South Africa: Ecosystem-Based Planning for Climate Change

World Resources Report Case Study

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INTRODUCTION

South Africa is one of 17 mega-diverse countries on the planet. Its terrestrial ecosystems are characterized by high levels of species diversity and endemism (species found nowhere else on Earth), particularly in plants, with the third highest number of vascular plant species in the world. With 1.2% of the earth's total land surface, South Africa contains almost 10% of the world's total known bird, fish and plant species, and over 6% of the world's mammal and reptile species. The country's marine and coastal ecosystems, straddling the Atlantic and Indian Oceans, include an exceptional range of habitats, with almost 15% of known coastal and marine species. Not only is the biodiversity of the country extremely diverse, but it is also highly threatened by a range of human activities including rapid urban expansion, expanding mining and agricultural sectors, and high levels of demand on resources including fish stocks, rangeland and water. The country has three globally recognized biodiversity hotspots,[1] namely, the Cape Floristic Region (one of the world's six Floral Kingdoms), the Succulent Karoo Hotspot (shared with Namibia, and one of only two arid hotspots in the world), and the Maputaland-Pondoland-Albany Hotspot (shared with Mozambique and Swaziland).

The climate change impact scenarios for South Africa regarding temperature, rainfall and biodiversity are complex, but are likely to include temperature increases on the order of 1-3°C, and disrupted regional rainfall patterns – likely becoming drier in the already semi-arid and arid West (with an overall 5-10% decrease in rainfall) and wetter in the East (Department of Environmental Affairs [DEA], 2010). In general, longer dry periods interspersed with more intense rainfall events are expected, with associated droughts and floods, decreased river flows and more intense and frequent wildfires.

A range of biodiversity impacts is predicted, including major range shifts for individual species and ecosystems, as well as changes in community structure, such as potential invasion of grasslands by woody plants because of increasing levels of carbon dioxide (DEA, 2010). A range of secondary negative impacts on biodiversity is expected as a result of climate change mitigation and adaptation

[1] A global biodiversity hotspot must include areas that are highly diverse (containing at least 1,500 endemic species of vascular plants, which equates to more than 0.5% of the world's total) and must have lost at least 70% of its original habitat (Myers *et al.*, 2000).

efforts in other sectors. These include the emergence of new industries such as biofuel crops, shifts in the areas targeted by agriculture due to changes in climatic suitability, new large dams to accommodate increased variability in water availability, and the emergence of areas suitable for new crops.

The intervention outlined in this case study is South Africa's emerging strategy of ecosystem-based adaptation[2] to climate change, based on maintaining sufficient intact natural habitat in an optimal configuration identified through systematic biodiversity planning. This has been done through: (i) producing biodiversity maps and guidelines in several provinces and municipalities that feed into spatial and development planning; and (ii) developing a national strategy for expanding protected areas. Climate change design principles (e.g prioritization of corridors, refugia areas where species may move to survive temperature increases, slopes with marked altitudinal changes in climate and large, connected remaining fragments) are explicitly used in the systematic biodiversity planning methodology underpinning both these interventions.

As a result, information on the areas important for ecosystem-based adaptation is being used to inform spatial planning and land-use decision-making. Also, protected areas are being expanded into areas that are important for ecosystem-based adaptation. Progress has been faster in some parts of the country than others, which will be explored below. In addition to the direct outcomes, the recognition that intact biodiversity is a key requirement for human adaptation to climate change and can potentially be both more effective and lower cost than engineered solutions is emerging as a powerful force for aligning biodiversity with developmental and social agendas.

SETTING

South Africa has a wide range of climatic conditions and variations in topography and geology that give rise to broad vegetation zones or biomes.[3] South Africa's nine biomes are: Albany Thicket, Desert, Forest, Fynbos, Grassland, Indian Ocean Coastal Belt, Nama-Karoo, Savanna and Succulent Karoo. Each supports its own collection of plant and animal species and provides a different set of social and economic opportunities.

Based on available data sets, scientists anticipate that the effects of climate change on species distributions, vegetation types and ecosystems in South Africa will be significant. Overall, there is likely to be shrinkage and shifting of optimal areas for major biomes, and range shifts of many species, particularly endemics, as well as an increase in extinctions. The most severe impacts are predicted for the South and West, in the winter rainfall regions of the Fynbos and Succulent Karoo Biomes, with 20 to 40% of the areas supporting these biomes being exposed to novel conditions by 2050 assuming middle to high range emissions scenarios.

[2] "Ecosystem-based adaptation is 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. Ecosystem-based adaptation uses the range of opportunities for the sustainable management, conservation, and restoration of ecosystems to provide services that enable people to adapt to the impacts 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" (Secretariat of the Convention on Biological Diversity, 2009).

[3] A biome is a major regional biotic community, such as a grassland or desert, characterized chiefly by the dominant forms of plant life and the prevailing climate.

Major range shifts have been predicted for 227 mammal species, and models suggest a potential 40% reduction in endemic plant species richness even under moderate climate change scenarios (DEA, 2010).

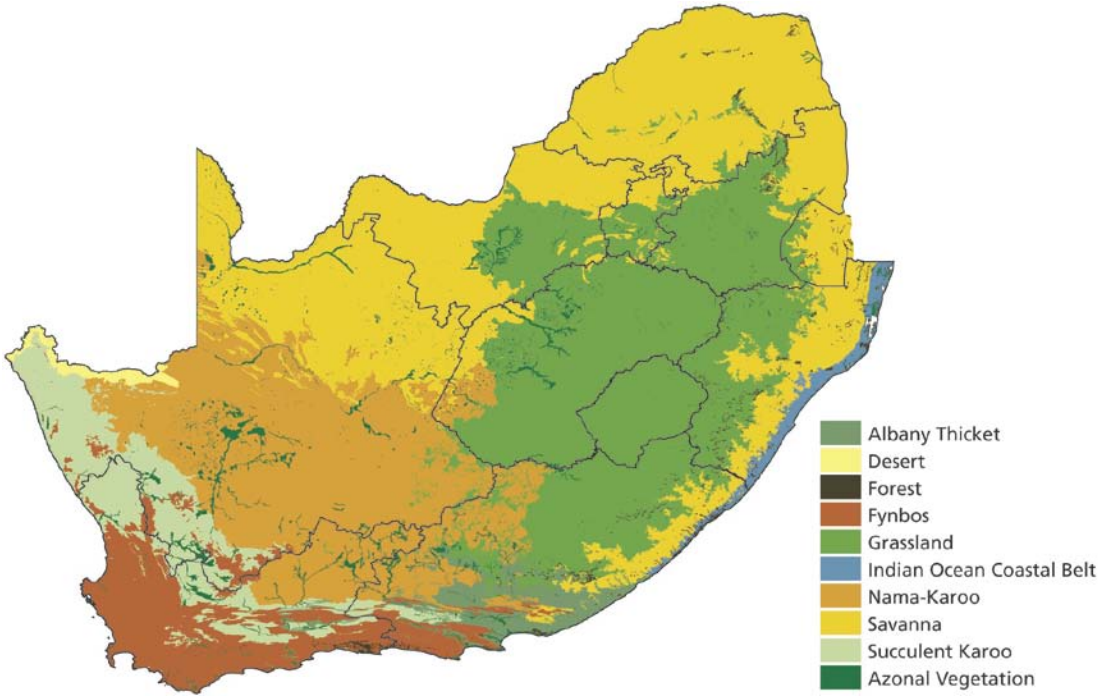

Figure 1: Biomes of South Africa (SANBI, 2010).

Since South Africa's first democratic elections in 1994, the government has faced enormous developmental challenges. Although South Africa is an upper middle income country, there is a massive wealth gap, with 43% of the population surviving on less than US$2 per day, and structural unemployment of up to 35%. With pressing needs for delivery of housing and services, rural development and land reform, food security and job creation, there are severe pressures on land and water resources in the country. It is important that biodiversity contributes, and is seen to contribute, to economic development and reduction in social inequality, rather than standing in the way of these requirements. The Department of Environmental Affairs and the South African National Biodiversity Institute (SANBI) are currently working on a project to develop and clearly package messages for other sectors of government about the importance of both biodiversity and ecosystem services for socio-economic development and in underpinning key sectors of the economy in South Africa.

The main driver of biodiversity loss is loss of natural habitat through the expansion of agriculture and urban development. The invasion of alien plants is also a significant driver, combined with overextraction of water, overgrazing, overfishing and frequent fires. Changes in temperature and precipitation patterns are likely to exacerbate these drivers in many cases. Attempts to *mitigate* climate change can also put pressure on biodiversity, for example, if land and water are required for crop-based biofuel production and for wind and solar energy schemes. Attempts to *adapt* to climate change may also be negative for biodiversity where approaches/adaptation responses drive agricultural expansion, as the area suitable for particular crops shrinks or shifts, or there are reductions in yield potential or the length of growing seasons, especially along the margins of semi-arid areas. Water is a major limiting factor for development, with demand predicted to exceed supply by 2025. Adaptation to increased pressure on

water supply through increased extraction of groundwater supplies or the construction of large dams would likely have a significant additional adverse impact on already strained freshwater systems.

Until recently, South Africa lacked maps showing the location of valuable biodiversity at a sufficiently fine scale to inform conservation work and land-use planning, or to enable the creation of corridors to allow plant and animal species to migrate over time and adapt to climate change. Over the past decade, the emphasis in conservation in South Africa has moved beyond the boundaries of protected areas to working across production landscapes, developing new tools to involve the private and public sectors in conserving biodiversity, and building ecosystem resilience to climate change.

TYPES OF RISK FACED

Two areas of climate risk are addressed by the intervention described in this case study – risks posed by the loss or decline of ecosystem services and risks of increased natural disasters. The intervention deliberately focuses on areas where intact biodiversity may help deal with risks to human social and economic systems (e.g. by protecting important water catchment areas or wetlands which help mitigate flood risk), rather than being strictly focused on biodiversity for its own sake.

The impacts of climate change will place increasing strain on the resilience of many ecosystems, damaging their ability to provide key ecosystem services.[4] This will negatively affect the livelihoods of the people in both rural and urban areas. The ecosystem service likely to be most significantly affected in South Africa is the provision and regulation of a reliable supply of good quality water. Large portions of South Africa are arid or semi-arid, or alternatively have water requirements that exceed local supplies and are dependent on water transfers. Water is the key limiting factor for development in many areas. A reduction in water provision and regulation will affect the health of households, the ability of the agricultural sector to provide food security, and the provision of jobs by industry. A current example can be seen in the threatened shutdown of PetroSA's petrochemical refinery in Mossel Bay because of prolonged drought in the Southern Cape region (*Engineering News*, 13 September 2010). In the Eastern Cape, drought has resulted in delays in the provision of low-cost housing in certain coastal towns because of the inability to secure reliable water supplies.

A second major area of risk in South Africa relates to a likely increase in climate-related disasters, particularly floods, fires and coastal storms.

Floods: Increased variability in precipitation (DEA, 2010), with more sudden heavy downpours, is likely to increase flooding, with the Overberg and the Garden Route in the Southern Cape already having experienced a number of abnormally large flood events in the past few years. With flooding comes the erosion of riverbanks and the loss of valuable soil resources for agriculture, as well as an increase in sediment into rivers. This, in turn, pollutes drinking water supplies downstream, reduces storage capacity of dams and silts up estuaries where many fish breed – all impacting on ecosystem functioning, livelihoods and the economy. Estimated direct financial costs associated with flooding for 2000-2008 are R4.6

[4] Humans benefit from a range of resources and processes that are supplied by natural ecosystems. Together, these benefits are known as ecosystem services and include both products like clean drinking water and processes such as waste decomposition.

billion (approximately US$660 million) (DEA, 2010).

Fires: As the climate becomes hotter and drier in some areas, it is predicted that there will be an increase in the frequency and intensity of wildfires (DEA, 2010). In the South Western Cape, high intensity fires are often associated with increased fuel-load due to the profusion of woody alien vegetation, which may also be exacerbated by climate change. Wildfires can cause loss of human life, livestock, property and livelihoods. In financial terms, it has been estimate that wildfires cause annual damage of around R743 million (approximately US$100 million) (Forsyth *et al.*, 2006). Although some South African ecosystems are fire-driven, too frequent fires have a negative impact on biodiversity. They can also cause changes in grazing regimes which may further damage natural habitats.

Storms: An increase in climate-related disasters is also anticipated as a result of increased storm surges and sea level rise. There is evidence that the intensity and frequency of extreme storms in South Africa is already increasing (Guastella and Rossouw, 2009), and current measured sea level rise is in line with international trends (Mather, 2009). The combination of sea level rise and storm surges will potentially threaten low-lying areas of the major coastal metropolitan centers of Cape Town, Durban, Port Elizabeth and East London (Mather, 2008). A study for Cape Town predicts an 85% chance of extreme winds causing 4.5 m storm surges in the next five years, which could cause about US$3 billion of damage to infrastructure. Storm surges along the KwaZulu-Natal North Coast in 2007 damaged roads and made a major dent in tourism earnings (*Business Day*, 22 March 2007). In addition, increasing salinization of groundwater and estuaries may impact on boreholes (which are particularly important for water provision for smaller coastal settlements) and on the many fish species that are dependent on estuaries as breeding grounds.

An additional risk is posed by increasing CO_2 levels, which are likely to cause bush encroachment in savannah ecosystems and the encroachment of woody species into grassland systems, with negative effects for grazing and livelihoods (despite potentially positive effects for carbon sequestration). In the northeastern parts of the country, increases in rainfall and temperature may cause failure of crops and the spread of malaria and cholera (DEA, 2010).

Overall, there are many risks posed by climate change to which South Africa is responding, particularly through mitigation strategies, as outlined in the country's Draft National Climate Change Response Green Paper which was released in November 2010, as well as by the newly formed National Planning Commission. Adaptation strategies at national and regional levels are still in formation, providing a major opportunity for the conservation of biodiversity to promote the use of natural rather than engineered solutions. For example, water supply can be increased by massively scaling up labor-intensive clearing of alien invasive plants in mountain catchments instead of (or as well as) building highly capital-intensive desalination plants. Importantly, this represents an opportunity to change the perception that the biodiversity agenda is in conflict with the development agenda. It also highlights to government and society the need for resilient ecosystems, based on the sufficient and efficient protection of identified natural areas, as a key requirement to support ongoing social and economic development.

It is in this context that South Africa is beginning to promote ecosystem-based adaptation to climate change, supporting the two interventions outlined in this case study – the incorporation of biodiversity information into spatial and development planning,

and a national strategy for expanding protected areas.

The starting point of South Africa's approach to systematic biodiversity planning is that we need to conserve (i) a representative sample of all biodiversity pattern, including species and their habitats (the principle of representation) and (ii) the ecological and evolutionary processes that allow this biodiversity to persist over time (the principle of persistence) (Driver *et al.*, 2003).

Systematic biodiversity planning does not primarily focus on species but on threatened terrestrial and aquatic ecosystems,[5] and highlights Ecological Support Areas important for ecosystem functioning as well as Critical Biodiversity Areas important for biodiversity pattern and ecological process. Although the exact relationship of structure and function in ecosystems is a highly complex area, the South African National Biodiversity Institute is proceeding from an understanding that conserving large areas of intact natural habitat has benefits both for biodiversity (diversity of genes, species and ecosystems) and for ecosystem functioning and therefore the ecosystem services derived by human communities (for example, those related to tourism, grazing, pollination and the provision and regulation of water supply). As some of these ecosystem services are threatened by climate change, conserving natural habitat thus strengthens adaptation to climate change (Secretariat of the Convention on Biological Diversity, 2009).

South Africa's focus a decade ago was on biodiversity pattern and process, with knowledge of climate change issues translating into broad attempts to conserve large north-south and mountain-coast corridors of natural habitat. Over the past few years, climate change issues have increased in prominence, with a concomitant increase in the attention given to ecosystem services. At the same time, our knowledge of how to incorporate more specific climate change design principles into systematic biodiversity planning has improved. The South African biodiversity sector is thus working with what it has developed in the past and found successful, and improving it in order to address current priorities. It is precisely this kind of adaptive approach and "work in progress" which are described in this case study.

[5] In South Africa, vegetation types have been considered to represent ecosystems, and are used as surrogates for biodiversity in systematic biodiversity planning.

POLICY INTERVENTION

Over the past decade South Africa has developed a landscape approach to conserving biodiversity and promoting ecosystem resilience – working within and beyond the boundaries of protected areas to manage a mosaic of land uses that includes protection, restoration, production and subsistence use, in order to deliver ecological, economic and social benefits. Critical elements of the approach include partnerships between diverse role-players (e.g. government, civil society and communities) and effective mainstreaming of biodiversity considerations in land-use planning and production sectors (Cadman *et al.*, 2010).

As part of this approach, South Africa has been working for the past decade to incorporate biodiversity into land use planning and decision-making. The reason for this is that loss of habitat is the single biggest cause of biodiversity loss, and South Africa wishes to conserve biodiversity pattern and process, in line with its own policies and its commitment to the Convention on Biological Diversity. South Africa also has an integrated system of spatial and development planning which is an important (though not the only) determinant of land use and land use change in the country, so mainstreaming spatial biodiversity information and land use guidelines into this system is an effective and efficient way to work.

In recent years, as the need for adaptation to climate change has become ever more apparent, systematic biodiversity planning methodologies have been enhanced to include climate change design principles, as reflected in the products of the last three years, discussed in this case study. A central element of the landscape approach is the promotion of ecosystem-based adaptation, maintaining biodiversity in intact natural systems which provide ecosystem services to help people adapt to the adverse effects of climate change.

Over the past three years, the South African government has made two interventions that form the basis of this case study, working through its statutory body responsible for biodiversity matters, the South African National Biodiversity Institute. Both these interventions are based on a systematic biodiversity planning methodology that incorporates explicit climate change design principles. This methodology and the two interventions are summarized here.

Methodology: Climate Change and Systematic Biodiversity Planning

A key feature of national biodiversity policy in South Africa is that it is based on systematic biodiversity planning (as opposed to being *ad hoc* and non-systematic or focusing only on species). Systematic biodiversity planning, also known as systematic conservation planning, involves mapping a wide range of information about biodiversity features (including both biodiversity pattern and ecological processes) and patterns of land and resource use. Conservation planners then set quantitative biodiversity targets for habitat types, ecological processes or species (for example, minimum range requirements for a threatened animal), and analyze the information using specialized software programs linked to Geographical Information Systems (GIS). Typically, South African systematic biodiversity plans of the past decade are focused on habitats and ecological processes, rather than the requirements of individual species.

Systematic biodiversity plans focus on efficient solutions which meet the required biodiversity targets in configurations which are least costly to society in terms of conflict with other valid land uses and in terms of the area required. Outputs are interpreted and presented as maps with associated land-use guidelines at various spatial scales to indicate where conservation action should be focused and to assess the implications of different land-use options for biodiversity. Conversely, the maps also indicate areas which are of less interest from a biodiversity perspective, and hence where developments should be facilitated.

Systematic biodiversity planning in South Africa has enabled a focus on ecosystems and ecological processes rather than on individual threatened species. This has meant that climate change issues can be incorporated in a spatially explicit manner, enabling systematic biodiversity planning to be consciously used as a tool for climate change adaptation. This has been practiced by the conservation planners who have completed the latest generation of plans, over the past three years. This process places importance on aligning biodiversity priority areas with corridors and areas of intact natural habitat that are essential for maintaining landscape-scale ecological functions and the ecosystem services they provide. In addition, these biodiversity priority areas are aligned with biophysical features that support ecosystem-based adaptation to climate change. These features include intact river and coastal corridors, mountain ranges, areas with refuge habitats such as cooler south-facing slopes and ravines, areas with a range of microclimates, altitudinal gradients, climatic gradients, areas of high topographic variation, or other ecological gradients. These are features of the landscape that increase the resilience of ecosystems to climate change, allow for migration and dispersal of

species, and contribute to ecosystem-based adaptation to climate change.

A key issue is avoiding the further fragmentation of landscapes, the loss or break-up of the best and most viable natural patches, and ensuring that landscapes are retained in as connected a configuration as possible. Securing corridors of well-managed, natural or near-natural habitats is seen as critical to allowing plant and animal species to move in response to climate change (Cadman *et al.*, 2010). Corridors also play an important role in helping human communities adapt to the effects of climate change. For example, maintaining indigenous vegetation along rivers can prevent the banks from being eroded when rivers swell during heavy rainfall. Keeping wetland ecosystems in a healthy state is critical for gathering, managing and delivering water – improving water quality, controlling erosion, sustaining river flows during dry seasons and reducing the impact of floods. Maintaining coastal dunes, mangrove swamps, kelp beds and healthy estuaries can provide natural buffers and protect human settlements against storm surges and coastal flooding, at far lower cost than engineered solutions. This is beneficial to society anyway, and becomes more important with increased risks of floods and coastal storm surges because of climate change.

A number of systematic biodiversity plans deliberately identify areas important for supporting the delivery of ecosystem goods and services. Examples of areas that are targeted, and which are also important for supporting the adaptation of society to climate change impacts, are catchments areas with high rainfall runoff, groundwater recharge areas, and individual wetlands and wetland systems which are important for moderating runoff patterns. Identifying areas that are important not just for biodiversity but for the services they deliver provides policymakers with a strong argument for their protection, in a way that would not be possible if they were associated only with a narrow biodiversity agenda. Framing areas as important for human development makes these solutions more acceptable to decision makers, even when the total land required to meet both biodiversity and ecosystem service objectives might be larger than that required to meet only biodiversity goals.

Rather than being specifically aimed at responding to a single climate change scenario, the design principles emphasize the conservation of areas important for maintaining ecological functioning under a range of climate scenarios, enabling a pragmatic response to the variation that is associated with climate change predictions on temperature and rainfall. For example, although there may be significant differences between various climate change scenarios, the areas that need to be protected, such as those with the greatest climatic and topographic gradients, or the greatest range of microclimates, or areas for climate refuge, generally remain the same. Although species and habitat modeling under future climate scenarios has been undertaken in many areas, this tends not to be the focus. The emphasis is on planning for the maintenance of ecological processes which support resilient systems and allow adaptation to take place, rather than attempting to identify in detail the requirements for a particular species or ecosystem.

Intervention 1: Biodiversity Sector Plans Feeding Into Local and Regional Planning

Systematic biodiversity planning, incorporating climate change design principles, is being used to develop Biodiversity Sector Plans (which may be formally published in the Government Gazette as Bioregional Plans) in seven of the nine provinces of South Africa, with plans for the remaining areas being anticipated. In some cases one plan has been produced for the whole province, and in other cases, a plan for each municipal district within the province. Systematic biodiversity planning is the accepted norm for Biodiversity Sector Plans, and if a plan is to be published as a Bioregional Plan, then

a peer-reviewed fine-scale systematic biodiversity plan is a legal prerequisite.

Currently the legal requirement is for systematic biodiversity plans that ensure the long-term persistence of biodiversity and take ecological processes into account (National Environmental Management: Biodiversity Act No. 10 of 2004). Climate change is not explicitly included, but the new generation of plans all include climate change design principles and these are widely accepted by the conservation planning community as necessary for all future plans.

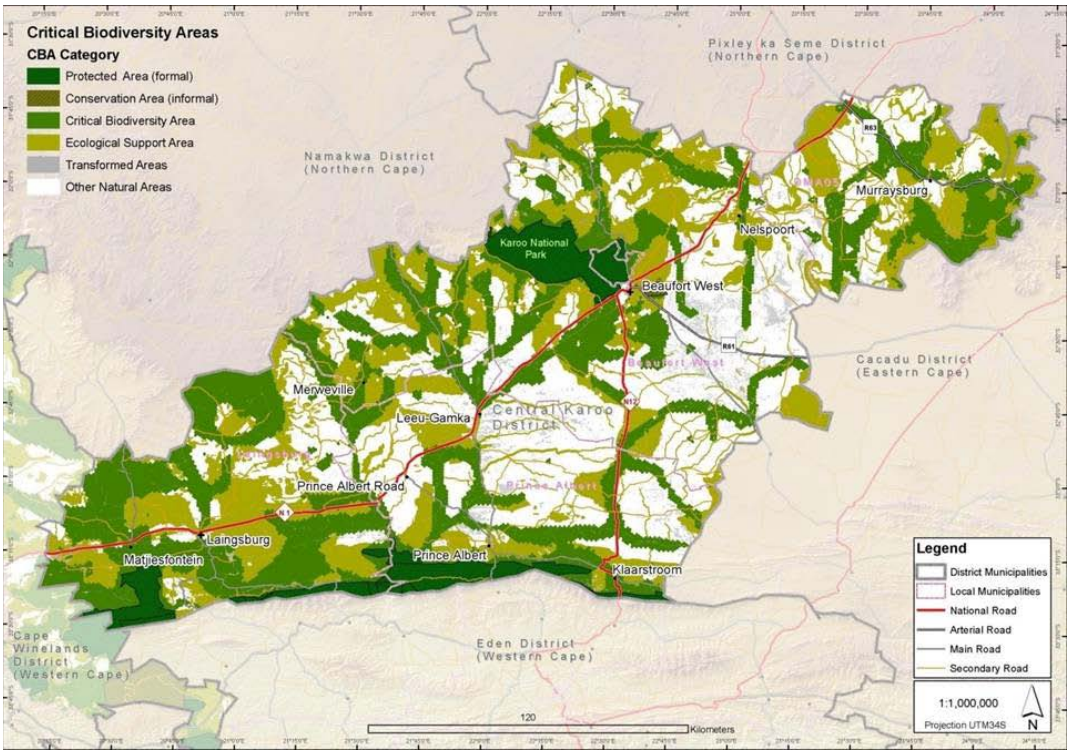

Figure 2: Map showing Critical Biodiversity Areas and Ecosystem Support Areas (SANBI, 2010).

Biodiversity Sector Plans are designed to guide land-use planning and decision-making by all sectors that impact on biodiversity. Local authorities are required by law to have an Integrated Development Plan, updated every five years, supported by a Spatial Development Framework. Local authorities are also required by law to incorporate biodiversity information into their Spatial Development Frameworks, and Biodiversity Sector Plans provide the required information in a format that is easy to understand and incorporate. They also have the potential to make a crucial contribution to climate change adaptation plans at local and provincial levels (not yet a legal requirement), as they provide spatial information that supports ecosystem-based adaptation, which forms a key portion of South Africa's adaptation strategy (DEA, 2010).

A Biodiversity Sector Plan provides a fine-scale map of "Critical Biodiversity Areas" and "Ecological Support Areas." Critical Biodiversity Areas are areas required to meet conservation targets for biodiversity pattern and ecological processes. Ecological Support Areas are areas required to support the ecological functioning of Critical Biodiversity Areas, and/or to deliver ecosystem services.

A critical difference between Ecological Support Areas and Critical Biodiversity Areas is that Critical Biodiversity Areas must be maintained in a natural or near-natural state, while the emphasis with Ecological Support Areas is that they should remain in a functional state and retain existing ecological processes. To provide a practical example, in a particular area most floodplain habitat may be designated as Ecological Support Area, which must remain functional to ensure ongoing habitat connectivity, to maintain hydrological processes

and to reduce flood damage; however, one particular area of that floodplain may be designated as a Critical Biodiversity Area, and must be kept in as close to a pristine state as possible because it is part of a threatened ecosystem, contains rare species and provides a key upland-lowland migration route for a range of species.

The maps are accompanied by descriptions of the Critical Biodiversity Areas and Ecological Support Areas, land-use guidelines linked to them, a short biodiversity profile of the region to provide contextual information and, usually, monitoring and review arrangements and supporting GIS data. The land-use guidelines, based on land management objectives, provide general recommendations for permissible activities in areas of biodiversity importance, while indicating other areas that are suitable for development.

In most of South Africa, decisions about land use are guided by laws, regulations and zoning schemes that govern what land uses are permissible in particular areas. A nested system of strategic development and spatial planning at national, provincial and local levels provides multiple opportunities to embed biodiversity considerations into land-use planning and decision-making processes. Although these nested systems are not yet in place in all areas, in most places at least two of the levels are functioning.

Biodiversity plans are now fed into municipal plans, required by law for all municipalities since 2000 (Cadman *et al.*, 2010). Each municipality must have an Integrated Development Plan. The Integrated Development Plan is updated every five years through a participatory process to guide and inform all municipal planning, budgeting, management and decision-making. Every Integrated Development Plan must include a Spatial Development Framework, which is an indicative spatial plan that reflects the Integrated Development Plan priorities and shows the current and future patterns of land use by all sectors, such as housing, agriculture, conservation and industry. The Spatial Development Framework must include a strategic environmental assessment, a policy for land use and development, and guidelines for land-use management. Climate change information is not currently a legal requirement.

Where Biodiversity Sector Plans are available, these have in all cases been taken up voluntarily into Integrated Development Plans and Spatial Development Frameworks as they have been updated (pers. comm. Jeffrey Manuel, SANBI). Incorporation of a published Bioregional Plan into a Spatial Development Framework is mandatory in terms of the National Environmental Management: Biodiversity Act No. 10 of 2004.

Municipal and provincial officials are frequently required to consider applications for new land-use activities, developments or rezoning. These are legal prerequisites for most land-use changes, e.g. a new housing development, a new resort or the plowing of natural habitat. Further, some of these involve a legal requirement for an Environmental Impact Assessment (EIA) to be conducted. The information contained in Biodiversity Sector Plans is accessible to officials and to consultants involved in EIAs to inform their decision making, and generally the approval authorities specify that this information be used. It is a prerequisite that published Bioregional Plans must be taken into account. South Africa has embarked on a process to secure buy-in from decision makers to change the way decisions are taken in practice. This has been done through hands-on training in some provinces, and the establishment of a Biodiversity-GIS website (http://bgis.sanbi.org) which provides spatial biodiversity information in the form of interactive maps and GIS data layers. The site is managed by the South African National Biodiversity Institute and has over 3,000 registered users, including people involved in planning, tourism, agriculture and environmental assessment.

EIAs are by their nature reactive, but the availability of the Biodiversity Sector Plans to guide these assessments means that they are starting to be carried out in a more strategic and forward-looking manner. Recent revisions in EIA legislation impose stricter conditions in Critical Biodiversity Areas. As gaining environmental approval is a costly, time-consuming and risky process for developers, making the Critical Biodiversity Area data freely available to developers and consultants is emerging as a key mechanism for influencing the nature of developments proposed for sensitive areas. This trend has been observed anecdotally by conservation agencies and is not yet reflected in the published literature.

Intervention 2: The Development of a National Protected Areas Expansion Strategy

Systematic biodiversity planning (incorporating climate change design principles) has also been used to develop a strategy to expand South Africa's protected area estate. The National Protected Areas Expansion Strategy (NPAES) was developed in 2008 by the South African National Biodiversity Institute with the support of South African National Parks for the then national Department of Environmental Affairs and Tourism, and was approved by the national government for implementation in March 2009 (NPAES, 2010).

The National Protected Areas Expansion Strategy provides a map of 44 important focus areas for protected area expansion – areas that capture the full range of biodiversity pattern and ecological processes (including important areas for climate change adaptation such as corridors and refugia), based on systematic biodiversity planning. In addition to improving representation of species and ecosystems in the protected area system, the strategy aims to achieve cost-effective expansion that enhances ecological sustainability and resilience to climate change. The strategy ties in with the international movement towards recognition of the role an expanded protected area network can play in climate change mitigation and adaptation, and hence highlighting the need for (i) having more, larger protected areas; (ii) connecting protected areas with natural corridors in the broader landscape; and (iii) focusing some management actions inside protected areas on resilience, adaptation and mitigation needs (Dudley *et al.*, 2010).

Figure 3: Umgano community stewardship site, KwaZulu-Natal province, South Africa (SANBI, 2010).

The strategy recommends two main mechanisms – acquisition of land and contractual agreements with private and communal landowners. Since acquisition is costly, and since the vast majority of valuable biodiversity is in private hands, with a portion under communal ownership, increasing emphasis is being placed on "biodiversity stewardship" work with private and communal landowners. This involves concluding contractual agreements to set aside portions of their land with valuable biodiversity[6] for varying lengths of time,

[6] National and provincial conservation agencies have clear evaluation and prioritization processes which rate properties on aspects such as the existence of habitats that are not sufficiently represented elsewhere in the protected area network, areas supporting threatened species or the location of a property in a key ecological corridor.

in exchange for receiving extension and management support from the state, property rate rebates and, in the near future, income tax rebates.

The National Protected Areas Expansion Strategy and the Biodiversity Sector Plans are informing the priorities of provincial and national conservation authorities in carrying out their stewardship work. In the Western Cape and KwaZulu-Natal provinces, a number of contractual agreements have been concluded in the last few years. The provincial conservation agency in the Western Cape (where much of the Cape Floristic Region falls), CapeNature, has produced an implementation plan for the province based on the National Protected Areas Expansion Strategy, and is working to raise resources through the National Treasury and from donors. South African National Parks has also signed contractual agreements with private landowners to incorporate identified priority areas of lowland Fynbos and Succulent Karoo into the protected area estate.

Mpumalanga Province, with the support of NGOs, has recently signed groundbreaking Protected Environment agreements to protect privately-owned areas with high levels of grassland biodiversity and important wetlands from mining threats. KwaZulu-Natal has expanded protection into private and communal areas through the innovative Black Rhino range expansion program, and in doing so has significantly improved the connectivity between state-owned reserves and consolidated identified climate change adaptation corridors. Other provinces have begun to commit resources and build capacity for carrying out this work.

OUTCOMES

South Africa has come a long way over the past decade in improving land-use planning and decision-making, using innovative means to move beyond the boundaries of protected areas in order to conserve biodiversity. This landscape approach has subsequently enabled the country to embark on a strategy of ecosystem-based adaptation to climate change – keeping corridors and other areas of natural vegetation intact in order to maintain ecosystem services that are threatened by the impacts of climate change.

This process is not based on systematic and detailed mapping of where all species or ecosystems are likely to move. Rather it is based on a general understanding that securing corridors of well-managed, natural or near-natural habitats is critical to capturing environmental gradients that allow plant and animal species to move in response to climate change. The National Protected Areas Expansion Strategy provides maps of the most important areas for protected area expansion with a focus on areas that capture the full range of biodiversity pattern and ecological processes, climatic gradients, a wide range of microhabitats, and natural corridors such as coastal, dune and river corridors.

For example, the recent expansion of Namaqua National Park was explicitly designed from the outset to link upland and lowland areas, establishing climate change gradients along which species can move. The park also includes climate refuges, such as mountain ravines and south-facing slopes that provide cooler and often more moist habitats that can be colonized by species under pressure from changing climates. Other ways in which resilience to climate change has been built include protecting as wide a variety of habitats as possible and increasing the number of vegetation types included in the park from one to twelve; increasing the altitudinal range from 350 to almost 1,000 m, and the variation in rainfall from 30 mm to 180 mm per annum; and incorporating a mean annual temperature variation between the hottest and coldest parts of the park of 3˚C.

Figure 4: Namaqua National Park (SANBI, 2010).

Systematic biodiversity planning has provided a powerful platform for this work, with a key intervention being the production of Biodiversity Sector Plans. In some provinces and districts there has been significant progress in making the transition from having the plans in place to actually implementing them on the ground, resulting in the real integration of biodiversity and climate change adaptation priorities into the policies, programs and day-to-day work of other sectors. Implementation has been possible in these cases because of three key factors – the availability of biodiversity information (with recent products incorporating climate change) both online through Biodiversity-GIS and from the South African National Biodiversity Institute and conservation agency staff, the availability of technical support and training by the South African National Biodiversity Institute and conservation agency staff, and the existence of champions within these provinces and districts.

Maps of Critical Biodiversity Areas and Ecosystem Support Areas have been incorporated into the proactive planning of many local and provincial authorities (for example, by including them as conservation zones rather than development areas in Spatial Development Frameworks and Environmental Management Frameworks), as well as in reactive responses to development pressures (e.g. the Biodiversity Sector Plans form a key component examined in Environmental Impact Assessments). Considerable time and effort have been invested in setting up and maintaining innovative cross-sectoral partnerships that enable ongoing follow-up with practitioners who are using the planning tools on a day-to-day basis, and doing hands-on training and capacity building.

The other key intervention based on systematic biodiversity planning is the development of national and provincial strategies for expanding protected areas, primarily through contractual agreements with private and communal landowners. Having maps of Critical Biodiversity Areas and Ecological Support Areas has enabled priorities to be set strategically for this "biodiversity stewardship" work. The national government has committed to a protected areas expansion strategy that has both climate change resilience and biodiversity conservation built into it (e.g. through the explicit identification of areas important for climate change adaptation). Conservation authorities are at varying stages of doing biodiversity stewardship work, but all are guided by systematically developed maps indicating priorities from the perspective both of conserving biodiversity pattern and ecological processes and of adapting to climate change, rather than being dependent on *ad hoc* decision-making. These interventions have put biodiversity conservation in South Africa on a sound footing to tackle the challenges faced by a developing nation in a world with a changing climate.

FACTORS THAT FACILITATED GOVERNMENT ACTION

South Africa is still in the process of establishing its policy around the strategy of ecosystem-based adaptation to climate change. A government Green Paper on South Africa's Climate Change Response Strategy is currently in draft form for consultation with stakeholders. However, the South African government has already committed itself to using tools like Bioregional Plans and the National

Protected Areas Expansion Strategy to maintain intact natural habitat. Some of the positive factors that have enabled the adoption of these tools include the following:

- South Africa has dedicated legal, policy and planning tools for biodiversity management and conservation, linked to legislation for broader environmental management. These tools feed into national planning processes incorporating a wide range of sectors. There is a consistent, nationally-endorsed format approved by the Minister of Water and Environmental Affairs for developing biodiversity plans and for feeding these into other planning processes and the economy. Currently the requirement is for systematic biodiversity plans that ensure the long-term persistence of biodiversity and take ecological processes into account. Climate change is not explicitly included, but the new generation of plans all include climate change design principles and these are widely accepted by the planning community as necessary for all future plans.

- The legal requirement for all municipalities to have an Integrated Development Plan and Spatial Development Framework has provided probably the single most strategic opportunity for building biodiversity opportunities and constraints into land-use planning and decision making at the local level. These plans and frameworks are required to take environmental requirements into account.

- Having maps and guidelines has provided the biodiversity sector with powerful tools for interacting with other sectors, and the principles of biodiversity planning, including setting explicit biodiversity targets, provide a rational, constructive platform for engaging with sectors whose interests are different from those of the biodiversity sector.

- Availability of land cover data and information on habitat types for the whole country has meant that these data layers could be used as a starting point in any part of the country, even where detailed biodiversity data was not available.

- South Africa is fortunate to have well-developed academic and research institutions and motivated people in civil society and government. It also has a national biodiversity institute that is part of government, mandated with functions that span science, policy and implementation. Although significant contributions have been made by international donor partners, in general this funding has supported local planning rather than introducing it from outside. Capacity to undertake the required work has either been in place or has been developed locally.

BARRIERS TO ADOPTING AND ADVANCING THE INTERVENTION

In many provinces and districts, the implementation of Biodiversity Sector Plans remains a big challenge. The effectiveness of feeding biodiversity information into land-use planning and decision-making depends on the effectiveness of the planning and decision-making itself. Although there are provinces and authorities which have well-developed and integrated planning and decision-making processes, in other areas (especially in rural local authorities and in the less developed and more agriculture-focused provinces), capacity is limited. In reality, much more decision-making is reactive rather than proactive, and in some areas much physical development takes place illegally, for example, landowners plowing up natural habitat or extracting groundwater without the necessary authorization or license.

In addition, merely having state-of-the-art biodiversity planning products does not guarantee

that they will be effectively used to guide appropriate development or wise biodiversity management. Generating the visible products of the biodiversity planning process – the maps and guidelines – is a critically important step, but it represents a small part of the process required to put the planning outputs into practice. Successful implementation of these tools requires that land-use planners and decision-makers, scientists, NGOs and other implementers are aware of them and use them proactively to guide day-to-day decisions about land use, and also that planning legislation is effectively enforced. This requires active capacity building both through formal training courses and through ongoing workplace-based support. The biodiversity sector also needs to provide ongoing technical support to users of the Biodiversity Sector Plans, assisting in their interpretation and application in planning and decision-making.

Successful implementation of the tools also depends on the maintenance of strong cross-sectoral partnerships, locally-based champions and the availability of adequate financial and human resources for ongoing implementation. A combination of government and donor resources is currently being used to generate the first round of systematic biodiversity plans across the country. It is not clear in many cases, however, where resources will come from to ensure that these plans are updated regularly and used effectively in development planning and decision-making.

The South African government has acknowledged that effective mainstreaming requires that considerable time, effort and resources be invested in:

- Making the maps, guidelines and associated information available to a wide range of end-users;
- Building workplace-based capacity for effective use of the products;
- Working with end-users in multiple sectors, providing day-to-day assistance to ensure that the products are actively used in a range of planning and decision-making processes; and
- Ongoing improvement of the science and strengthening the community of practice for development and mainstreaming of these types of tools (Cadman *et al.*, 2010).

These concerns apply equally to the implementation of the National Protected Areas Expansion Strategy, which will require a huge injection of resources if it is to fulfil its goal of expanding formal protected areas from 7.5% to 12% of the country over 20 years (including land with an average 2006 market value of over US$3 billion). Implementing the strategy requires focused efforts by key role players (e.g national and provincial conservation agencies), and needs to include both the continuation and intensification of current efforts, and the ongoing development of new and innovative mechanisms.

With regard to the continuation of existing initiatives, conservation agencies such as South African National Parks and provincial authorities need to continue to acquire land according to the strategic priorities for biodiversity conservation and adaptation to climate change. This involves raising funds from government and donor sources to purchase land, and securing ongoing revenue streams for effective management of new protected areas.

If South Africa is to meet its 2020 targets of protecting 12% of the nation's terrestrial areas and 20% of its marine area, and to contribute meaningfully to adaptation to climate change, the pace and scale of implementation need to be stepped up, using and refining new and innovative mechanisms such as contractual agreements and biodiversity offsets. A key challenge is ensuring that provincial and national conservation agencies secure the necessary resources to conduct

biodiversity stewardship work on an ongoing basis – both securing valuable sites for biodiversity and climate change adaptation, and supporting and monitoring these sites in the long term. Being able to implement the national and provincial strategies for protected area expansion and climate change adaptation thus depends on overcoming the barriers to increasing both human capacity and financial resources in local, provincial and national government.

CONCLUSIONS AND LESSONS LEARNED

Some of the lessons learned are as follows:

- A strong focus on systematic biodiversity planning, with biodiversity plans based on rigorous science, is an excellent basis for policy-making by government.

- Identifying areas where physical development can take place (rather than only identifying areas where it shouldn't take place) is a good way to get buy-in from decision-makers and can be used in integrated spatial and development planning to assist the government in meeting its socio-economic development goals.

- It is useful for systematic biodiversity plans to identify critical biodiversity areas (for meeting biodiversity targets) and ecological support areas (important for maintaining ecosystem services), incorporating climate change design principles.

- Focusing on the identification of threatened ecosystems, rather than on species alone, has proven compatible with a new emphasis on the explicit incorporation of climate change design principles at a landscape scale, providing land-use planners and decision-makers with real opportunities to make spatial decisions that maximize risk-avoidance, reduce biodiversity loss, enhance ecosystem resilience, and maintain ecosystem services – even in the face of climate change.

- It will be important to address the uneven spread of technical capacity across the country, to produce the required spatial and development plans, to integrate biodiversity information into them, and to implement them.

- It is important to update systematic biodiversity plans regularly to ensure that they do not lose their value. The updating process, and building capacity to implement the plans, will require ongoing commitment of resources by government in partnership with civil society and donor institutions.

In conclusion, the expansion of protected areas and the promotion of better land-use planning, while critical to building resilience to climate change and promoting economic development, are not recognized as pressing national priorities, and need to compete for resources with many other developmental challenges. A key example is the potential conflict between expanding the footprint of agriculture to promote food security in the face of climate change, and the need to maintain the increasingly threatened biodiversity and ecosystem services which underpin agriculture.
Significant effort and resources need to be invested in both the interventions outlined in this case study to make sure that they deliver on their promise to enhance socio-economic development, conserve biodiversity and promote ecosystem resilience. Furthermore, strong emphasis needs to be placed on ensuring that the role of ecosystem-based adaptation is recognized by decision makers, and that it is seen

as part of a developmental agenda, rather than being a separate green agenda competing for resources.

It is widely acknowledged in South Africa that the systematic biodiversity plans and protected areas expansion strategy outlined in this case study still need to be implemented effectively. Producing them has been a time-consuming process, building on years of practical experience gained through designing and implementing biodiversity planning interventions, with many lessons learned in the process and much refinement over time. There is now enormous potential to use these interventions to ensure that opportunities and constraints around biodiversity and climate change are incorporated proactively into integrated development planning, adaptation planning and land-use decision-making, to strengthen decision-making regarding infrastructure investment and economic development. Efforts to conserve biodiversity need to continue to make the case to national government for increased investment in this work.

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