodiversity focus);
- High value ecosystem service provision (for example catchment areas that supply water) to local residents; and
- Requests from Ward Councillors to address specific economic needs in their respective ward areas (namely socio-economic aspects).

Removal of alien invasive plants in eThekwini by eThekwini Municipality

Ecosystem-based approach

The Working for Ecosystems Programme plays a critical and innovative role in increasing the functionality of ecosystem goods and services, improving the lives of the local communities, and helping them adapt to inevitable climate change impacts. Controlling fire and Invasive Alien Plants (IAPs), results in a well-functioning ecosystem that will ensure better storm water attenuation, improved water infiltration and topsoil stabilisation thereby enhancing its ability to withstand climate change impacts.

The programme operates on a number of sites and the combined area size of the core sites is 1405.5 ha. It is worth mentioning that through the in-built 'Early Detection & Rapid Response' (EDRR) initiative, the Programme also responds to emerging species across the Municipality. Reports of emerging species (via the 'Durban Invasives Website'), results in deployment of the EDRR team. Training is provided not only to beneficiaries employed within the Programme but also to teams working within other projects that also control IAPs. This approach directly benefits other municipal departments, conservancies, community initiatives, non-governmental organisations (NGOs), non-profit organisations (NPOs) as well as academic institutions. Training is aimed at standardising methods of identification and control of IAPs and is provided at no extra costs to the recipients. The Municipality incurs the training costs and benefits through having its natural environment managed.

Methods applied in the WFE programme are the following:

- training on IAP identification, methods of eradication, as well as the importance of biodiversity and removal of IAPs
- engagement of community leaders for beneficiaries
- Small, Medium and Micro Enterprise (SMME) Development & Mentoring
- early detection and rapid response on emerging weeds
- partnership with relevant stakeholders like the South African National Biodiversity Institute (SANBI), the Endangered Wildlife Trust (EWT) and so on
- research opportunities for academic institutions

Through the Programme, a subproject called 'Naming IAPs into isiZulu' was initiated as a means to:

- ensure IAPs have isiZulu names
- review existing names given to IAPs, so that those names do not clash with names given to indigenous plants
- document and publish names given to IAPs

In terms of best practices, once a site has been chosen and the programme has initiated work on the site, the programme maintains its presence on that site indefinitely. Subsequent to initiating IAP control on a new site, an initial phase of control is executed. After completion of initial clearing, the site then receives regular follow-up control as part of an ongoing maintenance/management plan.

As for the EDRR team (as explained above), deployment reacts to reports of emerging species. The Environmental Planning & Climate Protection Department (EPCPD), of eThekwini Municipality, has a website (http://www.durbaninvasives.org.za) where emerging species for the eThekwini bioregion are listed. Any member of the public is able to login as a spotter and report a sighting of any emerging weeds. Once verified, EDRR team(s) are then deployed to control the reported emerging weed.

Evidence of success

Although IAP control is a continuous undertaking and hinges on active work being undertaken regularly, the core sites under WFE are rehabilitated in terms of the management of IAPs. Through the removal of IAPs, it can be confirmed that the natural ecosystem functionality is restored, with all attendant benefits (including ecosystem services). There have been employment opportunities, with 402 jobs created (188 females, 214 males and 214 youth) in the 2017/2018 financial year alone.

▲ Alien Invasive Plants control in Durban by eThekwini Municipality

Community members were exposed to various learnings. Although not formally quantified, the following were evident:

- business management (starting and running co-operations)
- financial management
- appreciation and acknowledgement of ecosystem services
- identification of IAPs
- controlling IAPs through the application of different methods
- conflict resolution and people management skills

In some areas, like Ntshongweni, during weekends beneficiaries started clearing IAPs within their own community as a means to engage youth.

Lessons learnt

Partnerships are essential and the natural environment is far more important than we realise, therefore, managing it for human livelihoods can never be stressed enough.

Key message

Biodiversity and functional ecosystems are key to improved ecosystem service provision. By looking after the natural environment, we can also generate jobs, build small businesses, and uplift local communities.

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3.2

FIRE AND INVASIVE SPECIES CONTROL PROGRAMME OF ETHEKWINI MUNICIPALITY

As a result of climate change, eThekwini Municipality (Durban, KwaZulu Natal) may face a number of risks including threats to biodiversity and ecosystems. Because eThekwini Municipality is located in the Maputaland-Pondoland-Albany global biodiversity hotspot, changes to the climate are expected to lead to changes to ecosystem functioning and loss of endemic species. It is also expected that there will be an increase in invasive alien plant species as a result of the increase in temperatures and atmospheric carbon levels. Projections indicate that there could be intense short-term rainfall (flooding) which may result in increased erosion and possibly the loss of coastal vegetation, as well as an increase in droughts.

The Fire and Invasive Species Control Programme was initiated by the eThekwini Municipality to restore degraded grassland ecosystems through the control of invasive alien plants (IAPs), and the application of controlled burns on important biodiversity sites. The programme aims to ensure optimal restoration of such biodiversity sites while at the same time delivering green jobs and skills development through employment and training of local people, specifically those from the previously disadvantaged areas.

It is anticipated that through appropriate control of IAPs and prescribed burns, ecological functionality and environmental integrity can be restored to local ecosystems, with the result that the resilience of such ecosystems, as well as the ecosystem services that they deliver will be improved.

▲ Fire control in eThekwini by Fire control in eThekwini

Important ecosystem services such as the storing of water, filtering of water by wetlands and other seepages, coastal protection, available grazing lands and cooling of urban areas may be severely impacted as a result of climate change.

The Kwa-Zulu Natal Sandstone Sourveld (KZNSS)vegetation type is present in some areas in and around eThekwini Municipality. This vegetation type has been significantly impacted previously by agricultural and human settlement development. Currently, only 14% of its original extent remains protected in Nature Reserves like Msinsi, Krantzkloof and Springside and in Giba Gorge Environmental Precinct. KZNSS, as is it affectionately known, is listed nationally and provincially as endangered and is critically endangered.

In order to ensure the long-term persistence of this grassland ecosystem, proper veld management interventions are required and this includes a carefully planned fire management strategy. The application of prescribed burns in grasslands ensures that woody material is controlled, thus preventing a situation where grassland patches are completely taken over by woody plant species. This phenomenon is referred to as bush encroachment. Bush encroachment can lead to the disappearance of some grassland species thus contributing to local extinction and a collapse in ecosystem functioning.

Ecosystem-based approach

Activities undertaken include Invasive Alien Plant (IAP) Control and prescribed burns. Other activities include monitoring the condition of the veld through Veld Condition Assessments (VCAs) and Fixed Point Photography. To a lesser extent, the programme also undertakes waste management on sites where operations are undertaken. Project sites are located across the extent of the Municipality. Sites vary in size but the total area under management adds up to 848 ha. Sites under restoration are mostly grassland ecosystems, though there are forest ecosystems as well.

The programme has been running since 2009. Currently it is in its third phase with an intention of proceeding to the fourth phase (each phase is for three financial years). The requirement of the programme is based on the National Environmental Biodiversity Act, 2004 (Act 10 of 2004), which requires control of invasive species for all landowners, including local government. Effectively, this means that the programme should continue in perpetuity. Internationally, South African is a signatory to the Convention on Biological Diversity (CBD) as of 2003 (United Nations 1992). Contained under the PREAMBLE of the convention is the confirmation that signatory states are:

- Responsible for the conservation of the biological diversity (Biodiversity) within their countries,
- That it is vital to anticipate, prevent and attack the cause of significant reduction or loss of biological diversity at source.

The above two points clearly indicate the need to identify, manage, and deal with any factor that could be a threat to biodiversity. Although African natural environments are adapted to fires unmanaged fires can be detrimental to receiving environments. It is for this reason that an effective fire management framework that has a link to both national and international best practices is required.

Evidence of success

The result of the long-term Veld Condition Assessment shows that the condition of most grasslands is improving. More than 70 per cent of the sites were in subclimax stage, a stage where maximum biodiversity thrives. Moreover, results from Fixed Point Photography indicate that bush encroachment has been reduced in most sites. In terms of IAP presence, the majority of the sites have moved from the initial phase to the follow-up and maintenance phase. This means that the level of invasion on all these sites has been reduced.

Based on post fire monitoring, species of special concern (red data species) were recorded on sites where post fire monitoring was conducted. Accordingly, population numbers of these species seem to be improving. This is based on the number of individual species recorded on each site. Field staff employed under the programme are from local communities. An attempt to employ qualifying individuals from all wards has been made. Part of the deliverable of the programme is to develop skills. Some of the skills that beneficiaries have developed include the following trainings:

- invasive alien plant control
- fire management
- health and safety
- Adult Basic Education and Training ABET (where required);
- high altitude training;
- driving (where required);
- project management
- financial management

Lessons learnt

Restoring degraded areas is a long-term process. Results are not immediate, and one is required to apply some level of patience. A restoration programme needs to be based on a proven scientific method or goal. Procurement processes can hinder programmes unnecessarily and should ideally be streamlined to facilitate faster appointment of service providers. Supportive legislation coupled with local government commitment to managing the natural environment can together form the foundation for improving ecosystem service delivery.

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3.3

ALIEN INVASIVE PLANT CLEARING PROJECT AND SPRING RESTORATION WITHIN SOUTH AFRICAN GRASSLANDS

The Gobodweni area is part of the Pondoland centre of Endemism, with about 200 endemic plants found here. This centre of endemism is threatened by clusters or pockets of predominantly Gum (Eucalyptus species) and Wattle (Acacia species) trees dominating infestations which are spreading into surrounding grasslands/rangelands. An increase or abundance of woody plants (invasive species) in the area is anticipated to be associated with high levels of CO_2 in the atmosphere and is aligned to the climate predictions as per the Alfred Nzo District Municipality (ADM) vulnerability assessment and the Long-Term Adaptation Scenarios. Increasing temperatures, changes in rainfall patterns and specifically increased frequency of high intensity rainfall are already occurring and damaging local infrastructure such as access roads and houses.

FIGURE 1

Gobodweni Arial View of the extent of infestation of alien invasive species

▲ Ring backed *Eucalyptus* tree along the stream by CSA

Wetlands and pockets of indigenous forest and surrounding grasslands, which provide important water infiltration services, habitat for species and water availability for community and livestock are impacted by the alien invasive species. Streams are drying up due to the impact of these invasive alien plants and their high uptake of water. These trees are owned by individual community members and serve as a main source of income through trading logs to commercial mills. The clusters pose a huge threat to ground water, wetlands and livestock grazing lands. Stream flow levels have decreased and are not sustained throughout the dry season due to the invasive species.

Ecosystem-based Adaptation activities

The wetlands and surrounding grasslands (livestock grazing areas), totalling 47 ha, were restored resulting in an increase

in water availability, stream flow and water infiltration services within this area. A team of 41 workers (40 general staff & one supervisor) were appointed and received monthly stipends of R2100.00 per person. The clearing Team was comprised of general workers and included 10 people who had organised themselves as a business cooperative prior to the start of the project. The team cleared Acacia and Eucalyptus species and the byproduct (wood) of Acacia trees was sold to generate additional income. The local community also collected and used some of the byproduct (Eucalyptus) material for domestic activities such as roofing, building, livestock kraals and so on.

The ring barking method was applied on larger trees, small trees were either cut into stumps or ring barked. Local communities assisted tremendously with locating and indicating the most affected areas. Information about the nature of wetlands and springs prior to infestations as compared to during and after infestation was very helpful in the process.

▲ Cooperative Member (Team Leader) alongside stacks of Wood (*Acacia mearnsii*)

Evidence of Success

About 47 ha of wetlands and grasslands were restored, including the streams located within the area, through the clearing of alien plants. The area was maintained under a conservation agreement to support the ongoing restoration/ maintenance of the cleared area. Incentives were provided to farmers (vaccinations, cattle licks and so on) who practice rotational grazing and resting pastures, and their ongoing support for the clearing and maintenance of the area.

The project has contributed to the restoration of the wetlands and streams with an impact on the surrounding grasslands, through alien clearing and grazing cattle after the clearing. The volume of water available in the streams and longevity of the flow throughout the year has increased as seen by community members. During initial community engagements, people were informed of climate change and related impacts for their area, as well as mitigation and adaptation measures. Furthermore, the adverse relationship between the alien invasive plants and ground water was shared with the community members.

There has been added job creation as monthly stipends support the local community. The 10 members of the clearing teams who formed a cooperative were selling the cut wattle trees to the broader community and received further income from these sales at R500.00 a truck load.

Lessons learnt

- Removal of alien invasive plants helps to improve ecosystem services, particularly water availability. In the longer term the impact on grasslands can be measured.
- Effective community engagement at all stages of the project was critical to help facilitate community support and involvement in the project and allowed for their ongoing support as future stewards of the land.
- Ecosystem-based approaches supported under the Expanded Public Works Programme (EPWP) have important socio-economic benefits for people that can help build resilience.

Key Message

Natural Resource Management (NRM) programmes can provide effective Ecosystem-based Adaptation benefits for communities provided there is local support and ongoing stewardship models for maintenance of affected areas.

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3.4

BUILDING A COMMUNITY-BASED CONSERVATION MODEL IN THE TRIBAL LANDS OF THE GREATER LIMPOPO TRANSFRONTIER CONSERVATION AREA, SOUTHERN AFRICA

The Kruger to Canyon Biosphere Reserve (K2C), located on the western border of the Greater Kruger National Park (GKNP), consists of 1 million hectares of both protected areas and agricultural lands across three major biomes: savannah woodlands, Afromontane forests and grasslands. The region is arguably one of the most biodiverse areas for large mammal species within southern Africa, with high nutritional grasslands supporting large populations of ungulates and associated predators. The Biosphere boasts 55% of the total terrestrial biodiversity of South Africa in only 1.5 per cent of the country's land area.

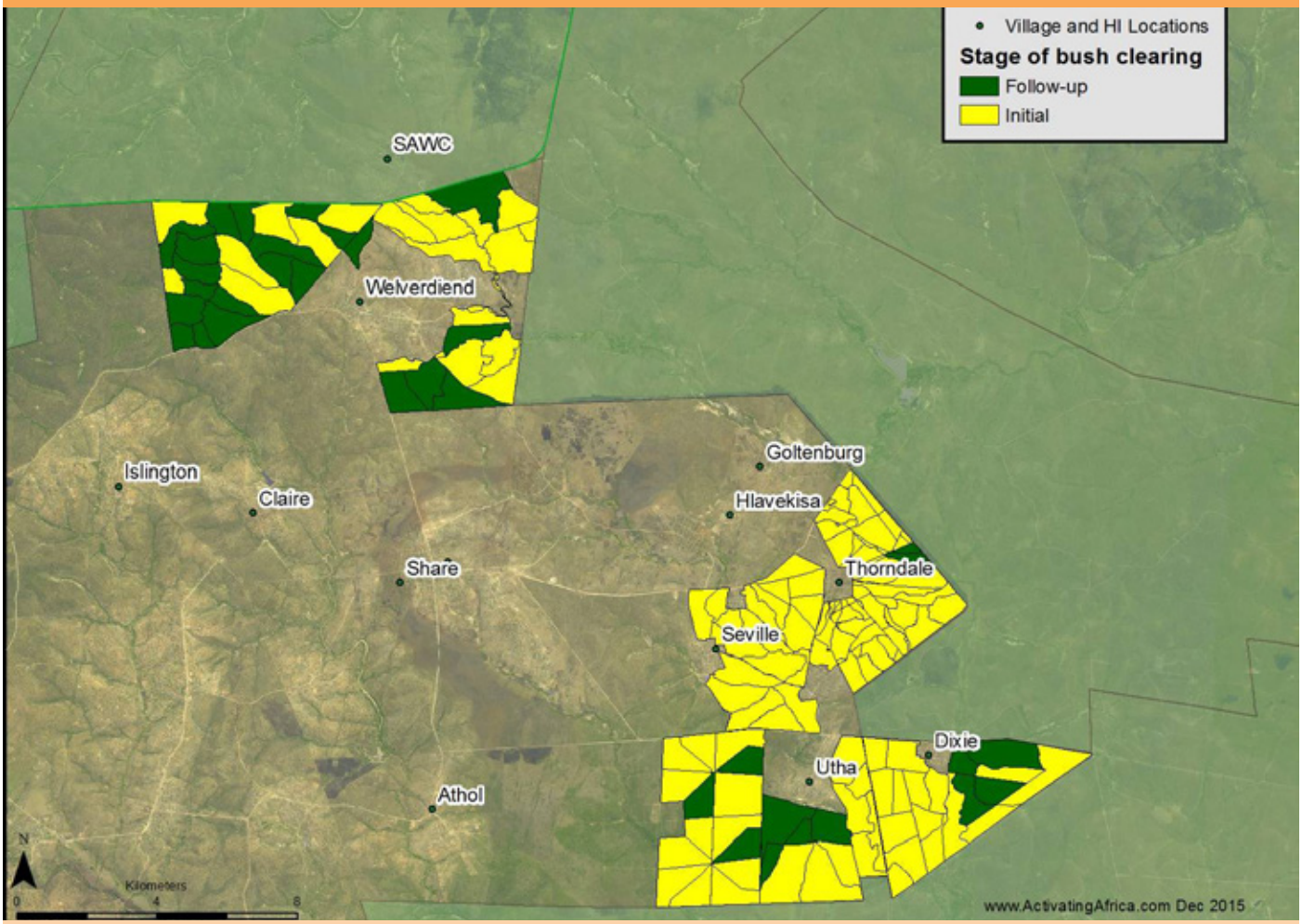
Land uses within the K2C are extremely diverse, and thus link into a stakeholder base that is not only very large, but also highly dynamic and complex. Main land uses include: conservation, agriculture, tourism, forestry, mining, rural development, and urban development. The most significant of these is Conservation Tourism as the K2C extends into the world-renowned Greater Kruger National Park (GKNP) which refers to the more than twenty private reserves west of the Kruger National Park.

Five major perennial rivers have their catchments in the western escarpment of the K2C, all flowing eastwards through varied land use into protected areas. These rivers are the lifeline of the protected areas as the average rainfall gradient drops steeply with elevation from the west (1500 mm) to the east (450 mm). Recognising the importance of the rivers flowing into the Kruger National Park, park management have revised their management strategies to include an explicit focus on the catchment areas of the park.

▲ Brush packing, shortly after bush thinning by CSA

The pilot site for this project is the Mnisi Traditional Authority area actively focusing on 395 livestock owners utilising 14 878 ha of communal rangeland immediately adjacent to the GKNP (Figure 1). These rangelands are a valuable source of a variety of natural resources upon which many households depend. The communal rangelands also form an important ecological buffer zone for protected areas. They are utilised by approximately 10 000 livestock (mainly cattle, but also goats) and form an important livelihood strategy for most of the approximately 6 000 people living in the area. The area is already experiencing the effects of a changing climate including increases in temperatures, changes in rainfall patterns and reduced availability of water including an increase in longer dry periods and even droughts. Existing unsustainable land use and development investments have already led to widespread degradation of our ecosystems and have enhanced the vulnerability within our communities, which climate change will further exacerbate. For example, bare soils lead to higher runoff and localised flooding events.

FIGURE 2



Current bush thinning areas under SANPARKS BSP by CSA

The cultural and subsistence importance of livestock, coupled with degraded existing rangelands, makes community livestock owners vulnerable to harsh climatic events. Bare soil and bush encroachment due to overgrazing and unmanaged grazing, lead to decreased grass cover (available livestock feed), less infiltration of water locally, increased runoff, localised flooding, loss of top soil and soil erosion.

Within the country's agricultural landscapes, it is both prudent and cost-effective to build the resilience of poor farming communities to climate change by restoring nature's capacity to retain soil, provide fodder for livestock, sequester carbon, replenish aquifers, store water, and reduce the impacts of floods and fires – which all form part of an Ecosystem-based approach to adaptation. Nearly 70% of South Africa's land is suitable for grazing livestock and, unlike irrigated agriculture which is highly vulnerable to the water scarcities predicted for South Africa, livestock production can be developed to work in harmony with natural systems regenerating degraded ecosystems, increasing biodiversity and improving biodiversity corridors between protected areas.

Ecosystem-based Adaptation activities

About 14 878 ha of Savanna bushveld that is currently bush encroached and overgrazed will be restored through bush thinning, erosion control and planned grazing or resting for the regrowth of grass. Activities include bush thinning (selective bush clearing) with brush packing of branches in existing bare soil or erosion sites and planned grazing of livestock in selected camps and resting to ensure sufficient growing periods for grass in rainfall seasons to allow grass cover to increase and go through the full growth cycle.

Conservation Agreements are used to promote behaviour change among livestock farmers and ensure rotational resting of grazing camps with planned grazing charts by-

▲ Bush thinning is the process of pruning trees up to 1.5 m and encouraging trees to grow upward rather than re-coppicing
by CSA

products. Negotiated incentives are delivered according to the conservation agreement and these incentives depend on the needs of the livestock farmers at the time. Incentives include:

- Training for farmers on sustainable livestock management.
- Opportunities to unlock market prices for livestock (such as branding and tagging as well as preparing livestock before sale).
- Introducing market competition such as a mobile abattoir.
- Fodder sales at reduced prices and production of local fodder from restoration by-products (branches, leaves and grass) and so on.

The project includes multiple phases:

- Bush thinning in progress since 2016 till 2020
- Conservation agreements since 2018 till 2020

Evidence of success

Planned restoration of ecosystem services includes improved water infiltration, prevention of soil erosion and provision of improved grazing services and biodiversity. There is an increase in grass cover and an increase in the available seed bank. The aim is that the restoration project will lead to consistently improved grass cover and grazing service for the area over time. Currently 6 500 ha under conservation agreement, will be restored to an improved functioning of ecosystem services and later expanded to include the full 14 848 ha.

A Socio-economic baseline survey was done in 2016 and a follow up survey was done recently (2019). Some of the socio-economic benefits being offered are job creation for bush clearers (contracted) and, anecdotally, farmers who have not had to buy as much fodder as usual since the implementation of the project. The price per kg for beef has increased from 65% of actual market price to 100% of market price through access to an alternative market which is an ongoing process using a mobile abattoir.

Key message

There is huge potential to support EbA through a conservation agreement model approach which also demonstrates how livestock can be a restoration tool in the process.

FOR MORE INFORMATION

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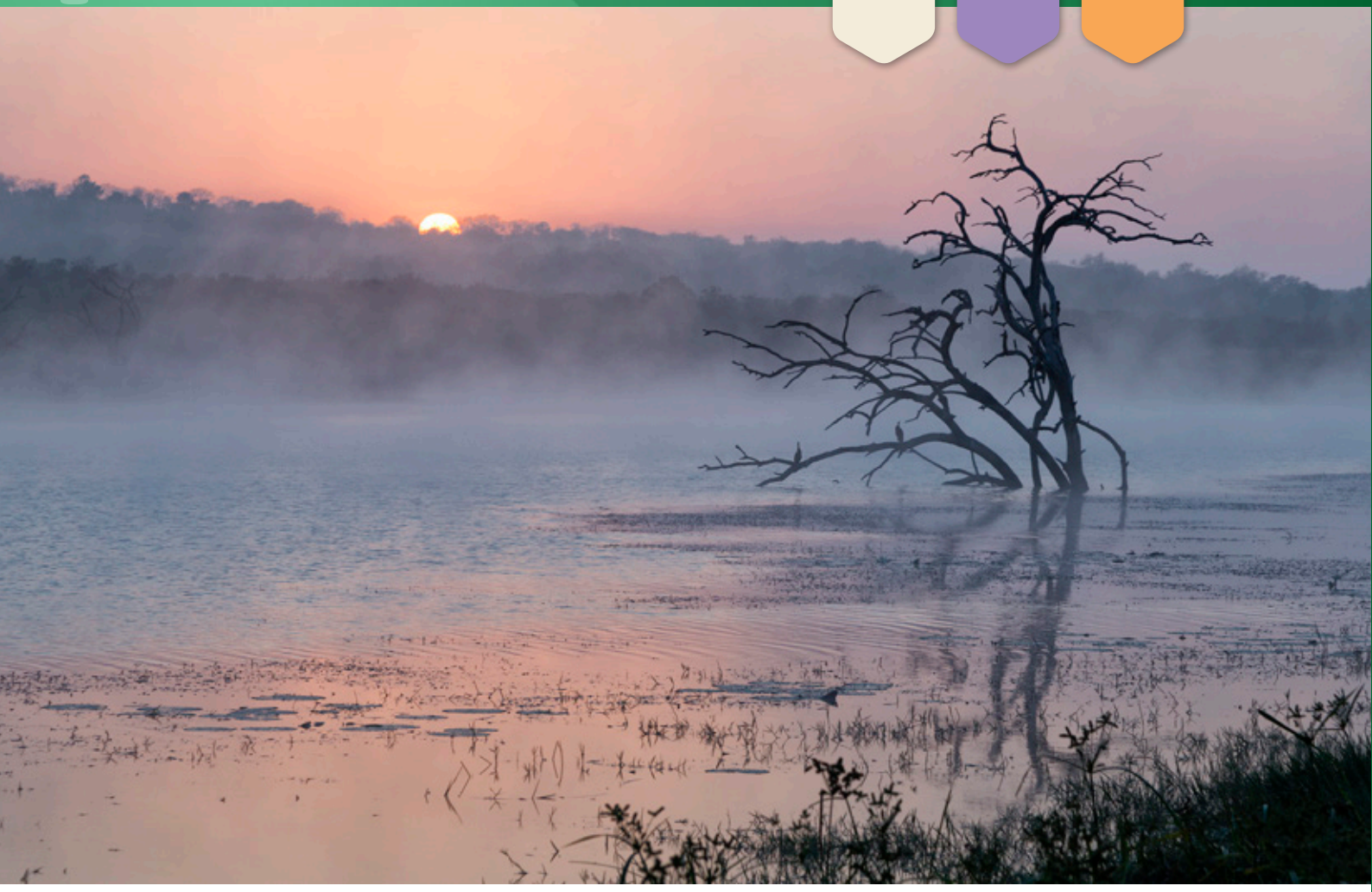
◀ Brush packing in erosion gulley enables grass growth and limits soil loss
by CSA

4 CONCLUSION



This study highlights different cases of ecosystem-based adaptation in the South African coastal and inland regions. South Africa has observed and is projecting further trends of marked temperature increases, rainfall variation and rising sea levels as well as an increased frequency of severe weather events. In vulnerable coastal regions such as Cape Town, climate change impacts arguably cause sea-level rise, storm surges, flooding and drought, among others.

As climate change facilitates the spread and establishment of many alien species and creates new opportunities for them to become invasive, rapid response measures to monitor and eradicate alien species become more significant as alien invasive species (AIS) can reduce the resilience of natural habitats, agricultural systems and urban areas to climate change.

Application of ecosystem-based adaptation has successfully prevented windblown sand from smothering coastal infrastructure through rehabilitating vegetated dune cordons demonstrating the provision of a 'buffer' to storm surges, sea-level rise and coastal erosion. Another example is the fire management of AIS in eThekwini, where a Veld Condition Assessment showed that the condition of most grasslands is improving and bush encroachment has been reduced. In Limpopo there is an increase in grass cover and an increase in the available seed bank. This study promotes the utilisation of EbA as it provides multiple benefits, namely resilient ecosystems and ecosystem services while also improving the livelihoods of communities.

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